International Conference

"Sericulture Challenges in the 21st Century" (Serichal 2007) & the 3rd BACSA meeting, 18 -21 September 2007, Vratza, Bulgaria

Supported by the FAO Regular Programme

P R O C E E D I N G S

Black, Caspian Seas and Central Asia Silk Association (BACSA) www.bacsa-silk.org

Sericulture Experiment Station, Vratza, Bulgaria

Vratza

2007

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Sericulture Experiment Station, Vratza, Bulgaria

Vratza

2007

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PROGRAMME

of

International Conference

"Sericulture Challenges in the 21st Century"
(Serichal 2007)
&
the 3rd BACSA meeting

18 - 21 September 2007
Vratza, Bulgaria

Organizing committee:

1. Mr. Kee Wook Sohn – FAO Technical officer
2. Dr Panomir Tzenov – BACSA President and Director of SES – Vratza, Bulgaria
3. Mr. Simeon Beshkov - President, Bulgarian Sericulture Association
4. Dr Evripidis Kipriotis – BACSA Vice - president for Europe, Greece
5. Dr Khomid Homidy – BACSA Vice – president for Central Asia, Uzbekistan

Organizers: The Bulgarian National Centre of Agricultural Sciences, Sericulture Experiment Station (SES), Vratza hosted the meeting in collaboration with The Food and Agriculture Organization of the United Nations (FAO) and Black, Caspian Seas and Central Asia Silk Association (BACSA).

DAY 1 (Tuesday, 18 September 2007)
Place: **Sericulture Experiment Station - Vratza**

8.30	Picking up from Hemus hotel
9.00 – 10.00	Registration
10.00 - 10.15	Opening
10.15 - 10.30	Welcoming speech by Mr. Kee Wook Sohn, FAO Food and Agricultural Industries Technical Officer
10.30 - 11.00	Report on the results from the international testing of different silkworm hybrids from 10 countries, held in 2006 and 2007 in Azerbaijan, Bulgaria, Romania and Uzbekistan under the BACSA framework – by Dr P. Tzenov, BACSA President
11.00 – 12.00	Round table discussion on the results from the international testing of different silkworm hybrids,

	Chairperson - Dr P. Tzenov, BACSA President, Facilitator: Mr. Kee Wook Sohn, FAO
12.00 – 13.00	"The project of Bulgarian Sericulture Association for sericulture development in Bulgaria", presentation by Mr. S. Beshkov – President of Bulgarian Sericulture Association
13.00 – 14.00	Coffee break – Swedish table
14.00 – 14.30	Round table discussion on the future planning on the global exchange of sericulture genetic resources, Chairperson - Mr. Kee Wook Sohn, FAO
14.30 – 15.00	Round table discussion on how to participate in "2009 International Year of Natural Fibres", Chairperson Mr. Kee Wook Sohn, FAO
15.00 – 16.00	Visit the Sericulture Experiment Station in Vratza, visits to laboratories and field work sites
16.00 – 16.30	Visit an "Exhibition on the History of Sericulture in Bulgaria"
16.30 – 18.30	Session for scientific articles
20.00	Welcoming dinner

DAY 2 (Wednesday, 19 September 2007)

8.30 – 11.00	Picking up from Hemus hotel, travel to Belogradchik town and visit the natural phenomenon "Belogradchik red rocks"
11.00 – 13.00	Travel to Gradetz village and visit a mulberry nursery
13.00 – 15.00	Travel to Vidin city on the Danube river and having lunch
15.00 – 17.00	Visit to the city of Vidin and medieval castle on the Danube river
17.00 – 19.00	Travel back to Vratza
20.00	Dinner

DAY 3 (Thursday, 20 September 2007)

Place: **SES – Vratza**

8.30	Picking up from Hemus hotel
9.00 – 11.00	Black, Caspian Seas and Central Asia Silk Association (BACSA), 3rd Executive Committee Meeting, including: 1. "FAO policy to support the global sericulture development" a presentation by Mr. Kee Wook Sohn, FAO 2. "The European Union policy to support the sericulture development" a presentation by Dr E. Kipriotis, director, Agricultural Research Station of Komotini, Greece 3. "Report on the BACSA activities during 2006/2007 and programme for the planned future activities" by Dr P. Tzenov, BACSA President 4. Round table discussion - Chairperson: Dr P. Tzenov, President of BACSA Facilitator: Mr. Kee Wook Sohn, FAO
11.00 – 13.00	Session for scientific articles
13.00 – 14.00	Coffee break – Swedish table
14.00 – 16.00	Visit the sericulture demo farm in Chiren village, established through the FAO project TCP/BUL/0065 A
16.00 – 19.00	Visit the Vratza's fair
20.00	Concluding and closing session and farewell dinner

DAY 4 (Friday, 21 September 2006)

9.00 – 11.00	Travel to Sofia
11.00 - 17.00	Visit Sofia
17.00 – 19.00	Travel back to Vratza

Saturday 22 September 2006 **Departure**

Opening Speech*

By

Dr Panomir Tzenov, President of BACSA

Ladies and gentlemen, Sericulturists and Distinguished delegates,

It is a privilege and an honor to meet all of you here at the Sericulture Experiment Station, Vratza, Bulgaria. I am very pleased to be in the company of fellow sericulturists in this important gathering for the purpose of sharing information and experiences in world sericulture development.

I would also like to express my gratitude to the Food and Agriculture Organization of the United Nations, FAO and the National Centre of Agricultural Sciences of the Republic of Bulgaria for the technical and financial support that made this international conference possible.

At the outset, it will be good for us to recall the unique qualities of the silk - this fiber, which has been the center of our attention for many years. As we all know, silk is the "queen of textile fibers". It is so unique that it can be mixed or twisted with other fibers for improved fabric production and diversification of products, but it can never be substituted in any of its uses. Many attempts were done to substitute silk with synthetic fibers but the resulting products were never able to duplicate the unique touch, feel and characteristics of silk.

You will recall that in the early 1990s, some companies in China as well as others damaged the image of silk with the mass production of low quality silk fabrics and wide circulation of the low quality products in the world markets. On top of this problem, the manufacture of super fine synthetic fibers and the improved quality of other natural fibers has encroached into a large portion of the share of silk in the world markets. This situation is likely to cause further reduction of total silk consumption to even less than 0.2 percent of the total textile consumption in the world market in the future.

While on the one hand we have the problems of low quality silk products and competition from other fibers, we are also beset with a serious situation of raw silk over-flooding the market resulting in low silk prices in the world market during the last ten years. Instead of competing with synthetic and other natural fibers (cotton and wool) in the world market, the tendency of silk producing countries was to compete with other silk producers, which therefore resulted in over-production of low quality products. As a consequence, the price of silk in the world market had been adversely affected. The fluctuation of silk price and unstable supply of high quality silk have impacted negatively on silk industry promotion particularly in Europe which led many silk-fabrics and silk garments manufacturing private companies to shift their major products from silk to other synthetic fibers.

Today, we may need to review the historical background of the sericulture industry development in order to know how sericulture industry could be promoted and industrialized more effectively in sericulture countries in order to meet the challenges of the times.

*** Information was used from the paper "DEVELOPMENTS IN THE WORLD SERICULTURE INDUSTRY: LESSONS AND CHALLENGES FOR DEVELOPING COUNTRIES" presented by Dr J. S. Lim at the 19th Congress of the International Sericultural Commission (ISC), September 21st -25th Bangkok, Thailand**

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As we all know, sericulture originated from China approximately five thousands years ago. Silk's good image as an excellent raw material drew the interest of other countries, namely, Korea, Japan and others in the Asian region and also in Europe. These countries focused mainly on uni and bi-voltine sericulture because of the suitable agro-climatic conditions in the temperate zone. However, poly-voltine sericulture also developed in tropical countries such as India, Thailand, Vietnam and others.

According to FAO's statistics, approximately 35-40 countries have been involved in sericulture industry development in the world. More than half of these countries are situated in Asia and more than 85 percent of raw silk/silk yarn are produced by the five major silk-producing countries such as China, India, Uzbekistan, Brazil and Thailand recently.

It is interesting to note, however, that various investigation and feasibility studies previously carried out by FAO indicate that there is a good potential for sericulture development, not only in the East Asia Region, but also in Eastern Europe, Central Asia, Latin America and the Africa Region, in terms of socio-economic and agro-climatic conditions.

Even though many countries want to promote sericulture as an economically viable agro-industry that could provide small farmers with job-opportunities and income resources, most of them could not successfully promote their sericulture industry, particularly for bi-voltine sericulture. It should therefore be useful to clarify why some countries could not easily promote sericulture and discuss some techniques for a successful sericultural industry development.

International organizations, on the other hand, have been doing their share in promoting sericulture. Over the last twenty years, international organizations like FAO, UNDP, ESCAP and others have assisted more than 20 countries in collaboration with FAO and other sericulturally developed countries such as Japan, Korea, India and others like Italy, France, Bulgaria, Thailand, Philippines in providing them with training programmes to develop their human resources on short/medium/long term basis (including M.Sc and Ph. D) in areas of sericulture.

We can summarize some important problems or constraints faced by small sericulture developing countries, which must be addressed in order for any sericulture industry development effort to succeed:

- Lack of the government necessary support (technical/ financial), and of a short/medium/long term sericulture development strategy as well as trained manpower for the establishment of essential institutions that will promote effective R & D activities;

- Lack of germplasm such as mulberry varieties and pure lines or parent stock for multiplication hybrid silkworm egg production;

- Lack of information on suitable internal/external market and relevant processing technology for manufacturing of quality silk/silk yarn/silk fabric products and their diversification;

- Lack of effective cocoon production basis such as young silkworm rearing facilities/system and establishment/operation of demonstration farms;

- Lack of positive involvement of NGO/or the private sector to accelerate sericulture industry development;

- Lack of a system on the basis of which sericulture farmers could sell their cocoons at the farm gate;

Having said these, I would like to recommend that international organizations such as FAO should continue their effort to assist sericulture countries, not only in the Asia region, but also others based on international cooperation/TCDC principle and in close coordination with selected sericulture countries like China, India, Japan, Korea etc. could share their valuable experiences and relevant updated technologies for sericulture industry development in the future.

Moreover, I would strongly recommend any funding/technical agencies such as FAO, UNDP and IFAD to fund a training support programme for economically viable sericulture development in Eastern Europe, Central Asia, Africa and Latin America countries. This is vital for sustaining efforts to spread the benefits of this unique industry in many other parts of the world, most especially to help alleviate poverty.

With these wishes and believing that the work of the present international meeting will be successful and useful for the world sericulture industry development I open the International conference “Sericulture Challenges in the 21st Century”.

Thank you very much for your kind attention!

Dr Panomir Tzenov

Plenary lecture

“Present status and utilization of sericulture germplasm and comparative studies of different silkworm hybrids performance for sericultural enterprise development in the Black, Caspian seas and Central Asia (BACSA) region”

By

P. Tzenov

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ABSTRACT

Sericulture should be considered as one of the important potential agro-industry in Eastern Europe and Central Asia region countries, now that the increasing number of farmers, i.e. approximately 500,000 households are involved in sericulture industry development activities in order to generate their income resources. 14 countries (Albania, Armenia, Azerbaijan, Bulgaria, Georgia, Greece, Kazakhstan, Kyrgyzstan, Romania, Tajikistan ,Turkmenistan, Turkey ,Ukraine, and Uzbekistan) are engaged actively in sericulture development activities in this region. The total number of mulberry accessions preserved in the region is 931 and the number of silkworm accessions is 767. The countries, having the richest sericulture genetic resources in the region are Azerbaijan, Bulgaria, Uzbekistan and Ukraine. Mulberry varieties from 22 countries and silkworm accessions from 20 different countries are presented at the regional sericulture germplasm. 424 different mulberry varieties and 262 silkworm breeds have been bred in the region. Some advanced methods in mulberry and silkworm selection such as polyploidy and mutation mulberry breeding, breeding sex limited for egg color and larval marking silkworm strains, breeding tolerant to adverse rearing conditions silkworm breeds, breeding partheno/androgenetic lines, and control the sex-balance have been developed in the region. A comparative testing of the best 15 commercial F_1 silkworm hybrids, produced in Azerbaijan, Bulgaria, Turkey, Romania, Ukraine and Uzbekistan as countries from the Black, Caspian seas and Central Asia (BACSA) region and their comparison with hybrids from China, Italy, Japan and Korea as world recognized standards has been carried out in four testing centers in Azerbaijan, Bulgaria, Romania and Uzbekistan. The hybrids were reared in the spring season under the standard technology and the data were obtained and calculated following the internationally recognized methods. The results obtained allow making the following more important conclusions: In all the four countries as the best silkworm hybrid performed the Japanese Shunrei x Shogetsu which scores in every point having both high cocoon yield by one box of eggs and high raw silk productivity. After the Japanese hybrid the local hybrids manifested the best performance in each testing country. The silkworm hybrids productivity is higher in Azerbaijan, Bulgaria and Romania, compared with Uzbekistan, so it may be concluded that the climatic conditions in Eastern Europe and Caucasus are more favorable for the silkworm rearing compared with those in Central Asia. The silkworm hybrids, produced in BACSA member countries have comparatively high

hatchability, pupation rate, cocoon weight, shell weight and fresh cocoon yield by one box of silkworm eggs. Compared with the Japanese and Korean hybrids the local hybrids, excluding the hybrid Turon 1, which has only male individuals, manifested lower cocoon shell ratio, raw silk percentage and consecutively lower raw silk yield by one box of eggs. The local hybrids as well as those from China, Korea and Italy showed raw silk yield by one box of silkworm eggs values below the Japanese hybrid Shunrei x Shogetsu. The breeding work in the BACSA member countries should be directed towards improvement the silk productivity of the hybrids, by the same time preserving their comparatively high pupation rate and cocoon yield. Considering the results obtained from this testing we may recommend as silkworm egg exporters among the BACSA member countries Azerbaijan, Bulgaria, Romania, Turkey and Ukraine.

Key words: mulberry, Morus sp., silkworm, Bombyx mori L, germplasm, Eastern Europe, Central Asia, selection, preservation, BACSA, hybrids, testing.

1. Introduction

The sericulture should be considered as one of the important potential agro-industry in East European and Ex-Soviet union Central Asian countries, situated around Black and Caspian seas region, now that the increasing number of farmers, i.e. approximately 660,000 households are involved in sericulture industry development activities in order to generate their income resources. 15 countries (Albania, Armenia, Azerbaijan, Bulgaria, Georgia, Greece, Iran, Kazakhstan, Kyrgyzstan, Romania, Tajikistan, Turkey, Turkmenistan, Ukraine and Uzbekistan) are engaged actively in sericulture development activities in this region. It is a common status of those countries in Black, Caspian seas and Central Asia region that sericulture industry activities have been recently declined to be in a critical stage of disappearing or inactivating to a serious extent, mainly due to the rapid change of political and economic structure with introduction of free-market system and the lack of potential internal and external market development. Although the cocoon/silk production in the countries from this region dropped dramatically in the recent decade, they still have very big potential for sericulture development because of very long tradition and experience in sericulture, availability of more than 250 million mulberry trees in the region as valuable natural resources which are enough for an annual production of about 50,000 ton of fresh cocoon, favourable climatic conditions allowing to produce high quality uni - bivoltine cocoons and raw silk, still comparatively low average monthly salary in most of these countries, comparatively well developed sericulture science, such as rich mulberry and silkworm genetic resources, own production of mulberry saplings and silkworm eggs. If those countries receive the necessary technical and financial support for sericulture revival and development, they could establish upgraded sericulture industry to reach a fresh cocoon production at the regional level of 80-100 000 t/year, raw silk production – 10 000 – 12 000 t/year and about more than 2 million farmer’s households would get income from sericulture and could probably earn approximately EUR 500 – 1500 per crop/family.

One of the big advantages for future sericulture development of the countries in this region is the availability of comparatively rich own mulberry and silkworm genetic resources and their possible development by using the modern methods of genetics and breeding in order to supply the farmers by high quality mulberry saplings and silkworm eggs and the silk textile industry with high grade cocoons/raw silk.

It has to be stated with sufficient reason that now-a-day successes in the world silkworm science and practice are built just on the most rationalized utilization of heterosis and hybridization. The selection is applied, in principle, to the crosses, with the aim of finding pairs of lines that cross well, so that the lines may be perpetuated and provide cross – bred individuals for commercial use. (Lea 1993, 1996; Harada, 1952; Hirobe, 1956; Yokojama, 1956; Craiciu and Otarasanu, 1971; Tadjieva, 1973; Craiciu et al., 1975; Akimenko, Braslavskii, 1976, 1977, 1984, 1995, 1997; Gvinipadze, Jobashvili, 1975; Kanarev, 1980; Nacheva, 1980, 1981, 1990; Shurshikova, 1981; Shahbazov, 1982; Petkov et al., 1987; Comprironona et al., 1987; Datta and Pershad, 1988; Tayade, 1987; Kantaratanakul et al., 1987; Jeong et al., 1990; Brasla and Matei, 1992; Vijaya and Das, 1992; Gupta et al., 1992; Sreerama et al., 1992; Osawa and Harada, 1994; Das et al., 1994; Badalov et al., 1993; Ignatova, 1999; Petkov et al., 1999; Greiss et al., 2003).

The silkworm breeds may form simple (A x B), triple [(A x B)x C] and double (four-way) crosses [(A x B) x (C x B)]. It is considered that the simple cross hybrids display a stronger hybrid vigor. On the other hand if compare the main quantitative characters values in the four-way hybrids with those in the initial parental pure lines, but not with the direct parents, the heterosis manifested is not very different from those detected in the simple cross hybrids (Tzenov, 2005, 2006). On studying different types of crosses, it was found that double and triple hybrids do not show bigger variation on account of the commercial traits of cocoons compared with simple ones. For triple hybrids it is difficult to choose between hybrids of the [(Japanese x Japanese) x Chinese] type and these of the [(Chinese x Chinese) x Japanese] type, though the quality of silk from the latter is considered better (Lea, 1993, 1996).

Double crosses of the [(Japanese x Chinese) x (Japanese x Chinese)] type produce cocoons not enough uniform in shape and in thread length compared with those from the [(Japanese x Japanese) x (Chinese x Chinese)] type, which is preferable. There are no significant differences between the simple, three and four-way hybrids, except for the fecundity characters in the parents which are higher in three and four-way crosses, compared with the simple hybrids.

In all the three types of commercial hybrids it was detected a comparatively high heterosis expression, both for the mid-parent value (MP) and the higher parent value (HP) as regards the main quantitative traits, such as cocoon weight, shell weight, shell percentage as well as the complex character fresh cocoon yield by one box of silkworm eggs. (Lea, 1993, 1996; Petkov, 1976, 1984, 1995; Hirata, 1985; Braslavskii, 1990, 1992; Nacheva, 1990; Gupta et al., 1992; Brasla and Matei, 1992; Osawa and Harada, 1994; Petkov et al., 1999)

However in crossing of silkworm breeds, having very big differences between their productivity the main quantitative characters inheritance in F_1 is intermediate with a high and positive heterosis expression for the MP and negative heterosis for the HP (Tzenov et al., 1999).

Most of the BACSA member countries have a well developed silkworm breeding science, resulted in creation series of highly productive commercial F_1 hybrids. However these hybrids require providing the optimal conditions for silkworm rearing, otherwise due to their sensitivity they suffer from diseases (mostly NPV and flachery) and the cocoon yield at farmer's level is poor. By the same time the practice in some of the region countries manifested that some hybrids imported from Japan, China, Korea, Italy and Thailand showed comparatively better results. The poor local hybrid silkworm egg quality is one of the reasons, forced some region countries (Tajikistan, Uzbekistan) to import, mostly from China every year more than 50 % of the necessary silkworm eggs.

On the other hand the region has a very high potential as producer of high quality silkworm eggs for self supply as well as export to the countries in Africa, Europe, Central Asia and the Near East. Therefore the problem of hybrid silkworm eggs quality has both economical and scientific importance. From the economical point of view the self-supply with eggs would provide a lot of incomes to the local egg production factories and contribute to a big extent to sericulture preservation and revival in the region countries. On the other hand if the locally produced silkworm hybrids considerably fall against the imported ones, that means the silkworm germplasm and the breeding practices in BACSA countries need of a serious improvement. Considering the above there is a necessity to make a comparative testing of the best commercial F_1 silkworm hybrids, produced in the Black, Caspian seas and Central Asia (BACSA) region countries and their comparison with hybrids from China, Italy, Japan and Korea as world recognized standards.

The expected outputs of this study are:

- Obtaining information about the quality of commercial silkworm hybrids, produced in the Black, Caspian Seas and Central Asia region, in comparison with the leading world standards from China, Italy, Japan and Korea.
- Making conclusions and recommendations regarding necessities and directions for improvement of silkworm germplasm and breeding work in the Black, Caspian Seas and Central Asia region countries.
- Giving recommendations about possible suppliers of high quality silkworm eggs from BACSA countries, China, Italy, Japan and Korea to the silkworm egg importers from Africa, Europe, Central Asia and the Near East.

2. Methodology for the international silkworm hybrid testing.

2.1. Allocation of the participating countries:

During the second BACSA executive meeting, held from 6 to 10 March 2006 at Bursa, Turkey the following countries have been allocated to participate in the international testing with their commercial silkworm hybrids:

1) From the BACSA region: Azerbaijan, Bulgaria, Romania, Turkey, Ukraine and Uzbekistan
2) Out of the region: China, Italy, Japan and Korea (South).

Allocation of the testing centers:

During the 2nd BACSA meeting, the following three testing centers were chosen:
Sericulture Research Institute, Gandja, Azerbaijan
Sericulture Experiment Station, Vratza, Bulgaria
Uzbek Sericulture Research Institute, Tashkent, Uzbekistan
In addition in 2007 as a fourth testing center was chosen the Commercial society "Sericarom" – research branch, Bucharest, in cooperation with the Apicultural and Sericultural Department, Faculty of Animal Husbandry and Biotechnology, University of Agricultural Science and Veterinary Medicine, Cluj Napoca, Romania.

2.2. Providing the silkworm egg samples

After making contacts with the participating countries/institutions the following silkworm hybrids have been provided to each one of the testing centers in March/April 2006 and 2007:

Hybrids	Country	Provider	Silkworm egg producer
Mayak 2 x Mayak 3	Azerbaijan	Dr B. Abbasov, Sericulture Research Institute, Gandja	Sericulture Research Institute, Gandja
Gandja 6 x Yashar	Azerbaijan	Dr B. Abbasov, Sericulture Research Institute, Gandja	Sericulture Research Institute, Gandja
Super 1 x Hesa 2	Bulgaria	Dr N. Petkov and Dr P. Tzenov, Sericulture Experiment Station, Vratza	Sericulture Experiment Station, Vratza
Vratza 35 x Marfa 2	Bulgaria	Dr N. Petkov and Dr P. Tzenov, Sericulture Experiment Station, Vratza	Sericulture Experiment Station, Vratza
Bai Yun x Qin Feng	China	Dr Y. Miao, Zhejiang National University, Hangzhou	Zhejiang Haining Slkworm Egg Station, Haining city, Zhejiang Province, China.

71 x 70 x 125 x 121	Italy	Dr S. Cappellozza, Sericulture Experiment Station, Padua	Sericulture Experiment Station, Padua
Shunrei x Shogetsu	Japan	Dr E. Kosegawa, Laboratory of Insect Genetics, National Institute of Agrobiological Science, Kobuchisawa 6585, Kitakoma-gun, Yamanashi-ken	Laboratory of Insect Genetics, National Institute of Agrobiological Science, Kobuchisawa 6585, Kitakoma-gun, Yamanashi-ken, Japan
N-137 x C-146	Japan	Dr E. Kosegawa, Laboratory of Insect Genetics, National Institute of Agrobiological Science, Kobuchisawa 6585, Kitakoma-gun, Yamanashi-ken	Laboratory of Insect Genetics, National Institute of Agrobiological Science, Kobuchisawa 6585, Kitakoma-gun, Yamanashi-ken, Japan
Baegokjam	Korea	Dr K. S. Ryu and Dr P. Kang, Department of Agricultural Biology, National Institute of Agricultural Science and Technology, Rural Development Administration, Suwon	Department of Agricultural Biology, National Institute of Agricultural Science and Technology, Rural Development Administration, Suwon
Record	Romania	Dr A. Matei, Commercial society "Sericarom" – Research department	Commercial society "Sericarom" – Research department
Baneasa super	Romania	Dr A. Matei, Commercial society "Sericarom" – Research department, Bucharest	Commercial society "Sericarom" – Research department, Bucharest
N x M	Turkey	Mr. A. Karagozoglu, Sericultural cooperative "Kozabirlik", Bursa	Sericultural cooperative "Kozabirlik", Bursa
Ukr. 26 x Ukr. 18	Ukraine	Dr O. Galanova, Sericulture Research Institute, Merefa	Sericulture Research Institute, Merefa
Ukr. 27 x Ukr. 15	Ukraine	Dr O. Galanova, Sericulture Research Institute, Merefa	Sericulture Research Institute, Merefa
Ipakchi 1 x Ipakchi 2	Uzbekistan	Dr H. Homidy, Uzbek Sericulture Research Institute, Tashkent	Uzbek Sericulture Research Institute, Tashkent
Turon ♂♂	Uzbekistan	Dr H. Homidy, Uzbek Sericulture Research Institute, Tashkent	Uzbek Sericulture Research Institute, Tashkent

Because of some difficulties in communication and transportation the Italian hybrid 71 x 70 x 125 x 121 was tested only in Azerbaijan and Bulgaria and the Romanian hybrids Record and Baneasa super – only in Bulgaria in 2006.
In 2007 the Uzbek hybrids Ipakchi 1 x Ipakchi 2 and Turon were tested in Uzbekistan only. The Chinese hybrid Bai Yun x Qin Feng was tested only in 2006. The Japanese hybrid N-137 x C-146 was tested only in 2007.

The following methodology was kept in conformity with:

Methodology of the silkworm rearing:

The eggs were hatched in the spring season (April – May) in the minimal volume of 3 g per hybrid.
After the second molt from each hybrid are counted 4 replicates, consisting of 200 larvae each, grown until the cocooning.
The rearing technology followed was the standard one. (Grekov et al., 2005).

Methodology for obtaining the data and calculation of the main breeding characters values:

Qualitative characters

-**egg serosa color:** It is determined visually on all the silkworm eggs of each hybrid before the start of incubation. The color could be gray-green, green-gray, brown, yellow, and yellow and gray in the sex-limited for egg color hybrids.

-**egg chorion color:** It is determined visually on all the silkworm eggs from each hybrid, immediately after the hatching. The color is white or yellow.

-body color of the last instar larva: It is determined visually on the 5^{th}-7^{th} day of the fifth instar on all silkworm larvae of the hybrid. It could be bluish white, yellowish white, reddish white, translucent, black and yellowish orange.

-body shape of the last instar larva: It is determined visually on the 5^{th}-7^{th} day of the fifth instar on all silkworm larvae of the hybrid. The body shape could be thinner and longer, normal, thicker and shorter, bigger and smaller.

-larval markings: It is determined visually on the 5^{th}-7^{th} day of the 5^{th} instar on the all larvae reared per each hybrid. The larval markings could be:
-plain;
-normal marked, having eye spot on the second thoracic segment, crescents on the second abdominal segment, and star spot on the fifth abdominal segment;
-pale marked;
-zebra;
-zebra with crescents and star spot;
-striped;

-cocoon shape: It is determined visually after harvesting and floss removal, on the whole amount of good quality cocoons produced per each hybrid. Cocoon shape is oval, elongated oval, elongated, elongated with constriction, spindle.

-cocoon color: It is determined visually after harvesting and floss removal on the whole amount of good quality cocoons produced per each hybrid. Cocoon color may be white and colored.

-cocoon size: It is determined on random sample of 100 good quality cocoons. The cocoon size is big, medium, small.

-cocoon nature of grains: It is determined on random sample of 100 good quality cocoons. It is fine, medium, coarse and flossy.

Quantitative characters

-hatchability in %: It is determined on 4 replicates, consisted of 200 normal eggs per each hybrid. It is calculated on the 3rd day after hatching by the following formula:

$$Eggs \quad hatchability \quad = \frac{Number \quad of \quad normal \quad eggs - number \quad of \quad non \quad hatched \quad eggs}{Number \quad of \quad normal \quad eggs} \quad x \quad 100$$

-larval duration in h: The beginning is day and hour of larval brushing, the end is day and hour when the feeding is stopped and larvae mounted.

-5th instar duration in h: The beginning is day and hour of the first feeding after the 4th molt, the end is day and hour when the feeding is stopped and larvae mounted.

-pupation rate in %: It is calculated by the formula:

$$Pupation \quad rate \quad = \frac{Number \quad of \quad cocoons \quad with \quad alive \quad pupa}{Number \quad of \quad larvae \quad counted \quad after \quad second \quad moult} \quad x \quad 100$$

-fresh cocoon grades in %: It is determined after the cocoon harvesting and floss removal. The cocoons are assorted in good quality (having alive pupae and without any big defects on the shell), double cocoons and unreelable cocoons. After the assorting all the three categories are weighed and the percentage of each category towards the total cocoon yield is calculated.

-fresh cocoon weight, and shell weight in g: There are used the following two methods:
1. All good quality cocoons per replicate are weighed and after that divided by their number;
2.A random sample consisted of 30 female and 30 male good quality cocoons/shells is taken and after weighting their weight is divided by the number.

-shell percentage: It is calculated by the formula:

$$Shell \quad percentage \quad = \frac{Weight \quad of \quad cocoon \quad shell}{Weight \quad of \quad fresh \quad cocoon} \quad x \quad 100$$

-fresh cocoon yield by replicate in kg: It is determined by weighting all good quality cocoons obtained.

-fresh cocoon yield by one box of eggs (20000 eggs) in kg: It is calculated by the following formula:

$$Fresh \quad cocoon \quad yield \quad = \frac{Cocoon \quad yield \quad per \quad repetiiton}{Number \quad of \quad larvae \quad in \quad repetition} \quad x \quad eggs \quad hatchabiliity \quad x \quad 20000$$

-filament length in m: It is determined on a random sample of 30 good quality cocoons after single cocoon reeling test.

-filament weight in g: After the cocoon reeling the filament is dried to constant weight and weighed.

-filament size in denier: It is calculated by the formula:

$$Filament \quad size \quad = \frac{Weight \quad of \quad filament}{Filament \quad length} \quad x \quad 9$$

-reelability in %: It is calculated by the formula:

$$Cocoon \quad reelability = \frac{Filament \quad weight}{Filament \quad weight + weight \quad of \quad other \quad products} \quad x \quad 100$$

-raw silk percentage: The formula used is:

$$Raw \quad silk \quad percentage = \frac{Filament \quad weight}{Weight \quad of \quad dry \quad cocoon} \quad x \quad 100$$

-raw silk yield by one box of silkworm eggs: .The following formula is used:

$$Raw\,silk\ yield = Yield\ of\ fresh\ cocoons \quad x \quad dry\ cocoons\ percentage \quad x \quad raw\ silk\ percentage$$

3. Conservation status of sericulture genetic resources in the BACSA region countries.

3.1.Present status of sericulture germplasm maintenance.

The total number and the share of each country in mulberry and silkworm genetic resources in the region are given in Table 1. The total number of mulberry accessions available is 931 and of silkworm accessions is 767. However these genetic resources are not distributed uniformly between the different countries. Regarding the number of mulberry accessions maintained Azerbaijan occupies the first position with 285 numbers and 30.61 %, followed by Uzbekistan (213 and 22.87 %), Bulgaria (140 and 15.04 %) and Ukraine (110 and 11.82 %). The number of mulberry accessions is the smallest in Greece and Turkey. However there are a lot of mulberry trees growing in Greece, a part of them of old, but unknown and comparatively highly productive varieties. These already available mulberry resources in Greece should be further studied and systematized.

With 230 numbers (30.00 %) Bulgaria occupies the first position as regards the number of silkworm accessions maintained, followed by Uzbekistan, having 172 accessions (22.42 %), Ukraine (116 numbers and 15.12 %) and Azerbaijan with 85 silkworm accessions(11.08 %) .

Romania, Georgia and Turkey maintain 65, 56 and 23 accessions each respectively and Greece has 20 silkworm strains.

It could be concluded that if compared with the sericulture genetic resources, maintained in other sericulturally advanced countries, such as China, Japan, Korea and India the total number of mulberry and silkworm accessions preserved at the countries of Eastern Europe and Central Asia is also huge. Moreover there was a good germplasm exchange system established between most of those countries in the near past.

The origin of mulberry and silkworm accessions, preserved at the regional germplasm is presented in Table 2 and Table 3. It is evident from Table 2 that most of mulberry varieties preserved in the region originated from Azerbaijan (229 and 24.70 %), Uzbekistan (169 and 18.15 %), Japan (139 and 14.93 %), Bulgaria (87 and 9.34 %), Ukraine, Georgia and China. Mulberry varieties from 22 different countries are totally presented at the regional germplasm, including some accessions from one of the most sericulturally advanced countries such as Japan and China.

Table 1. General data about sericulture genetic resources in some East European and Central Asian countries

Country	**Number of mulberry accessions**	**%**	**Number of silkworm accessions**	**%**	**Number of own commercial silkworm hybrids**
Azerbaijan	285	30.61	85	11.08	5
Bulgaria	140	15.04	230	30.00	4
Georgia	90	9.67	56	7.30	5
Greece	15	1.61	20	2.61	0
Romania	63	6.77	65	8.47	6
Turkey	15	1.61	23	3.00	2
Ukraine	110	11.82	116	15.12	3
Uzbekistan	213	22.87	172	22.42	7
Total	931	100.00	767	100.00	32

Table 2. The origin of mulberry genetic resources maintained in Eastern Europe and Central Asia .

COUNTRIES OF ORIGIN	EAST EUROPEAN AND CENTRAL ASIAN COUNTRIES									
	Azerbaijan	Bulgaria	Georgia	Greece	Romania	Turkey	Ukraine	Uzbekistan	Total	In percents
Azerbaijan	186	8	17	-	3	-	1	15	230	24.70
Japan	38	17	25	1	11	6	6	35	139	14.93
Uzbekistan	29	11	8	-	2	-	11	108	169	18.15
Bulgaria	7	59	1	8	3	-	4	5	87	9.34
Vietnam	6	-	-	-	-	-		1	7	0.75
Ukraine	4	4	6	-	7	-	60	2	83	8.92
Georgia	3	12	26	-	1	-		2	44	4.73
China	3	10	-	6	12	2	1	5	39	4.18
Italy	3	11	1	-	4	-	1	-	20	2.15
India	3	-	-	-	-	-	2	-	5	0.54
Russia	2	2	6	-	-	-	8	9	27	2.90
France	1	-	-	-	-	-		-	1	0.11

Tajikistan	**-**	**-**	**-**	**-**	**-**	**-**		**26**	**26**	**2.79**
Turkey	**-**	**-**	**-**	**-**	**-**	**2**		**-**	**2**	**0.21**
Romania	**-**	**-**	**-**	**-**	**20**	**-**	**2**	**-**	**22**	**2.36**
Armenia	**-**	**1**	**-**	**-**	**-**	**-**		**-**	**1**	**0.11**
Egypt	**-**	**5**	**-**	**-**	**-**	**-**		**-**	**5**	**0.54**
Korea	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**-**	**5**	**0.54**
Afghanistan	**-**	**-**	**-**	**-**	**-**	**-**		**1**	**1**	**0.11**
USA	**-**	**-**	**-**	**-**	**-**	**-**		**1**	**1**	**0.11**
Kazakhstan	**-**	**-**	**-**	**-**	**-**	**-**		**1**	**1**	**0.11**
Iran	**-**	**-**	**-**	**-**	**-**	**-**		**1**	**1**	**0.11**
Unknown	**-**	**-**	**-**	**-**	**-**	**2**	**12**	**1**	**15**	**1.61**
Total	**285**	**140**	**90**	**15**	**63**	**15**	**110**	**213**	**931**	**100**

Table 3. The origin of silkworm genetic resources maintained in Eastern Europe and Central Asia.

COUNTRIES OF ORIGIN	EAST EUROPEAN AND CENTRAL ASIAN COUNTRIES									
	Azerbaijan	Bulgaria	Georgia	Greece	Romania	Turkey	Ukraine	Uzbekistan	Total	In percents
Azerbaijan	56	4	-		-	-		13	73	9.52
Japan	4	12	4		29	11	8	13	81	10.56
Uzbekistan	5	8	5		-	-	5	46	69	9.00
Bulgaria	4	121	-	10	-	-	18	13	166	21.64
Vietnam	-	2	-		-	-		3	5	0.65
Ukraine	3	20	6		-	-	51	3	83	10.82
Georgia	-	2	32		-	-	2	11	46	6.00
China	12	5	8		19	6	11	38	100	13.04
Italy	-	1	-		-	-		11	12	1.56
India	1	-	1		5	-	2	7	16	2.08
Russia	-	-	-		-	-	11	6	17	2.22
France	-	-	-		-	3	1	-	4	0.52

Turkey	**-**	**-**	**-**		**-**	**3**		**3**	**6**	**0.78**
Romania	**-**	**6**	**-**		**12**	**-**	**7**	**4**	**29**	**3.78**
Egypt	**-**	**37**	**-**	**10**	**-**	**-**		**-**	**47**	**6.13**
Syria	**-**	**2**	**-**		**-**	**-**		**-**	**2**	**0.26**
North Korea	**-**	**8**	**-**		**-**	**-**		**-**	**8**	**1.05**
Madagascar	**-**	**1**	**-**		**-**	**-**		**-**	**1**	**0.13**
Austria	**-**	**1**	**-**		**-**	**-**		**-**	**1**	**0.13**
Kyrgyzstan	**-**	**-**	**-**		**-**	**-**		**1**	**1**	**0.13**
Total	**85**	**230**	**56**	**20**	**65**	**23**	**116**	**172**	**767**	**100**

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However it must be taken into account that one same mulberry varieties are preserved simultaneously at different countries from the region, therefore the real number of mulberry accessions available is less than the total number presented. The countries, having the highest diversity as regards the mulberry accessions origin are Uzbekistan (from 14 different countries), Azerbaijan (from 12 countries) and Bulgaria (from 11 countries).
The data presented in Table 3 manifest that the silkworm accessions preserved in the region originated from 20 different countries. The countries represented in the highest extent in the regional silkworm germplasm are Bulgaria (166 and 21.64 %), China (100 and 13. 04 %), Ukraine (83 and 10.82 %), Japan (81 and 10.56 %), Azerbaijan (73 and 9.52 %) and Uzbekistan (69 and 9.00 %). Similarly to mulberry varieties, a part of silkworm accessions are maintained simultaneously at different countries. The countries, having the highest diversity as regards the silkworm accessions origin are Bulgaria (from 15 different countries), Uzbekistan (from 14 countries), Ukraine (from 10 countries) and Azerbaijan (from 7 countries). We could make the conclusion that compared with the present cocoon /silk production at the regional level those countries maintain a rich collection of both mulberry and silkworm genetic resources.

4. Results from the international testing of different F_1 silkworm hybrids made in 2006 and 2007.

The results obtained for the main quantitative characters values manifested the following:

Hatchability: It is comparatively high in all the hybrids.

Pupation rate: It is comparatively high in all the hybrids except for in the hybrid Ukr. 26 x Ukr. 18.

Fresh cocoon weight: It is the highest in Shunrei x Shogetsu, Vratza 35 x Merefa 2, Ukr. 27 x Ukr. 15 and Record.

Cocoon shell weight: It is the highest in Shunrei x Shogetsu, Vratza 35 x Merefa 2, Ukr. 27 x Ukr. 15 and Record.

Cocoon shell percentage: It is the highest in Shunrei x Shogetsu, N 137 x C 146, Turon and Baegogjam.

Fresh cocoon yield by one box of eggs: It is the highest in Shunrei x Shogetsu, Vratza 35 x Merefa 2, Baneasa super and Super 1 x Hesa 2.

Cocoon filament length: It is the highest in Shunrei x Shogetsu, N x M, N 137 x C 146 and Baegokjam.

Reelability: It is the highest in Bai Yun x Qin Feng, 70 x 71 x 125 x 121, Shunrei x Shogetsu and Baegokjam.

Raw silk percentage: It is the highest in Turon, Shunrei x Shogetsu, N 137 x C 146 and Baegokjam.

Raw silk yield by one box of eggs: It is the highest in Shunrei x Shogetsu, Vratza 35 x Merefa 2, Ukr. 27 x Ukr. 15 and N x M.

The best four hybrids are:

1. Shunrei x Shogetsu
2. Vratza 35 x Merefa 2
3. Ukr. 27 x Ukr. 15
4. N x M

5. Conclusions and recommendations

- The sericulture should be considered as one of the important potential agro-industry in Eastern Europe and Central Asia region countries, now that the increasing number of farmers, i.e. approximately 660,000 households are involved in order to generate their income resources. 15 countries (Albania, Armenia, Azerbaijan, Bulgaria, Georgia, Greece, Iran, Kazakhstan, Kyrgyzstan, Romania, Tajikistan, Turkey, Turkmenistan, Ukraine, and Uzbekistan) are engaged actively in sericulture development activities in this region.

- The total number of mulberry accessions preserved in the region is 931 and the number of silkworm accessions is 767. Compared with the present cocoon /silk production at the regional level those countries maintain a rich collection of both mulberry and silkworm genetic resources.

- The countries, having the richest sericulture genetic resources in the region are Azerbaijan, Bulgaria, Uzbekistan and Ukraine.

- Mulberry varieties from 22 countries and silkworm accessions from 20 different countries are totally presented at the regional sericultural germplasm, including some accessions from one of the most sericulturally advanced countries such as Japan, Korea and China.

- Most of mulberry varieties preserved in the region originated from Azerbaijan (229 and 24.70 %), Uzbekistan (169 and 18.15 %), Japan (139 and 14.93 %), Bulgaria (87 and 9.34 %), Ukraine, Georgia and China. The countries, having the highest diversity as regards the mulberry accessions origin are Uzbekistan (from 15 different countries), Azerbaijan (from 12 countries) and Bulgaria (from 11 countries).

- The countries represented in the highest extent in the regional silkworm germplasm are Bulgaria (166 and 21.64 %), China (100 and 13. 04 %), Ukraine (83 and 10.82 %), Japan (81 and 10.56 %), Azerbaijan (73 and 9.52 %) and Uzbekistan (69 and 9.00 %). The countries, having the highest diversity as regards the silkworm accessions origin are Bulgaria (from 15 different countries), Uzbekistan (from 14 countries), Ukraine (from 10 countries) and Azerbaijan (from 7 countries).

- Both mulberry and silkworm genetic resources are maintained by correct methodologies. However, due to the economical problems, the number of accessions preserved has been decreased to some extent during the recent decade in some region countries.

- The mulberry leaf yield in the accessions maintained varies from 5.1 to 12.3 t /ha and appears to be lower than in other sericulturally advanced countries from the temperate belt like Japan, China and Korea. However this lower leaf yield could be more attributed to the comparatively dryer summer in this region rather than the genetic potential of the mulberry varieties. It could be concluded that the mulberry accessions preserved in the region manifest comparatively high genetic potential for production of high quality leaves and good productivity per one hectare.

- The silkworm accessions preserved in the region manifested comparatively high variation of the main productive characters, such as cocoon weight from 1.603 g to 2.438 g, shell ratio from 12.23 % to 24.90 % and filament length from 791 m to 1581 m. Some of silkworm accessions and pure lines maintained in the region manifest comparatively high productivity.

- 424 different mulberry varieties and 262 silkworm breeds have been bred in the region. The biggest number of mulberry varieties and silkworm breeds were selected in Azerbaijan, Uzbekistan, Ukraine and Bulgaria.

- Some advanced methods in mulberry and silkworm selection such as polyploidy and mutation mulberry breeding, breeding sex limited for egg color and larval marking silkworm strains, breeding tolerant to adverse rearing conditions silkworm breeds, breeding parthenogenetic/androgenetic lines, and control the sex-balance have been developed in the region.

- In all the four countries as the best silkworm hybrid performed the Japanese Shunrei x Shogetsu which scores in every point having both high cocoon yield by one box of eggs and high raw silk productivity.

- After the Japanese hybrid the local hybrids manifested the best performance in each testing country.

- The silkworm hybrids productivity is higher in Azerbaijan, Bulgaria and Romania, compared with Uzbekistan, so it may be concluded that the climatic conditions in Eastern Europe and Caucasus are more favorable for the silkworm rearing compared with those in Central Asia.

- The silkworm hybrids, produced in BACSA member countries have comparatively high hatchability, pupation rate, cocoon weight, shell weight and fresh cocoon yield by one box of silkworm eggs.

- Compared with the Japanese and Korean hybrids the local hybrids, excluding the hybrid Turon 1, which has only male individuals, manifested lower cocoon shell ratio, raw silk percentage and consecutively much lower raw silk yield by one box of eggs.

- The local hybrids as well as those from China, Korea and Italy showed raw silk yield by one box of silkworm eggs values below the Japanese hybrid Shunrei x Shogetsu.

- The breeding work in the BACSA member countries should be directed towards improvement the silk productivity of the hybrids, by the same time preserving their comparatively high pupation rate and cocoon yield.

- Considering the results obtained from this testing we may recommend as silkworm egg exporters among the BACSA member countries Azerbaijan, Bulgaria, Romania, Turkey and Ukraine.

- The exchange of mulberry and silkworm germplasm between the BACSA countries will facilitate the initiation, expansion or rehabilitation of silkworm and/or mulberry breeding programmes in the recipient countries. This will enable the promotion of sericulture industries which will contribute to national economic development.

- Since the region has comparatively rich sericulture genetic resources and advanced science in the field of mulberry and silkworm breeding, in the future some of these countries could be chosen as a regional centers for germplasm keeping (conservation), supply with parental silkworm eggs, mulberry saplings of chosen varieties, training in the field of mulberry and silkworm germplasm collection, maintenance, conservation and breeding techniques. Those countries could also be used as a source for providing technical expertise, mulberry saplings and silkworm eggs to the newly sericulture developing countries from Africa and Near East.

Table 4. Qualitative characters in different silkworm hybrids.

Hybrids	**Country**	**Egg serosa color**	**Egg chorion color**	**Body color of the last instar larva**	**Body shape of the last instar larva**	**Larval markings**
Mayak 2 x Mayak 3	Azerbaijan	Gray	White, yellow	Bluish – white	Smaller	Plain and marked
Gandja 6 x Yashar	Azerbaijan	Gray	White, yellow	Bluish – white	Normal	Marked
Super 1 x Hesa 2	Bulgaria	Gray	White	Bluish - white	Normal	Marked
Vratza 35 x Merefa 2	Bulgaria	Gray	White	Bluish - white	Bigger	Marked and plain
Bai Yun x Qin Feng	China	Gray	White	Yellowish – white	Smaller	Plain
71 x 70 x 125 x 121	Italy	Gray	White	Bluish – white	Normal	Marked
Shunrei x Shogetsu	Japan	Gray	White, yellow	Bluish – white	Normal	Marked
Baegokjam	Korea	Gray	White, yellow	Bluish – white	Smaller	Marked
Record	Romania	Gray	White	Bluish – white	Normal	Marked
Baneasa super	Romania	Gray - green	White, yellow	Bluish – white	Normal	Marked
N x M	Turkey	Gray	White, yellow	Bluish - white	Normal	Marked
Ukr. 26 x Ukr. 18	Ukraine	Gray	White, yellow	Bluish – white	Bigger	Plain and marked
Ukr. 27 x Ukr. 15	Ukraine	Gray-green	yellow	Bluish – white	Normal	Plain and marked
Ipakchi 1 x Ipakchi 2	Uzbekistan	Gray	White, yellow	Bluish – white	Normal	Plain and marked
Turon ♂♂	Uzbekistan	Gray	White, yellow	Bluish – white	Normal	Marked

Table 5. Qualitative characters in different silkworm hybrids.

Hybrids	Country	Cocoon shape	Cocoon color	Cocoon size	Cocoon natu
Mayak 2 x Mayak 3	Azerbaijan	Oval elongated	White	Big	Coarse
Gandja 6 x Yashar	Azerbaijan	Elongated oval	White	Small	Medium
Super 1 x Hesa 2	Bulgaria	Elongated oval	White	Medium	Fine
Vratza 35 x Merefa 2	Bulgaria	Elongated oval	White	Medium	Medium
Bai Yun x Qin Feng	China	Elongated oval	White	Small	Medium
71 x 70 x 125 x 121	Italy	Elongated oval	White	Medium	Medium
Shunrei x Shogetsu	Japan	Elongated oval	White	Medium	Fine
Baegokjam	Korea	Elongated oval	White	Small	Medium
Record	Romania	Elongated oval	White	Medium	Medium
Baneasa super	Romania	Elongated oval	White	Medium	Coarse
N x M	Turkey	Elongated oval	White	Big	Coarse
Ukr. 26 x Ukr. 18	Ukraine	Elongated oval	White	Big	Coarse
Ukr. 27 x Ukr. 15	Ukraine	Elongated oval	White	Medium	Medium
Ipakchi 1 x Ipakchi 2	Uzbekistan	Elongated oval	White	Medium	Medium
Turon ♂♂	Uzbekistan	Elongated oval	White	Medium	Medium

Table 6. Average performance of the silkworm hybrids tested in 2006 and 2007.

Hybrids	**Country**	**Hatchability (%)**	**Pupation rate (%)**	**Fresh cocoon weight (g)**	**Cocoon shell weight (g)**	**Cocoon shell percentage (%)**
Mayak 2 x Mayak 3	Azerbaijan	94.94	87.60	1.977	0.430	21.78
Gandja 6 x Yashar	Azerbaijan	94.76	89.08	1.976	0.422	21.39
Super 1 x Hesa 2	Bulgaria	93.68	92.58	2.046	0.432	21.14
Vratza 35 x Merefa 2	Bulgaria	95.09	89.83	2.136	0.466	21.76
Bai Yun x Qin Feng	China	96.92	92.38	1.112	0.371	21.67
71 x 70 x 125 x 121	Italy	92.94	94.32	2.048	0.409*	20.02
Shunrei x Shogetsu	Japan	97.71	92.78	2.147	0.513	23.90
N 137 x C 146	Japan	94.19	89.68	1.832	0.422	23.10
Baegokjam	Korea	93.72	91.12	1.835	0.413	22.53
Record	Romania	92.39	89.34	2.257	0.459	20.45
Baneasa super	Romania	95.73	92.24	2.191	0.449	20.67
N x M	Turkey	95.71	87.18	2.037	0.441	21.76
Ukr. 26 x Ukr. 18	Ukraine	93.09	81.80	2.027	0.441	21.82
Ukr. 27 x Ukr. 15	Ukraine	92.94	88.19	2.093	0.457	21.86
Ipakchi 1 x Ipakchi 2	Uzbekistan	89.77	88.85	1.367	0.403	21.62
Turon ♂♂	Uzbekistan	68.50	89.72	1.988	0.483	24.33

Table 7. Average performance of the silkworm hybrids tested in 2006 and 2007.

Hybrids	**Country**	**Fresh cocoon yield by one box of eggs (kg)**	**Cocoon filament length (m)**	**Reelability (%)**	**Raw silk percentage (%)**	**Raw silk yield by one box of eggs (kg)**
Mayak 2 x Mayak 3	Azerbaijan	32.906	1030	87.05	40.78	5.795
Gandja 6 x Yashar	Azerbaijan	33.487	1024	85.39	38.48	5.551
Super 1 x Hesa 2	Bulgaria	35.413	1084	87.26	38.43	5.668
Vratza 35 x Merefa 2	Bulgaria	36.776	1121	84.55	39.36	6.020
Bai Yun x Qin Feng	China	29.530	1062	88.78	40.60	4.910
71 x 70 x 125 x 121	Italy	35.019	1156	88.34	43.14	5.748
Shunrei x Shogetsu	Japan	38.727	1303	88.24	42.92	7.383
N 137 x C 146	Japan	30.157	1199	85.51	42.69	5.866
Baegokjam	Korea	31.049	1147	87.99	42.65	5.681
Record	Romania	36.659	1070	86.22	30.44	5.002
Baneasa super	Romania	38.032	1071	83.98	39.52	5.275
N x M	Turkey	34.140	1210	85.89	38.95	5.800
Ukr. 26 x Ukr. 18	Ukraine	33.595	1075	83.50	38.94	5.142
Ukr. 27 x Ukr. 15	Ukraine	34.029	1094	84.30	38.33	5.875
Ipakchi 1 x Ipakchi 2	Uzbekistan	30.077	990	85.16	38.70	4.95
Turon ♂♂	Uzbekistan	32.121	1043	87.78	44.10	5.710

6. References

1. Abbasov B. (2005) Revival of sericultural industries and promotion of small silk enterprise development in Azerbaijan. In: Proceedings of “International Workshop on Revival and Promotion of Sericultural Industries and Small Silk Enterprise Development in the Black & Caspian Seas Region”, Tashkent, Uzbekistan; 11–15 April 2005
2. Azizyan A., Ter-Hovhannesyan Asya and Azizyan Armen, 2006, THE SITUATION OF SERICULTURE IN ARMENIA, "International Workshop on Silk Handcrafts Cottage Industries and Silk Enterprises Development in Africa, Europe, Central Asia, and Near East", Bursa, Turkey 6 -10 March 2006.
3. Beshkov S., Tzenov P. (2005) Project for sericulture rehabilitation, development and silk production growth in Bulgaria for the period of 2005-2010. In: “International Workshop on Revival and Promotion of Sericultural Industries and Small Silk Enterprise Development in the Black & Caspian Seas Region”, Tashkent, Uzbekistan; 553-558.
4. Chen Y. (2002) Conservation status of silkworm genetic resources in China. In: ”Expert consultation on promotion of global exchange of sericulture germplasm resources”, Satellite session of XIX th ISC Congress,21st -25th , September 2002,Bangkok,Thailand.
5. Galanova O., Oleksiychenko N., Lyashenko Y., Kyrychenko I., Zlotin O.,Tarasov G. Homidy H. & Umarov S. (2005) Revival of sericultural industries and promotion of small silk enterprise development in Ukraine. In: Proceedings of “International Workshop on Revival and Promotion of Sericultural Industries and Small Silk Enterprise Development in the Black & Caspian Seas Region”, Tashkent, Uzbekistan; 11–15 April 2005.
6. Greiss H. (2003) Genetic-selection studies on silkworm Bombyx mori L. under different environmental conditions. Abstract of the dissertation for conferment of educational and scientific degree PhD, Sofia, 63 pp.
7. Grekov D. & Tzenov P. (2005) Revival of sericultural industries and promotion of small silk enterprise development in Bulgaria. In: Proceedings of “International Workshop on Revival and Promotion of Sericultural Industries and Small Silk Enterprise Development in the Black & Caspian Seas Region”, Tashkent, Uzbekistan; 11–15 April 2005
8. Grekov D., Tzenov P. (2005) Present situation and strategies for revival and promotion of sericultural industries and small enterprise development in Bulgaria. In: “International Workshop on Revival and Promotion of Sericultural Industries and Small Silk Enterprise Development in the Black & Caspian Seas Region”, Tashkent, Uzbekistan; 87-133
9. Grekov D., Tzenov P., Beshkov S. & N.I. Petkov (2006) Follow-up activities of Tashkent Workshop and national strategy for sericulture revival and development in Bulgaria, with emphasis on status and/or prospects of silk handcraft cottage industries development. In: International Workshop on Silk Handcrafts Cottage Industries and Silk Enterprises Development in Africa, Europe, Central Asia and the Near East, Bursa, Turkey
10. Homidy H. & Umarov S. (2005) Revival of sericultural industries and promotion of small silk enterprise development in Uzbekistan. In: Proceedings of “International Workshop on Revival and Promotion of Sericultural Industries and Small Silk Enterprise Development in the Black & Caspian Seas Region”, Tashkent, Uzbekistan; 11–15 April 2005
11. Karagozoglu A. (2005) Revival of sericultural industries and promotion of small silk enterprise development in Turkey. In: Proceedings of “International Workshop on Revival and Promotion of Sericultural Industries and Small Silk Enterprise Development in the Black & Caspian Seas Region”, Tashkent, Uzbekistan; 11–15 April 2005
12. Kipriotis E. (2005) Revival of sericultural industries and promotion of small silk enterprise development in Greece. In: Proceedings of “International Workshop on

Revival and Promotion of Sericultural Industries and Small Silk Enterprise Development in the Black & Caspian Seas Region", Tashkent, Uzbekistan; 11–15 April 2005

13. Lim J.S. (2002) Mission report on the present/past status of sericulture development activities and genetic resources information in the countries of Turkey/Ukraine/Romania/Bulgaria/Greece in the Black sea region ,Consultant's mission report, FAO, Rome, 73 pp.
14. Lim J.S. (2002) Developments in the world sericulture industry: Lessons and challenges for developing countries ,19th congress of International Sericultural Commission, Sep. 2002, Bangkok, Thailand, 13 pp.
15. Mirhosseini S. & Mavvajpour M. (2005) Revival of sericultural industries and promotion of small silk enterprise development in Iran. In: Proceedings of "International Workshop on Revival and Promotion of Sericultural Industries and Small Silk Enterprise Development in the Black & Caspian Seas Region", Tashkent, Uzbekistan; 11–15 April 2005
16. Nacheva Y.,Petkov N.,Malinova K. (1998) Possibilities for silkworm,Bombyx mori L. bisexual androgenetic lines selection, Animal sciences,supplement,82-85. (in Bulgarian)
17. Nikoleishvili G. & Sarajishvili A., 2006, Follow-up activities of Tashkent Workshop and national strategy for sericulture revival and development in Georgia, "International Workshop on Silk Handcrafts Cottage Industries and Silk Enterprises Development in Africa, Europe, Central Asia, and Near East", Bursa, Turkey 6 -10 March 2006.
18. Pau E. & Brailoiu D., 2006, SILK HANDICRAFTS COTTAGE INDUSTRIES AND SILK ENTERPRISES DEVELOPMENT IN ROMANIA, "International Workshop on Silk Handcrafts Cottage Industries and Silk Enterprises Development in Africa, Europe, Central Asia, and Near East", Bursa, Turkey 6 -10 March 2006.
19. Petkov N. (1995) Selection and genetic studies and results of the selection of breeds, lines and hybrids of the silkworm,Bombyx mori L., Dr of Sc thesis, Sofia. (In Bulgarian)
20. Petkov N., Tzenov P. & D. Grekov, 2006, Silk Handcrafts Cottage Industries and Silk Enterprises Development in Bulgaria, "International Workshop on Silk Handcrafts Cottage Industries and Silk Enterprises Development in Africa, Europe, Central Asia, and Near East", Bursa, Turkey 6 -10 March 2006.
21. Petkov Z. (1998) Studies on some mulberry species and varieties (Morus sp.) and influence of some of them on silkworm(Bombyx mori L.) development and productivity., PHD thesis. Sofia. (in Bulgarian).
22. Strunnikov V., Gulamova L., Karimova Sh., Jakubov A., Alimova R., Kurbanov (1986) Results of investigations on studying the possibilities for creation of genetical copies of female and male silkworms from the commercial breeds. Sbornik "Nauchnie osnovi razvitija shelkovodstva ", Tashkent, 14-27. (in Russian)
23. Strunnikov V. (1987) Genetical methods for silkworm breeding and sex regulation, Agropromizdat,Moskow,7-103 (in Russian)
24. Tzenov P. (1998) Study on possibilities for keeping and maintenance of tropical multivoltine race at Bulgarian climatic condition by rearing of 1 generation yearly, Animal science, supplement, 113-116. (In Bulgarian)
25. Tzenov P.,Nacheva Y.,Lazarov J. (2001) Study on the preservation terms of nondiapausing silkworm, Bombyx mori L. eggs at low temperature, Bulgarian Journal of Agricultural Science, 7, 467-470.
26. Tzenov P., Z.I.De Guzman (2004) Breeding the new Bulgarian sex-limited for larval markings silkworm Bombyx mori L. commercial hybrid Ze/4 and study on its performance in the Philippines and Bulgaria, Sericologia, 297-312. (France)

27. Tzenov P.(2003) Mission report on the present/past status and main constraints of sericulture development in the countries of Caspian sea region (Azerbaijan, Georgia, Uzbekistan), Consultant's mission report, FAO, 50 pp.
28. Tzenov P., Lea H.Z. (2005) Regional strategies proposed for revival and promotion of sericultural industries and small enterprise development in the countries of Black, Caspian seas and Central Asia region. In: "International Workshop on Revival and Promotion of Sericultural Industries and Small Silk Enterprise Development in the Black & Caspian Seas Region", Tashkent, Uzbekistan; 11–15 April 2005, 19-61
29. Tzenov P. (2005) Some aspects of the silk knitting technology. In: "International Workshop on Revival and Promotion of Sericultural Industries and Small Silk Enterprise Development in the Black & Caspian Seas Region", Tashkent, Uzbekistan; 505-512.
30. Tzenov P. & H.Z. Lea (2006) Silk Handcrafts Cottage Industries and Small Enterprises in Africa, Europe, Central Asia and the Near East.In: International Workshop on Silk Handcrafts Cottage Industries and Silk Enterprises Development in Africa, Europe, Central Asia and the Near East, Bursa, Turkey
31. Xhoxhi A., 2006, THE TRADITION REVIVAL AND DEVELOPMENT OF SERICULTURE IN ALBANIA, "International Workshop on Silk Handcrafts Cottage Industries and Silk Enterprises Development in Africa, Europe, Central Asia, and Near East", Bursa, Turkey 6 -10 March 2006.

Section 1. Moriculture and non-mulberry food plants for sericigenous insects: selection, propagation and cultivation

ASSESSMENT OF HARVESTABLE LEAF YIELD AND EFFECT OF DEFOLIATION ON SEED YIELD AND QUALITY IN CASTOR (*RICINUS COMMUNIS*), THE PRIMARY FOOD PLANT OF ERI SILKWORM, *SAMIA CYNTHIA RICINI* BOISDUVAL

By

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ABSTRACT

India is the only country which produces all the four types of silk, namely, mulberry, tasar, muga and eri. At present eri silkworm rearing is practiced mostly in the North Eastern states of India, producing 1245, 745 and 129 tones of eri cocoons, raw silk and silk waste respectively. Considering the high potentiality of ericulture to provide year- round employment and to alleviate the poverty of farmers of the rural areas, especially that of women, efforts are being taken in recent years to introduce ericulture as a subsidiary farm enterprise under the concept of integrated farming system in other states of India as well. Castor, Ricinus communis L., the primary food plant of Eri silk worm, Samia cynthia ricini Boisduval is widely cultivated in many states of India for seed purpose, which yields castor oil, an important non edible oil, used in many industries. Since castor seed production is also important and cultivating castor solely for the purpose of leaf to be used for rearing may not be economical, it is necessary to find out the quantum of leaf that can be harvested without adversely affecting the seed yield. The present study finds out the quantity of leaf available for eri silkworm rearing at 25,40,50 and 100 % levels of harvest and the effect of leaf harvest on castor seed yield and quality. The study also finds that castor leaf harvest beyond 25% level adversely affects the seed yield as well as seed quality with respect to germination and seedling vigor. The seed yield loss at 25,40 and 50 % levels of harvest was 10.68, 34.36 and 59.39 percentages respectively over control. The germination percentage of seeds and the vigor of germinated seedlings were also adversely affected when there was more than 25% leaf harvest.

Key words: Eri silk worm rearing, castor, defoliation effect, seed yield, seed quality

INTRODUCTION

Castor (*Ricinus communis* L.) is an important non edible oilseed crop and occupies an important place in the country's vegetable oil economy. Castor leaf is the primary food of eri silkworm, *Samia cynthia ricini* Boisduval.At present Eri silkworm rearing is practiced mostly in North Eastern states of India, producing 1245,745 and 129 tones of eri cocoons, raw silk and silk waste respectively. Owing to its polyphagous, multivoltine and completely domesticated nature, eri culture is being practiced throughout the year depending on the availability of castor leaf. Considering the high potentiality of ericulture to provide year-round employment and to alleviate the poverty of farmers of rural areas, especially that of women, efforts are being taken in recent years to introduce ericulture as a subsidiary farm enterprise under the concept of integrated farming system. Castor cultivation for the sole purpose of eri silkworm rearing is uneconomical and impractical due to high cultivation cost. But when grown both for seed production and eri silkworm rearing, it may work out to be economical (Chaudhury, 1979; Dookia and Mishra, 1979; Devaiah *et al*, 1980). Though there are some reports on the harvestable leaf yield of castor, there is no consensus on this aspect. Raghavaiah (2003) suggests that 25-30% leaves can be harvested without reducing castor seed yield. Jayaraj (2004) reported that 25-40 % leaves does not make any appreciable loss in castor seed yield. Report on the effect of leaf harvest on castor seed quality is nil. Hence, the present study was conducted to find out the quantity of castor leaf that can be harvested and utilized for eri silkworm rearing and the effect of leaf harvest at different levels on castor leaf yield and quality, so that a suitable harvesting technique can be worked out for utilizing both seed and leaf for economical augmentation of castor cultivators of India.

MATERIALS AND METHODS

The experiment was conducted at Central Sericultural Research and Training Institute, Mysore for three consecutive years (2005-2007) with non bloomy green Local(Kranti) castor variety. The experiment was taken up on sandy loam soil having a pH of 5.45; organic carbon percentage 0.117, Phosphorous 3.0kg/ha and potassium 224 kgs/ha. The experiment was laid out in randomized complete block design with four treatments and control as follows under rain fed condition:

T0 = Control (no leaf harvest)

T1= 25% leaf harvest

T2= 40% leaf harvest

T3= 50% leaf harvest

T4= 100% leaf harvest

Each treatment had 4 replications. The plot size for each replication was 8 x 6 m with plant spacing 1m x 1m. Seeds were pre-soaked in water mixed with Carbendazim 50% WP at the rate of 2gm per kg seeds for 24 hours and sown in the field. Seeds were sown at a depth of 1.5 to 2 inch in the soil and irrigation was given immediately to facilitate quick germination. Farm yard manure at the rate of 5 ton/ac was applied as basal dose before sowing of seeds. NPK (36:16:8/ac/yr) in the form of Ammonium sulphate, Single super phosphate and Muriate of potash were applied in 2 split doses (Anonymous, 2004). First dose of NPK in the form of 120 kg Ammonium sulphate, 100 kg Single super phosphate and 13.5 kg Muriate of potash was applied one month after germination of seeds. 60 kg Ammonium sulphate was applied three months after germination as 2nd dose.

The leaf harvests were made during 4th, 5th and 6th months. During each leaf harvest, total number of leaves /plant was counted to effect defoliation at respective levels in each treatment. Petiole weight was deducted and the leaf yield wherever mentioned represents only the lamina weight. Seeds were harvested in two pickings. First seed harvest was made during 5th month and the second during 7th month. Plant protection measures were taken whenever it was found necessary.

To study the quality of seeds harvested from each treatment, weight of 100 seeds was taken and the number of seeds /kg was calculated. From each treatment 100 seeds were sown in nursery beds to study the germination percentage and vigor index. On 10th day, the seedlings were uprooted carefully to study the vigor index. The vigor index of control as well as treated seeds was calculated by using the formula, VI= (mean root length + mean shoot length) x % of seed germination (Abdul Baki and Anderson, 1972)

RESULTS AND DISCUSSION

When 25% leaves were harvested, the leaf yield was 627.09 kg/ac which is sufficient to rear 62 eri layings to produce 31 kg cocoons. The seed yield loss was 10.68% over control (non-harvest). When there was 40% leaf harvest, leaf yield was 893.96 kg/ac which is sufficient to rear 75 eri layings and to produce 37 kg cocoons. There was a loss of 34.36% seed over control.

In case of 50% leaf harvest, leaf yield was 1185.66 kg/ac which is sufficient to produce 59 kg cocoons from118 layings . Seed yield loss was 59.39% over control. Leaf yield at 100% level of harvest was 2468.94 kg/ac. which is sufficient to rear 245 layings and to produce 122 kg cocoons. There was a seed yield loss of 88.20%.

The seed quality with respect to seed weight, germination percentage and vigor index of germinated seedlings was drastically reduced when there was leaf harvest. This was more evident in case of 40 and 100 % level of leaf harvest. Number of seeds /kg was 1857,2237,2618,2632 and 2785 in case of control, T1, T2, T3 and T4 respectively. Germination was 72,63,28,22 and 20% respectively. (Fig. 1). The vigor index of germinated seedlings also varied according to the level of leaf harvest (Fig.2). Maximum vigor index was seen in control (1077.84),followed by in 25% leaf harvest and the minimum in 100% leaf harvest.

There are few reports on attempted efforts to utilize both castor seed and leaf to enhance farmer’s income. Sundaramurthy (1977) reported a seed yield loss of 30-40% when leaves were plucked for eri silkworm rearing. Md. Isa *et al* (1994) suggested that 75 % leaf harvest on castor is economically viable. However, in the present study it was found that harvesting more than 25% leaves reduces seed yield drastically and may not be an economically viable proposition. More so, when the study finds that seed quality with respect to seed weight, germination and seedling vigor also deteriorates. More the leaf harvest, lesser the seed quality. In the present study it was found that there was a loss of only 10.68% seeds when 25% leaves were harvested for eri silkworm rearing. Considering the additional income from 31 kg cocoons obtained by rearing 62 Eri layings, harvesting of 25% leaves seems to be economically viable.

Table.1. Effect of defoliation on castor seed yield, var. NBG Local (Kranthi)

Treatment	Av. leaf yld/plot (567Sq.ft (kg.)	Av. seed yld/plot (567 sq.ft) (kg.)	Calculated leaf yld/ac (kg.)	Calculated seed yld.ac.(Kg.)	Loss of seed yld. over control (%)
T0 (control)	--	3.36	--	257.73	--
T1(25%)	8.15	2.92	627.00	228.54	10.68
T2(40%)	11.61	2.16	893.96	163.05	34.36
T3(50%)	15.39	1.35	1185.66	104.00	59.39
T4(100%)	31.99	0.38	2468.94	30.67	88.20
C.D				21.66	
C.V%				7.34 * *	

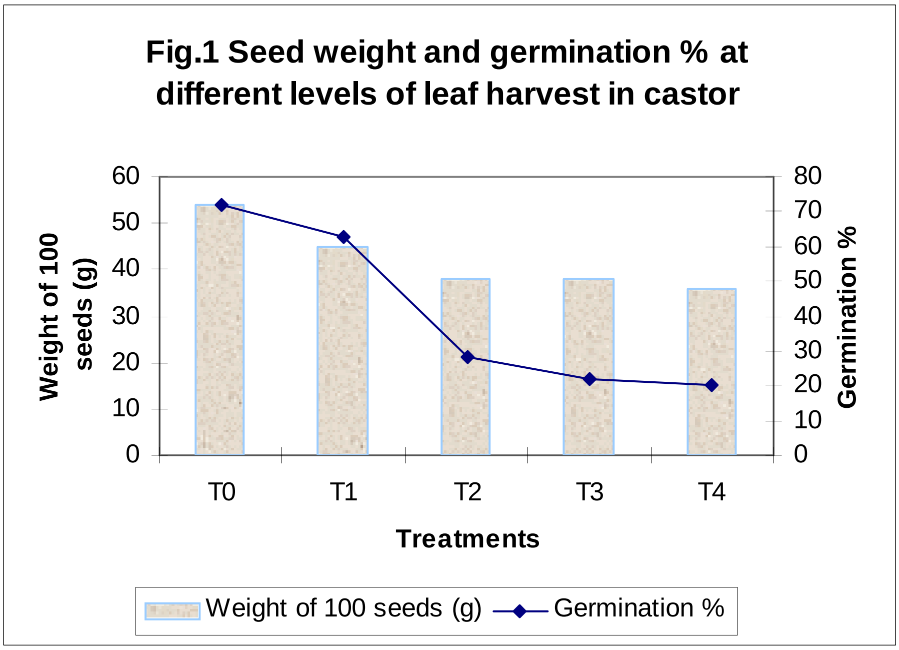
Fig.1 Seed weight and germination % at different levels of leaf harvest in castor
Weight of 100 seeds (g)
Germination %
60
50
40
30
20
10
0
80
70
60
50
40
30
20
10
0
T0
T1
T2
T3
T4
Treatments
Weight of 100 seeds (g)
Germination %

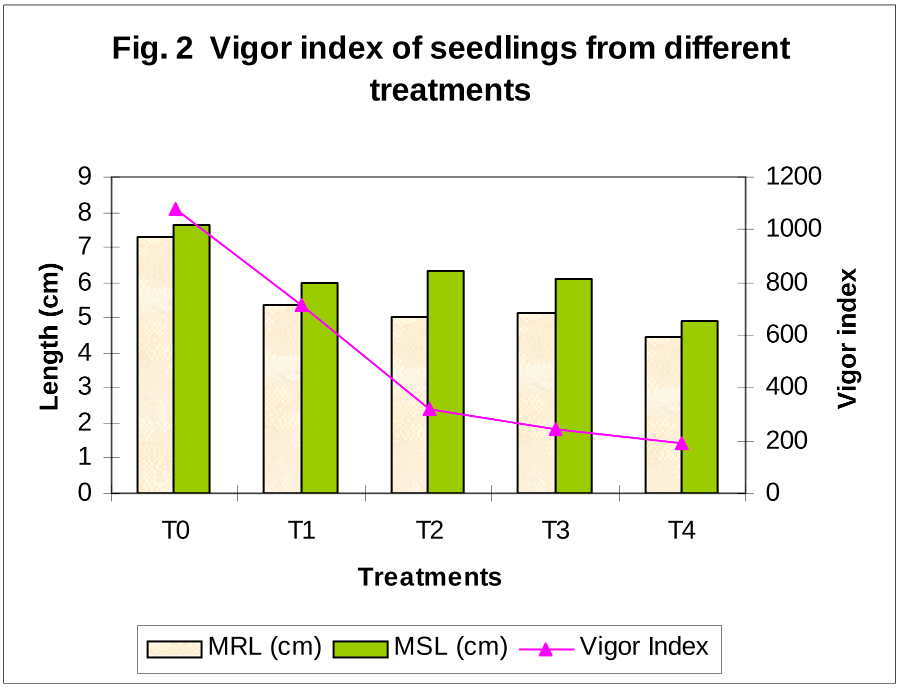
Fig. 2 Vigor index of seedlings from different treatments
Length (cm)
Vigor index
9
8
7
6
5
4
3
2
1
0
1200
1000
800
600
400
200
0
T0
T1
T2
T3
T4
Treatments
MRL (cm)
MSL (cm)
Vigor Index

REFERENCES

Abdul Baki, A.A and J.D. Anderson (1972) Physiological and biochemical deterioration of seeds. In: Seed Biology vol. II (Ed. Kozlowski, T.T) Academic press, New York, pp283-315.

Anonymous (2004) Package of practices for eri host plant cultivation and silkwor rearing. Central Muga, Eri Research and Training Institute, Laghdoigarh, Jorhat, Assam

Chaudhury, S.N(1979) Effect of leaf harvest on the leaf and seed yield of three local castor (*Ricinus communis*) varieties. **J. Assam Sci. Soc**., 22(B) 28-32.

Devaiah, M.C; Govindan R and Tippeswamy,C (1984)Economics of rearing of eri silkworm, *Samia cynthia ricini* Boisduval on castor (*Ricinus communis* L) **Indian J. Seric.** 23:117-120

Dookia B.R and Mishra, S.D (1979) Effect of defoliation on the seed yield in Aruna castor (*Ricinus communis)* **Geobios** ,6(6) 285-286

Isa Md; Yadav, G.S; Prasad, D.N and Sinha , S.S (1994) Effect of leaf harvest on the seed yield of castor (*Ricinus communis* L.) **Indian J. Seric**.33: 76-77

Jayaraj, S.(2004) Ericulture for employment and income generation in South India.Keynote address delivered at the workshop on prospects for development of Ericulture in Karnataka. Univ. Agric. Sciences, Dharwad, June 12.

Raghavaiah, C.V (2003) Strategy for production of eri silk through utilization of castor for foraging. **Indian Silk** 42(1) 33-35.

Sundaramurthy, T.S (1977) Technology of Tasar; Central Silk Board, Bombay.

Mulberry's Fruit treatment Properties and Its Many-sided Apply

By

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ABSTRACT

Technological scheme for reception of concentrates containing biological-active substances of mulberry fruits is elaborated.

By studying organoleptical and chemical contents of mulberry fruits and its concentrates; It is possible to use them as additional products in food-industry.

By analysis, it is established, that fruits of mulberry and its concentrates have high-contents of iron and maybe recommend for treating in case of anemia .

Introduction

From twenty-six species of mulberries which consist of Moraceae, only Morus and Trophis give eatable fruit. From here Trophis is spread in tropical countries, but species of Morus is spread widely from its biological singularity.

Mulberry's fruit can be applied as raw, remake and dry. It is the best early ripe and pleasant fruit among other plants. New picked mulberry is the best remedy against intestine illness.

Dried mulberry's fruit get in the sun 40°-45° degrees Celsius. Thin layer thrown mulberry losts moisture soon and after stir and winnow remains constant weight.

Getting product grind and use one of the precise food in the East countries. From the flouer of mulberry is made mulberry's chocolate which has food value as treatment designation. It use against anemia.

With ripe mulberry's spirit boiling prepares mulberry's Vodka, which is the best alcoholic product and for its composition it considers one of the precious drink.

Mulberry's grape juice, so-called vegetative honey „Bekmazi" is prepared with filtration of white mulberry. It must be boiled until liquid doesn't become very thick and dark-chestnut. To make sweet patties first must make a sauce then mix some flour and pour into the sackcloth to dry in the sun.

To make jam of mulberry use black mulberry's ripe, sweet-acidulous tasty fruit.

Vinegar of mulberry is prepared by white mulberry's fruit. Fruit is put into the clay vessel and put it in the sun 40-45 days. In this time it reforms strong vinegar and it keeps very long time. In the cannery is prepared sweet juice, jam and compote from the mulberry's fruit.

Seed, juice, Bacmaze, meal of chocolate and mulberry's fruit

There are different acids in the composition of mulberry's fruit (wine, phosphorus, lemon, glycerin, extraction substances).

According prezenious, black mulberry's fruit (M.nigra L) consists of water –84,64%, grape sugar 9,91%, free acid 1,86%, nitrogen substance 0,36%pectin substances 2,38%, ash0,66%, nucleus 0,91%. Iron's rust composition are very important high than it is in the apple(1,4%) and strawberry's (5%) iron's rust.

Research object and method

Our object of research was taken wood plant mulberry. It is is one of the important plant to use which fruit selects for its special food value. Its leave's juice use as a healing remedy during avitaminos. It lessens sugar content in a blood, so it applys for diabetes illness.

Fruit regulates metabolism, it is sweaty and cough remedy.

For object of research we take white and black mulberry. In order to get food appendage fruit was picked during its technical ripe, when sugar content was equaled 12-14%. Mulberry's fruit was washed, filtrated and getting juice removed the seed. Then it was condensed.

From about 100 kilograms mulberry was got 30-35 kilograms juice.

Getting product represents high quality concentrate which get from ecological fresh place, where weren't used pesticides and other chemical preparations.

In the mulberry's fruit and its concentrate sugars are limited with SomojiNelson's method, general fenol's- with folichokaltes method, general nitrogen –Keldal's method, painters – kolorimetrul method.

THE RESULTS OF RESEARCH

Task of research represented to learn mulberry's fruit and its extract, which keeps well and its transportation is easy. Among the mulberry's fruit chemical component there is sugar (glucose, fructose), nitrogen substances, organic acids (lemon, apple, phosphorus), iron, pectin.
Experimental research has shown that it includes wide specter of biological active substances.
From the table it seems it can be used as food appendage in the children's food technology and in the confectionery industry. Its fruit and consentral includes iron.

Chemical contents of mulberry fruit table#1

#	Name of chemical component	Mulberry's fruit		Mulberry's concentrate	
		White	black	White	black
1	carbohydrates	12,1	11,5	30,4	28,3
2	Glucose	6,5	6,3	15,2	16,01
3	Fructose	4,75	4,5	12,4	11,35
4	Sacarose	1,01	1,3	3,03	2,4
5	General phenol substances	45	100	65	130
6	paint	-	16	-	40
7	General nitrogen	0,36	0,25	1,1	1,0
8	Pectin	1,95	2,1	12,7	10
9	iron	5,6	4,85	12,7	10

About different colors of mulberry's fruit and from its preparated concentrate's chemical compositions are given in the table#1.
According statistical data the most part of Georgian population affect, deficit of iron, among them are pregnant and schoolchildren.
The task of our research foreseed to produce ecological fresh food appendage that helps populations health improvement. Extract of mulberry can use to make soft and alcoholic drinks which will be competition, high tasty and treatment properties local brandy.

Used Literature

1.N.Shavrovi „Mulberry as a Fruitful plant" Tbilisi 1894
2.Sh.Khatiashvili, T.Maglakelidze„Mulberry's natural juice's work out". Economy of work in 1977.
3.G .Zviadadze, „Mulberring". Tbilisi, 1969.
4.L.Chantladze, Sh.Abramidze „The mystery of Matusala". Tbilisi, 1991.
5. Nelson N.A. Photometric adaftation of the Somogyi method for the determetion of glucose – I.B.Cem. 1964. 153.#2. pp.75.

MULBERRY CULTIVATION THROUGH ORGANIC FARMING IN INDIA – AN UPCOMING CONCEPT

By

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ABSTRACT

Sericulture is one of the most integrated rural industries ancillary to agriculture involving on farm as well as off farm activities. Mulberry cultivation is one of the most integral parts of the entire gamut of sericultural activities because the quality of silk produced by the mulberry silkworm depends to a large extent on the quality of mulberry leaves fed. The cropping intensity of mulberry a perennial crop cultivated for more than 20 years on the same piece of land is becoming more acute [400-500%] with harvest of whole shoots 5 times per year [90 tonnes green biomass / ha / yr] especially in irrigated zones. Uptake studies indicate removal of about 500kg N, 90kg P and 300kg K / ha / year from the soil system. In view of the aforesaid ill effects, a new thrust has developed for mulberry cultivation through organic farming which aims at keeping the soil alive and healthy through use of organic wastes and other biological material alongwith biofertilizers. The main components of organic farming are Green manuring, Crop rotation, Organic manure viz. FYM, compost, vermicompost, biopesticide, biofertilizers [Shivasankar 2003]. In mulberry, all the above components except crop rotation can be used. In the backdrop of the above issues an attempt has been made in the paper to review the work done in India towards improvement of soil health through organic mulberry cultivation.

Keywords: Mulberry cultivation, Organic farming

INTRODUCTION

In the aftermath of the Green Revolution a manifold increase in fertilizer consumption was observed globally. India also was no exception with the fertilizer consumption increasing from 6600 tonnes in 1951-52 to about 20 million tonnes in the 20th century. These agrochemicals proved to be one of the major pollutants and due to their indiscriminate use became responsible for causing environmental pollution and health hazards to consumers. In order to overcome the hazards, many forms of agricultural development approaches generally referred to as alternate agriculture emerged in the 20th century especially since 1970s. These included organic agriculture, natural farming, biodynamic agriculture, ecological agriculture, sustainable agriculture and low external input agriculture. Among these, organic farming has assumed the dimension of a revolution in agriculture [MacRae, et al., 1990; Padel & Lampkin, 1994; Lampkin, 1994.].

Organic farming is not a new concept, but, has been the dominant form of agriculture during the entire period of recorded history of mankind except for a few decades in the last century. Among all farming systems, organic farming is gaining wide attention among farmers, entrepreneurs, policy makers and agricultural scientists for varied reasons such as, minimization of dependence on chemical inputs, safeguarding / improving quality of resources and environment, providing an opportunity to increase rural employment and achieve long term improvements in the quality of resource base. Thus, organic farming is proving to be one of the best suited forms of farming especially for small and marginal farmers as most of them cannot afford and mostly do not use FYM or chemical fertilizers. In India, the Govt. of India has launched the National Programme for Organic Production to ensure focussed and well directed development of organic agriculture.

The basis of modern organic farming revolution started in India long before the Green revolution or modern organic farming started in the West. Presently, various forms of organic farming are being successfully practiced under diverse climatic conditions, particularly in rainfed, tribal, mountains and hill areas of the country where the economically important forest produce like herbs, medicinal plants etc. come under this category by default. However, India is not in a position to completely eliminate the use of chemical fertilizers. Hence, the need of the hour is to gradually reduce doses of chemical fertilizers used balancing it by increasing use of optimum quantity of organic manures and biofertilizers through evolution of eco-friendly technologies for sustainable crops alongwith maintenance of the biodiversity.

Organic farming in sericulture

Sericulture is one of the most integrated rural industries involving on farm as well as off farm activities. It generates ample rural employment and hence is practiced by small and marginal farmers across the country. Sericulture has 2 main activities viz. mulberry cultivation and silkworm rearing. Mulberry cultivation is one of the most integral parts of the entire gamut of sericultural activities because the quality of silk produced by the mulberry silkworm depends to a large extent on the quality of mulberry leaves fed. As in the case of other crops, in view of the adverse effects of chemical agriculture in its current form on the environment, farm diversity, food quality etc., a new thrust has developed for organic farming aiming at cultivating mulberry keeping the soil alive and healthy through use of organic wastes and other biological material alongwith biofertilizers. As we know, organic farming involves Green manuring / mulching, Crop rotation, Organic manures, Biopesticides, Biofertilizers [Shivasankar 2003]. In mulberry, all the above components except crop rotation can be used.

Evolution of improved high yielding mulberry varieties and adoption of improved agronomic practices have aided in increasing the yield of mulberry substantially from 7-10 MT/ha/annum [Local, Kajili] in the 1970s to more than 60 MT/ha/annum [V1] from the 1990s onwards. However, this improvement in mulberry leaf yield was mainly due to considerable increase in the quantum of chemical fertilizers used. The per annum requirement of Nitrogen, Phosphorus and Potassium for existing mulberry area is to the tune of 75,572, 25,910 and 30,228 MT, respectively, [Dandin, 2003]. In addition, the cropping intensity becomes more acute [400-500%] with adoption of whole shoot harvesting 5 times per year [90 tonnes green biomass / ha / yr] especially in alluvial irrigated zones. Uptake studies indicate removal of about 500kg N, 90kg P and 300kg K / ha / year from the soil system.

In view of the increased global emphasis on organic farming, research institutes under Central Silk Board / State Governments / Universities and few other agencies have initiated projects / experiments on organic mulberry cultivation. These have yielded impressive results also. In the backdrop of the above issues a review has been made to project the attempts done in mulberry cultivation by way of incorporation of various components of organic farming singly and as integrated packages towards improvement of soil health leading to increased quality mulberry leaf yield.

Green manures / mulch / cover crops conserve and improve the soil in various ways. Green-manure crops generally used are legumes such as soybeans, green gram, groundnuts and pigeon peas. The green manure crops take nitrogen from the air and fix it in a form they can use. When the crop dies and rots, the nitrogen in them is released into the soil and other plants absorb it. Mulch is dry, vegetative material, used to cover the soil. Cover crops are grasses, legumes or small grains grown between regular grain crop production periods. They are planted in a garden to protect the soil from erosion and to improve the soil by adding organic matter. The green-manure crops and mulch help reduce evaporation and retain moisture, reduce soil erosion and provide plant nutrients as the material decomposes. In mulberry cultivation also studies on green manuring / mulching / cover crops have been taken up.

Studies conducted by the research institutes of the Central Silk Board have yielded positive results. The Central Sericultural Research and Training Institute [CSR&TI], at Berhampore recorded a gain of 48% in mulberry leaf yield under agroclimatic conditions of Eastern India during winter through mulching with black polythelene and 50% gain in mulberry leaf yield on mulching with Ulu grass [Report on Research Work at CSR&TI Berhampore, 1943-2005]. Mulching in general was observed to decrease the soil moisture depletion in West Bengal [Purohit et al., 1990 & 1992]. Another study on organic farming revealed that, growing cover crop *Vigna sinensis* reduced weed growth by 33% in mulberry gardens without affection mulberry leaf yield and reduced cost on digging and weeding by 41% [Annual Report of CSR&TI Berhampore, 2002-03]. Koraput district is predominantly hilly area with dry period from October to May due to which leaf yield from the mulberry gardens which are grown under rainfed conditions is very low. Studies conducted revealed that, use of dried seedless Napier grass with cessation of monsoon till advent of next monsoon aided in harvesting 23% more quality leaf in Koraput district [Purohit et al., 2006].

Under South Indian conditions, growing green manure crops [Dhaincha and Sunhemp] in the mulberry gardens in dryland areas of Chamarajanagar district in Karnataka, indicated improvement in soil moisture [0-30cm depth] by 16% [Annual Report of CSR&TI Mysore 2005-06]. Incorporation of sunhemp and dhaincha as green manure in between paired rows of mulberry also was effective in conserving soil moisture in [Chandrasekhar et al., 2006]. Raising Dhaincha green manure crop continuously for 2 years as intercrop in mulberry plantations at RSRS Salem with high soil pH [> 9] reduced native soil pH from 9.2 to 8.35 and contributed to 38kg N / crop / ac. mulberry garden in the form of nodules through Nitrogen fixation [Dhahira Beevi et al., 2003]. Dhaincha green manure crop cultivation also enhanced the population of *Coccinella septempunctata, Minochilus sexmaculatus* and *Acantholepis* sp. significantly due to which colonizaion of mealy bug was disturbed thus reducing incidence of tukra disease in such mulberry plantations compared to monocrop mulberry cultivation [Balasaraswathi et al., 2003]. The sericulture belt of Chamrajnagar in Karnataka being a rainfed area and 80% farmers practice sericulture for a livelihood, soil moisture conservation is of utmost importance. Studies conducted revealed that, soil moisture conservation practices by summer ploughing + application of FYM + ridge and furrow making and green manure mulching in monsoon with application of biofertilizers improved leaf yield by 30% [Srikantaswamy et al., 2006]. In the State of Uttaranchal most of the mulberry gardens exist under rainfed conditions. Studies carried out revealed that, incorporation of Dhaincha as green manure improved the growth of mulberry variety S146 by increasing the fertility and moisture content of the soil [Alok Gautam et al., 2006].

An attempt to reduce the ill effects of chemical fertilizers was made by recommending application of Farmyard manure [FYM] @20kg /ha/annum in mulberry plantation. However, in recent times it is found that the availability of FYM is gradually decreasing, mainly due to increased use of dung as a biofuel by large number of farmers. Hence, research activities were emphasized on finding out an alternative to FYM.

In sericulture, mulberry cultivation as well as silkworm rearing generates sizeable amount of waste in the form of unused mulberry leaves / shoots / silkworm litter / pupal waste etc. which can be utilized for production of organic manure. Datta et al., 1994 observed that, pupal waste production after reeling is estimated to be 23334 MT of dry pupae / year which form a sizeable quantity of silkworm rearing waste. Around 60kg waste is generated from every 100kg of leaf fed to silkworms. Availability of wastes at this rate will approximately be 15MT / ha / yr which is equivalent to 280 - 300kg N, 90 – 100kg P and 150 – 200kg K [Das et al., 1997]. In sericulture, residue is available @ of about 15MT / per hectare out of which 12-13MT vermicompost can be produced [Veeraiah, 2003]. Several biosources other than FYM have been recorded for organic farming in mulbery cultivation viz. SeriAzo, VAM, Seriphos, vermicompost, compost, green manure. In a study conducted at CSR&TI Mysore it was found that, application of 20MT of seri-compost with recommended dose of fertilizers increased mulberry leaf yield by nearly 10MT/ha/yr [Dandin, 2003]. Application of 20MT of sericompost / ha / year was sufficient to ensure leaf yield at par with application of 20MT FYM and recommended chemical fertilizers [Bhogesha et al., 2006]. Juyal et al., 2004 have reported that, *Eudrilus euginae* is the best species of earthworm suitable for sub-tropical and tropical areas. Studies carried out at CSR&TI Berhampore advocated conversion of farm and rearing waste into vermicompost and utilization instead of FYM [Setua et al., 1999]. Studies were also conducted on the feasibility of vermicompost preparation in Koraput region of Orissa in Eastern India covering small and marginal tribal farmers practising mulberry sericulture under rainfed conditions. Results revealed that, 1.5MT vermicompost can be prepared utilizing seri-waste generated from 3 silkworm crops from 1 ac. of rainfed mulberry garden. Sale of this vermicompost enabled the tribal farmers of this area to earn a net income of Rs.2200/-. Studies conducted at CSR&TI Pampore under Jammu & Kashmir conditions revealed that, application of vermicompost alone enhanced the inorganic nitrogen, potash, phosphorus, organic carbon and pH of soil. Sericultural wastes after vermicomposting were found to be a good source of organic manure for mulberry tree cultivation in rainfed sub-tropical conditions.

Small scale demonstrations carried out at farmers' level on vermicompost preparation indicated that, they are convinced of the benefits of using vermicompost and are willing to adopt the technology. In view of this, large scale demonstrations are under progress through Government Research Institutes / Departments / Universities and other agencies in the country for creation of widespread awareness on the benefits of vermicompost among larger numbers of the farmers for enhancing mulberry leaf yield.

Use of pescticides like Carbendazim, Capton, Nuvon, Metasystox etc. is quite rampant in mulberry cultivation for prevention of diseases like leaf spot, leaf rust, bacterial blight etc. and of pests like thrips, jassids, mealy bug etc. In order to prevent the ill effects of application of chemical pesticides, studies were carried out on botanical and biological control of pests and diseases in mulberry. Studies carried out in South India revealed that, soil application of Bionema [*Verticillium chlamydosporum*] after mixing with neem oil cake and FYM [1 : 24 : 200] @200g / plant in 3 doses / year followed by regular irrigation alongwith application of bacterial biofertilizer / VAM, controlled root-knot disease up to 94% without any residual toxicity on silkworm [Sharma et al., 2005]. Similarly, application of leaf extracts of *Adhatoda vasica*, *Calotropis gigantea*, and seed extract of *Anona squamosa* on mealy bug resulted in 80% mortality within 72 hours, while, extracts of leaves and flowers of *Melia azedarach* and *Adhatoda vasica* caused 5 and 60% mortality of egg and larvae of leaf roller, respectively [Report on Research Work at CSR&TI Berhampore, 2005]. Application of biocontrol agents *Trichoderma harzianum* and *T.viride* aided in significant reduction in root knot and root disease intensity by 60-65 and 65-70%, respectively. These biocontrol agents helped in saving Rs.2140/- and Rs.2200/- for control of root knot and root rot diseases, respectively. The leaf yield loss was curtailed by 10% which would fetch an additional income of Rs.3000/- per ac/yr [Sukumar et al., 2005]. *Verticillum chlamydosporum* was observed to reduce egg masses of the root knot nematode *Meloidogyne incognita* by 72% and root galls in the plant by 70% indicating the possibility of reduction in use of chemical nematicides [Vijayakumari & Sujathamma, 2006]. Combined application of Bionema, neem oil cake, VAM, bacterial biofertilizer and *Verticillium chlamydosporum* reduced disease severity in mulberry by 94%. Further, an Integrated Disease

Management strategy has been developed for control of root knot disease complex caused by *Meloidogyne incognita* with association of *Fusarium solani* and *F.oxysporum.* This strategy revealed that, application of bioconsortium prepared from *Trichoderma harzianium* and *T.viride*, *Lawsonia inermis* and FYM [1:1:10:25] @200g/plant recorded maximum reduction in disease complex by 80-82%. The tecnology is easily adoptable, eco friendly and has no residualeffeton silkworm. The cost benefit ratio is worked out at 1:1.2 [Annual Report of CSR&TI Mysore, 2005-06]

In an attempt to reduce the input of chemical fertilizers, studies on, application of biofertilizers conducted under agroclimatic conditions of Eastern India revealed that, application of *Azotobacter* and *Azospirillum,* @20kg/ha/year replaced 50 and 25% Nitrogen input, respectively, without deterioration in leaf production and quality. Further, Indepth studies revealed that, application of *Azotobacter chroococcum* @20kg/ha/year under irrigated conditions and 10 kg/ha/year under rainfed condition with 50% reduced dose of nitrogenous fertilizer gave leaf yield at par with those plants that received full dose of nitrogenous fertilizer. Similarly, use of Vesicular Arbuscular Mycorrhizal saplings grown in nursery @200kg/ha under irrigated conditions or 80kg/ha under rainfed condition alongwith 60-80% reduced dose of phosphate fertilizer gave leaf yield at par with those plants that received full dose of phosphate fertilizer. Studies have also proved that, inoculation of Vesicular Arbuscular Mycorrhiza to mulberry could save 70-80% inorganic phosphatic fertilizer in soil rich in non-soluble phosphorus [Annual Report of CSR&TI Berhampore, 1996-97; Setua et al., 1999; Sudhakar et al., 2000; Report on R&D activities of CSR&TI Berhampore, 2005]. Combined inoculation of *Azospirillum brasilense* and *Azotobacter lipoferum* was observed to increase mulberry leaf yield by 16%. Individually the leaf yield increase was 10% and 8.5% with *Azospirillum brasilense* and *Azotobacter lipoferum,* respectively. Nitrogen assimilation efficiency increased by 11% with individual and 13% with combined inoculation due to biological N fixation [Dayakar & Nagendra, 2005]. Under temperate conditions of J&K, use of biofertilizers + 50% chemical fertilizers in mulberry cultivation revealed that, rooting parameters in saplings were at par with those receiving full dose of chemical fertilizers [Annual Report of CSR&TI Pampore, 2005-06]. Further intensive studies are underway.

Integrated package of practices

Studies conducted on the impact of various components of organic farming on mulberry cultivation singly and in combination with one or the other component revealed that, the productivity and quality of the mulberry leaf revealed a definite increase. However, the farmers were not regular in adopting these individual technologies. In the backdrop of these results, it was felt that development of integrated package of practices for mulberry cultivation would be more feasible.

Studies carried out in the seventies under Eastern agro-climatic conditions revealed that, highest leaf yield of 26t / ha / yr could be obtained with application of N336, P2O5 180, K2O 112 kg / ha /yr and FYM 22t / ha /yr and this was recommended [Roy et al., 1973]. Studies carried out in 1983-84 by Viswanathan and Kavir revealed that, application of basic dose of FYM a+ full dose of P & K + 25% N through biofertilizers by spray + 75% N through chemical fertilizers increased leaf yield by 5% compared to basic dose of FYM + full dose of NPK. Results of further studies conducted by CSR&TI Berhampore on the effect of biofertilizer, Azotobacter on growth and leaf yield of mulberry revealed that, application of FYM [50 kg N2/ha/yr] + full dose of P and K [180 kg & 112 kg/ha/yr] + 25% N2 through biofertilizer spray + 75% N2 through chemical fertilizer increased leaf yield by 5% compared to full dose of NPK [Report on Research Work at CSR&TI Berhampore, 2005]. In general, the yield of mulberry was found to increase significantly with combined use of organic materials and nitrogen fertilizer in Gangetic alluvial soil. During the 1990s need was realized to intensify the search for organic sources of nutrition in mulberry cultivation. In a study to develop sustainable production system, it was found that, reduced dose of N108:P30:K84 alongwith vermicompost, *Azotobacter* sp., Arbuscular mycorrhizal fungi, Plant growth reulator and application of all furrow irrigation increased leaf yield by 13% in the mulberry variety S1635, while, the cost of production reduced by 12% [Report on R&D activities at CSR&TI Berhampore, 2005].

Intensive studies to search for organic sources of nutrition suitable for mulberry cultivation lead to the development of an Integrated Nutrient Management package which could curtail inorganic N by 50% and P by 80%[Setua et al., 1999, Sudhakar et al., 1999 & 2000]. This package was cost effective and eco-friendly. In order to restore soil health intensive studies were conducted to bring out a comprehensive nutrient management package. Results revealed that, the integrated nutrient management package developed curtailed inorganic Nitrogen and Phosphorus by 50% and 80%, respectively. Studies carried out at CSR&TI Berhampore by way of a full fledged project on organic farming brought out a package consisting of mycorrhizal mulberry [S1 variety] saplings at 90 x 90cm spacing alongwith green manuring with *Crotolarea juncea* during rainy season, utilization of cover crop *Vigna umbellata* during winter season and application of 50% reduced dose of NPK was efficient in reducing the cost of expenditure for mulberry leaf production with more leaf yield and quality [Annual Report of CSR&TI Berhampore, 2002-03]. Similarly, studies carried out on Integrated Nutritive Management of mulberry plants in the tribal area of Eastern Ghats in Bayapul village of Orissa that included vermicompost @4MT/ac in 3 equal split doses, biofertilizer – Nitrofert [*Azotobacter* sp.] @ 4kg/ac in 3 equal split doses and 50% recommended NPK fertilizers inreased mulberry leaf yield in the rainfed mulbery plantation of tribal farmers in the district of Koraput and Rayagada by 13%, cocoon yield by 12% and cocoon quality [SR%] by 3.5% enabling the farmers increase their income [Shankar Rao et al., 2006].

Similar studies carried out in South India indicated that, co-inoculation of mulberry with phosphate solubilizing bacteria, VAM, *Azotobacter chroococcum* alongwith 50% recommended chemical fertilizer gave yield at par with full dose of chemical fertilizer [Bhogesha et al., 2005]. Studies conducted at the University of Agricultural Sciences, Bangalore, Karnataka revealed that, the multivoltine pure silkworm breed – Pure Mysore reared on organically raised M5 variety mulberry leaves under rainfed conditions of South India was superior in larval, cocoon and post cocoon as well as grainage parameters indicating the possibility of using organic manures [silkworm exreta, honge cake, sheep manure] singly or in combinations as alternate or substitute to FYM for mulberry cultivation under rainfed conditions [Chinnaswamy et al., 2005]. Studies conducted at CSR&TI Mysore with V1 mulberry variety under irrigated conditions indicated the possibiligy of sustained production of mulberry through application of Integrated Technology Package comprising of 50% recommended dose of NPK in the form of chemical fertilizers and 50% through organic forms like biofertilizers, compost, vermicompost, and green manure crops [Thippeswamy et al., 2005]. An Integrated Nutrient Management module was tested in the states of A.P., Karnataka and Tamil Nadu which included Incorporation of Green cover crops viz. Dhaincha [*Sesbania aculeata*] or Sunhemp [*Crotalaria juncea*], Treatment of green manure seeds with Rhizobium @500g/ha/crop, application of biofertilizers [*Azotobacter* or *Azospirillum*], Biocomposting, Application of FYM, Spraying Seriboost and Application of chemical fertilizer NPK @ 350:140:140kg/ha/yr. Results revealed that, FYM could be curtailed to 4MT from the following year as green manuring contributed to 50% of organic manure and after one year. Further, *in situ* composting of green manures and application of biofertilizers substituted about 50% nitrogen and so nitrogen application in inorganic form was curtailed by 25% in 2nd year and 50% in 3rd year. This in turn revealed a distinct possibility of improvement in soil chemical, physical and biological properties [Jayaraj, et al.,2003]. .

Studies on the impact of individual components of organic farming are under progress at the Central Sericultural Research & Training Institute, Pampore and its Regional Stations at Jammu and Sahaspur so as to develop an integrated package of practice for mulberry cultivation.

Future plan

Inspite of the above findings, improvement in leaf yield and quality and constraints for widespread use are yet to be overcome. With recent advances in plant improvement research, new varieties of mulberry with higher leaf production potential have been evolved. In view of the above, implementation of projects on organic farming have been intensified for sustained quality mulberry leaf production under different agro-climatic conditions of the country. A project has been initiated under agroclimatic conditions of Eastern India by Central Silk Board to evolve a suitable combination of organic sources of nutrients so as to partially or as far as possible to replace use of inorganic form of nutrients in cultivation of mulberry. Eco-friendly organic sources of nutrients and better form of their use will be identified which can sustain quality and yield of mulberry over long periods. In J&K a sericulturally traditional state, mulberry is grown under rainfed / dry farming conditions and rainfall is erratic, added to steep rise in fertilizer prices. In view of the same, studies are in progress to find out the economic viability of raising fast growing leguminous green manuring crops to conserve soil moisture. In this direction, the Regional Sericulture Station of Central Silk Board at Jammu has initiated studies on organic farming with a project to find out the effects of green manuring and mulching on soil moisture conservation, growth, yield and quality mulberry leaf production under rainfed conditions. Thus studies carried out thus far have indicated that, some of the alternate organic farming practices [Gupta 2000] that can be adopted in mulberry cultivation for increased leaf yield through integrated packages are:

- Application of growth promoting Rhizobium bacteria for new plantation
- Application of green manure, farmyard manure, compost, vermicompost and biofertilizers like *Azotobacter* sp. for nutrient supplement
- Use of *Trichoderma, Verticillium chlamydosporum* cultures and Vesicular Arbuscular Mycorrhyzae for protection of saplings in nursery from fungal and soil borne diseases
- Application of neem oil cake / neem oil spray for improved mulberry leaf production
- Application of neem oil cake, oil cake, pongamia cake and groundnut cake, extracts of leaves and flowers of plants as botanical pesticides and biocontrol agents like *Verticillium chlamydosporium*, *Trichoderma* spp for foliar / soil borne diseases

The FAO has also realized the potential of organic production in general by medium and small farmers of developing countries and stressed on capacity building to orient organic production ventures towards global revolution in organic farming. Hence, it is essential that, a meticulous database on the impact of organic mulberry cultivation taken up by the Research Institutes as well as other agencies in the form of integrated packages of practices be developed to monitor the process and bring out recommendations that will ensure success to the sericulturists.

REFERENCES

1. Alok Gautam, Ramakant, Juyal, A.C. and Chakraborti, S. [2006]. Effect of *Sesbania aculeata* as green manure on growth andyield of S146 mulberry [*Morus* L. spp.]. Proc. Of Regional Seminar on Prospects and problems of sericulture as an economic enterprise in North Western India. November 11-12, 2006, pp. 152 – 153
2. Annual Report of CSR&TI Berhampore for 1996-97, pp 170.
3. Annual Report of CSR&TI Berhampore for 2002-03, pp 180.

4. Annual Report of CSR&TI Pampore for 2004-05, pp 185.
5. Annual Report of CSR&TI Berhampore for 2005-06, pp 190.
6. Annual Report of CSR&TI Mysore for 2005-06, pp 210.
7. Balasaraswati, S., Masilamani, S., Dhahira Beevi, N. and Qadri, S.M.H [2003]. Attracting and sustaining natural enemies in mulberry [*Morus alba* L.] by intercropping with Dhaincha [*Sesbania aculeata*]. National Conference on Tropical Sericulture for Global Competitiveness, CSR&TI Mysoe, November 5-7, 2003 pp 63.
8. Bhogesha, K., Das, P.K. and Nagaraj, B. [2006]. Biofarming for mulberry production. Proc. of National Seminar on Organic Farming for alleviation of rural poverty organized by Association for Promotion of Organic Farming, Bangalore on Aug. 8 & 9, 2006, pp – 29 – 30.
9. Chandrasekhar, Kallimani S. and Shashikala S.G.[2006]. LEISA practices towards sustainable sericulture. Proc. of National Seminar on Organic Farming for alleviation of rural poverty organized by Association for Promotion of Organic Farming, Bangalore on Aug. 8 & 9, 2006, pp – 25 – 27.
10. Chinnaswamy, K.P., Pasha, S.N. and Fatima, S. [2005]. Productivity of multivoltine silkworm seed breed – Pure Mysore on organically grown rainfed mulbery. In the 20th Congress of International Sericutlure Commission. Conference Papers, Vol.I, pp 119 – 121.
11. Dandin, S.B. [2003]. New approaches for oranic inputs for sustainable sericulture. Paper presented in the Workshop on organic farming and rainwater harvesting for sustainable sericulture on September 26th & 27th, 2007 at RSRS Kodathi.
12. Das, P.K., Bhogesha, K., Sundareswaran, P., Madhava Rao, Y.R. and Sharma, D.D. [1997]. Indian Silk, 35, 2, 23-26.
13. Datta, R.N., Majumder, S.K., Kar.K. and Chinya, P.K. [1994]. Pupae waste may be a source for amino acids preparation. Indian Silk, 32:2-5.
14. Dayakar Yadav B.R. and Nagendra Kumar T.D. [2005]. *Azospirillum* and *Azotobacter* strain combination on yield and uptake of mulberry [*Morus indica*]. In the 20th Congress of International Sericutlure Commission. Conference Papers, Vol.I, pp 130 – 136.
15. Dhahira Beevi, N., S.Masilamani and Qadri, S.M.H. [2003]. Growth nodulation and biomass of Dhaincha [*Sesbania aculeata*] intercrop in mulberry under alkaline soil conditions. Advances in Tropical Sericulture, NASSI, Bangalore Eds. Dr.S.B.Dandin, Dr.R.K.Mishra, Dr.V.P.Gupta and Dr.Y.S.Reddy pp 192-193.
16. Gupta, V.P. [2000]. Biological control of mulberry diseases – The current status. In Diseases of Plantation crops, spices, betelvine and mulberry. Ed. Dasgupta, 2000, pp 145-148
17. Jayaraj, S, Veeraiah, T.M., Qadri, S.M.H., Amarnath, S., Jaishankar, Srinivasa Rao T.V.S, Ramamohana Rao, Samuthiravel, P., Ravikumar, J., Chandrasekhar Reddy, D. and Dandin, S.B. [2005]. Proc. of National Seminar on Organic Farming for alleviation of rural poverty organized by Association for Promotion of Organic Farming, Bangalore on Aug. 8 & 9, 2006, pp – 68 – 76.
18. Juyal, A.C., Chakrabarti, S. and Mohan, R. [2004]. Scope for vermicompost in sericulture in North West India. Indian Silk 43, 5, 13-14.
19. Lampkin, N. [1994]. In the Economics of Organic Farming: An international perspective, CABI, Oxford, U.K.
20. MacRae, R., Hill, S., Mahuys, G and Heming, J. [1990]. Advances in Agronomy, 43, p – 155.
21. Padel, S. and Lampkin, N. [1994]. In the Economics of Organic Farming: An international perspective, CABI, Oxford, U.K.

22. Purohit, K.M., Ray,D. and Subba Rao, G. [1990]. Effect of mulches on soil temperature, soil moisture, growth and leaf yield of mulberry during winter under rainfed conditions in West Bengal.
23. Purohit, K.M., Ray,D. and Subba Rao, G. [1992]. Influence of phytomulches on soil temperature, soil moisture conservation, growth and leaf yield of rainfed mulberry during winter in West Bengal. Indian J.Seric. 31 [1] : 41 - 47
24. Purohit, K.M., R,N,Dutta, K.C. Brahma, R.Sahu and N.N.Saxena [2006]. Effect of *in situ* soil moisture conservation on growth and leaf yield of rainfed mulberry in the Eastern Ghat Highland zone of Koraput District in Orissa. Proc. Of Regional Seminar on Prospects and problems of sericulture as an economic enterprise in North Western India. November 11-12, 2006, pp. 105 – 108
25. Report on research work at CSR&TI Berhampore since inception [1943-2005]
26. Report on R&D activities at CSR&TI Berhampore since last 15 years [2005]
27. Roy D., Mondal, L.N., Pain, A.K. and Mondal, S.K. [1973]. Effect of NPK and farm yard manure on the yield and nutritive value of mulberry leaf. Ind. J.Seric. 12 : 7 - 12
28. Setua, G.C., Kar, R., Ghosh, J.K., Das, N.K., and Sen, S.K. [1999]. Influence of Arbuscular Mycorrhiza on growth, leaf yield and phosphorus uptake in mulberry [*Morus alba* L.] under rainfed laterite soil conditions. Biol. Fertil. Soils 29 : 98 - 103.
29. Setua, G.C., Kar, R., Satpathy, B., Das, N.K., Ghosh, J.K. and Saratchandra, B. [1999]. Effect of Vesicular Arbuscula Mycorrhiza on growth, leaf yield and phosphorus uptake in mulberry [*Morus alba* L.] under irrigated alluvial soil conditions. Indian J. Agric. Sci. 49 [13]: 833-836.
30. Shankar Rao, K.V., Brahma K.C., Purohit, K.M. Saxena, N.N. and Sarkar, A. [2006]. Effect of integrated nutritive manaement on the commercial mulberry cocoon yield in the Eastern Ghat Highland zone of Orissa. National Seminar on Organic Farming for alleviation of rural poverty, pp – 24 – 25.
31. Sharma, D.D., Mala V.Rajan and N.B.Choudhary [2005]. Integrated management of root knot disease in mulberry. Paper presented in the 20th Congress of International Sericutlure Commission. Conference Papers, Vol.I, pp 82 – 86.
32. Shivsankar, K. [2003]. Organic produce and organic standards : A challenge for sericulture. Paper presented in the Workshop on organic farming and rainwater harvesting for sustainable sericulture on at RSRS Kodathi.
33. Srikantaswamy, R., Mala V.Rajan, Vijaya Prakash and Naaraj, B. [2006]. Utilization of bio resources for sustainable sericulture development under rainfed conditions of Chamarajnagar. National Seminar on Organic Farming for alleviation of rural poverty, pp – 28 - 29.
34. Sudhakar, P., Chattopadhyay, G.N., Gangwar, S.K. and Ghosh, K. [1999]. Occurrence of nitrogen fixing bacterial in mulberry [*Morus* sp.] mulberry ardens in relation to soil characters. Ind.Agric. 43 [3 & 4]:181 – 190
35. Sudhakar, P., Gangwar, S.K., Satpathy, B., Sahu, P.K., Ghosh, K. and Saratchandra, B. [2000]. Evaluation of nitrogen fixing bacterial for control of foliar diseases of mulberry [*Morus* sp.]. Ind. J. Seric. 39 [1] : 9 - 11.
36. Sudhakar, P., Chattopadhyay, G.N., Gangwar, S.K. and Ghosh, K. [2000]. Effect of Azotobacter biofertilizer with inorganic nitrogen on leaf yield and quality of muberry [*Morus alba* L.]. Tropical Science, Cambridge 40[1]:1-8.
37. Sukumar, J., Padma, S.D. and Thimma Reddy H. [2006]. Trichoderma spp. – an ecofriendly boon for root disease control in mulberry. Proc. of National Seminar on Organic Farming for alleviation of rural poverty organized by Association for Promotion of Organic Farming, Bangalore on Aug. 8 & 9, 2006, pp – 32 – 33

38. Thippeswamy, T., Das, P.K., Subbaswamy, M.R. and Chandrakant, K.S. [2005]. The 20th Congress of the International Sericulture Commission held at Bangalore from Dec.15-18, 2005, pp 37-40.
39. Veeraiah, T.M. [2003]. Role of green manure crops for soil health and fertility. Paper presented in the Workshop on organic farming and rainwater harvesting for sustainable sericulture on September 26th & 27th, 2007 at RSRS Kodathi.
40. Vijayakumari, N. and Sujathamma, P. [2006]. *Verticillium chlamydosporum* – a potential biocontrol agent for the management of root knot nematode *Meloidogyne incognita* Chitwood in mulberry. Proc. Of Regional Seminar on Prospects and problems of sericulture as an economic enterprise in North Western India. November 11-12, 2006, pp. 67 – 69

Researches concerning "in vitro" cloning of some parental mulberry varieties used to obtain hybrid lineas of morus genus

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ABSTRACT

In this paper the results of cloning „in vitro" obtaining of some mulberry varieties used as parental forms (female and male forms) gilongins of different Morus varieties for the new mulberry hybrid intra and interspecifics lineas is presented.

There were cloning through morphogengetic culture the varieties: Kokuso 21, Kokuso 25, Uraina 1, Olteni, Ichinose, Moretti, China 1, Bulgaria 2005, Comansesti 1-7 and Calafat.

Explants source was represented by herbaceus shoots forced from winter buds.

In order to inoculate the culture medium used was MS medium (Murashige and Skoog) with macro and microelements, Sequestrin solutions, vitamines (Thiamine hydrochloride, Nicotinic Acid,Pyridoxine), glicyne, myo-inozitol, agar, growthing hormons (kinetin and BAP - Benzylaminopurine).

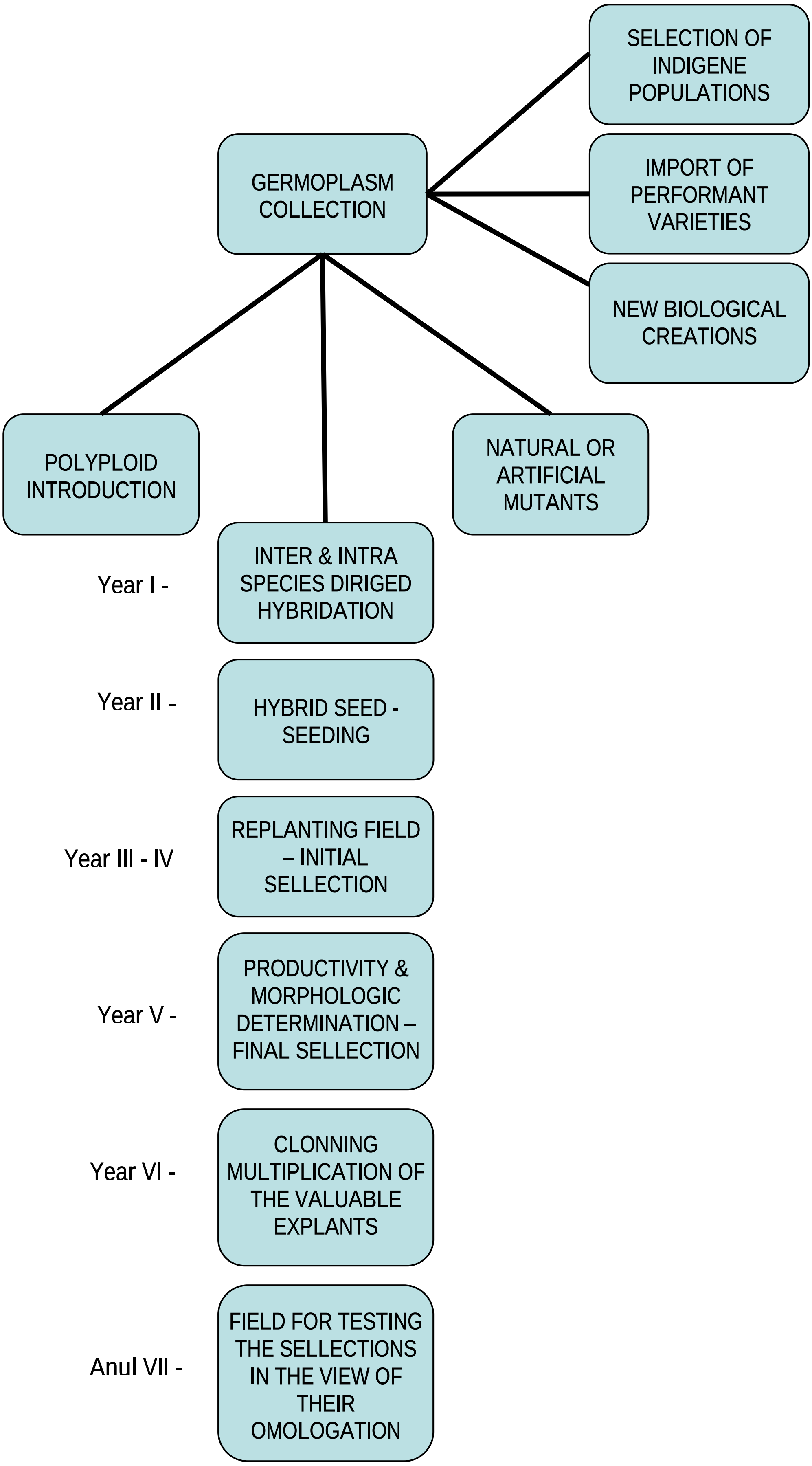
Keywords: „in vitro" cloning, mulberry varieties, culture medium, vitroplants.

INTRODUCTION

The mulberry varieties and hybrids belonging to the Patrimony of the SC Sericarom – Research Branch represent the main vegetal genetic resource. The strategical action for preservation and breading mulberry resources are:

- the preservation of mulberry genetic resource „in vivo" and „in vitro" condition;
- the enrichment of mulberry genetic collection by the most valuable mulberry varieties collected from word genetic mulberry fund;
- the prevetion of the „ genetic erosion" by the preservation of a biological material with a large genetic variability;
- the genetic intracloning selection to mentaining the genetic potential.

The germplasm colection of *Morus sp* can be qualitative and quantitative improuved according to the following diagram:


SELECTION OF INDIGENE POPULATIONS
GERMOPLASM COLLECTION
IMPORT OF PERFORMANT VARIETIES
NEW BIOLOGICAL CREATIONS
POLYPLOID INTRODUCTION
NATURAL OR ARTIFICIAL MUTANTS
Year I -
INTER & INTRA SPECIES DIRIGED HYBRIDATION
Year II -
HYBRID SEED - SEEDING
Year III - IV
REPLANTING FIELD – INITIAL SELLECTION
Year V -
PRODUCTIVITY & MORPHOLOGIC DETERMINATION – FINAL SELLECTION
Year VI -
CLONNING MULTIPLICATION OF THE VALUABLE EXPLANTS
Anul VII -
FIELD FOR TESTING THE SELLECTIONS IN THE VIEW OF THEIR OMOLOGATION

The present researches had as a purpose the obtaining the mulberry vitroplants, applying "in vitro" multiplication techniques to parental forms intended to be used in obtaining new mulberry hybrid lines.

MATERIALS AND METHODS

The mulberry varieties Kokuso 21, Kokuso 25, Uraina 1, Olteni, Ichinose, Moretti, China 2, Bulgaria 2005, Comansesti 1-7, Calafat and Morrus nigra have been used as a explant source. These varieties are used in the breeding programme as parental forms for obtaining new mulberry hybrid lines in two different period 2002-2003 and 2006-2007.

Explant sources consisted in actively growing young shoots developed in laboratory conditions, forced from winter buds from branches harvested in December, belonging to mature mulberry trees in the varieties mentioned above, from the collection of SC SERICAROM SA – Research Branch. The work protocol for obtaining mulberry vitroplants includes the following stages:

1. Surface sterilization of the plant material

- maintaining the young mulberry shoots for one hour under running tap water for some mechanical removement of the possible contminants;
- explant detaching, consisting in 1 – 2 cm nodal segments with axillary buds;
- sterilization in 10% commercial bleach for 30 minutes under continuous shaking, followed by 3 rinsing with distilled water, 10 minutes each rinsing.; the sterilizetion must be done in aseptic conditon in a laminar flow cabinet.

2. Primary culture initiation and morphogenetic culture obtaining – the explants have been inoculated in sterile conditions on the Murashige and Skoog (MS) basal medium supplemented with 1 mg/l BAP (benzylamionopurine) and 2 mg/l kinetin.

The incubation – after inoculation, the cultures have been transferred in a culture room, and grown at 25-28°C, with a16/8 hours photoperiod and a 3000 lux light intensity.

The elongation of the main shoot and the axillary shoot proliferation was recorded after 10-21 days since culture initiation. Periodical subculturings have been performed, by transferring the cultures on fresh culture medium every 3-4 weeks (fig.1).

During every subculture, the 1-2 cm elongated shoots were detached and transferred to a rhizogenetic medium, in order to obtain plants able to be acclimatized.

3. The rooting – was acieved by transfering the detached shoots to a MS liquid culture medium supplemented with 1 mg/l (photo no.2). This stage suppose basal liquid culture medium MS utilization suplimented with the growing hormone IBA (indole-3-butyric acid) in concentration of 1mg/l IBA (indole-3-butyric acid). The root primordia appear after 15-21 days of culturing on the rooting medium.

4. Vitroplants acclimatization – it is an important stage because due to some vitroplant morphological characteristics especially of the leaf anatomy, the micropropagated plants do not survive the direct transfer from „in vitro" conditions to greenhouse or field environments(poorly developed epicuticular waxes and palisade layer, defficient functioning of stomata, etc.). Some other characteristics that regards the shoot and root anatomy in ,in vitro" conditions are also contributing to the "acclimatization shock" of micropropagated plants, expressed mainly by a watter stress, due to excessive transpiration from above ground parts of plants or from inadequate uptake of water from the roots.

The acclimatization stage had as a purpose the ensuring that the mulberry vitroplants are able to change from the heterotroph nutrition to the autotroph one, when are transferred to natural growing conditions.

During the acclimatization stage we had in view to provide the vitroplants taken out from the culture vessels with a high relative air humidity (70-80%) and decreasing it gradually.

In the absence of a humidifier for producing artificial mist we obtained a good percent of acclimatization by gradually reducing the high relative humidity from inside the culture vessel following the gradual removing of the culture vessel stopper. After the vitroplants are taken out from the culture vessel, maintaining them in a hidroponic solution for 2 weeks is stimulating the development of new adventitious roots, with functional adsorbant root hairs, making them suitable to adapt to autotrof conditions.

The acclimatized autonomous mulberry vitroplants were then transferred to pots, in a substrate consisting in a mixture of vermiculite, manure and sand in 1:1:1 proportion, and were maintained for 3-4 weeks in laboratory conditions under moderate watering before being transferred to greenhouse conditions.

RESULTS AND DISCUSSION

By using the above described protocol, the following results have been obtained in the mulberry varieties taken into study:

Actively growing shoots were obtained by forcing dormant buds from branches collected between December 2002 and 2006 and also February 2003 and March 2007 from mature mulberry trees, and were used as explant sources. The inoculation of the nodal explants with axillary buds has been performed in February and Marcj 2003 and also March 2007, and during April – June 2007, we performed the subsequent transfers necessary for the establishment of proliferative cultures, elongation of shoots and the adventitious root development (Table no. 1).

Mulberry vitroplants obtaining in our experimental conditions according to the genotype

Table no.1

Mulberry varieties	Date of inoculation	Number of inoculated explants	Date of trasferring on fresh agarized MS culture medium	Number of transferred cultures	Date of transfer on the rooting medium	Number of rooted vitroplants
Kokuso 21	26.II.2002	20	25.IV.2002	18	26.V.2002	15
Morus nigra	5.III.2003	25	10.V.2003	20	15.VI.2003	5
Kokuso 25	17.III.2007	11	24.IV.2007	10	28.V.2007	9
Calafat	17.III.2007	6	24.IV.2007	5	28.V.2007	5
Ucraina 1	17.III.2007	22	24.IV.2007	16	28.V.2007	10
Olteni	17.III.2007	32	24.IV.2007	22	29.V.2007	7
Ichinose	22.III.2007	20	24.IV.2007	18	28.V.2007	5
Comanesti 1	22.III.2007	7	24.IV.2007	5	28.V.2007	9
Ucraina 1	22.III.2007	13	24.IV.2007	8	28.V.2007	11
China 2	22.III.2007	8	24.IV.2007	2	29.V.2007	2
Kokuso 25	22.III.2007	20	26.IV.2007	18	29.V.2007	8
Bulgaria 2005	22.III.2007	5	24.IV.2007	2	28.V.2007	2
Comanesti 2	29.III.2007	12	26.IV.2007	9	29.V.2007	5
Comanesti 3	29.III.2007	14	26.IV.2007	14	29.V.2007	3
Comanesti 4	29.III.2007	18	26.IV.2007	17	29.V.2007	6
Comanesti 5	29.III.2007	24	26.IV.2007	22	29.V.2007	4

Comanesti 7	29.III.2007	8	24.IV.2007	7	29.V.2007	5
Ucraina 1	29.III.2007	9	26.IV.2007	9	29.V.2007	3
Moreti	29.III.2007	3	24.IV.2007	3	29.V.2007	2
Kokuso 25	29.III.2007	7	26.IV.2007	6	29.V.2007	2

During 2002 year from the initial number of 20 inoculated explant Kokuso 21 variety has been established 15 morphogenetic cultures and for the Morus nigra inculated in 2003 year has been established only 5 morphogenetic cultures.

From the initial number of 239 inoculated explants during 2007, 193 morphogenetic cultures have been established, with some genotypes being refractory to develop multiple shoots „in vitro" from every inoculated nodal explant. The elongated shoots detached in the interval April – June 2007 and transferred to the rooting medium resulted in obtaining 98 vitroplants, with Kokuso 25 being the most responsive (19 rooted plantlets).

In Annex no 1 the synthetic informations regarding viability and somatometric determinations performed on mulberry vitroplnats regenerated from different genotypes are presented.

- according to the genotype, the viability and the morphogenetic capacity of the inoculated explants varied between 0,00% for Calafat, Olteni and China 2 varieties and 75,00% for Kokuso 21, the others varieties having intermediary values;
- The average length of the vitroplants obtained in 2007 varied between 5,2 cm at Comanesti 1-7 variety and 22,00 cm at Kokuso 25 variety and 24,0 cm for Bulgaria 2005 variety;
- The average length of mulberry vitroplants leaves has 10,0 cm at Kokuso 25 variety; 7,0 cm at Bulgaria 2005 variety and 2,5 cm at Moretti variety.

CONCLUSIONS

Based on our experimental results, the following aspectsmay be emphasized;

- under the culture conditions described for "in vitro" multiplication of Kokuso 21, Kokuso 25, Uraina 1, Olteni, Ichinose, Moretti, China 2, Bulgaria 2005, Comansesti 1-7, Calafat and Morrus nigra varieties, results of practical importance have been obtained only for Kokuso 21 and Kokuso 25, Ucraina 1, Comanesti 1-7, Bulgaria 2005, Moretti and Ichinose, these varieties showing more than 50,00% rooting percentage. As regards Calafat, China 2, Olteni varieties and Morus nigra, more experimental work must be done in order to obtain a number of regenerants significant from practical point of view;
- somatometric mulberry vitroplants determinations has shown the best value (24,0cm) of the average lengh in Bulgaria 2005 variety and 22,0 cm for Kokuso 25 variety.
- according to the genotype and the „in vitro" protocol, the viability and the morphogenetic capacity of the inoculated explants has shown the best value 75,00% for Kokuso 21.

Anex No. 1

Somatometric mulberry vitroplants measurements on MS liquid culture medium

No	Mulberry varities	No. of nodal explantes inoculated on solid MS with agar	No. of nodal explantes inoculated on liquid MS medium	No. of nodal explantes inoculated on liquid MS medium				Lenght Average of rooted explantes cm	Lenght maximum of rooted vitroplants leave cm	No. of rooted vitroplants
				rooted	unrooted	Contaminated	rooting %			
1	Kokuso 21	20	20	15	5	-	75,00	-	-	15,00
2	Morus nigra	25	25	5	20	-	20,00	-	-	3,00
3	Kokuso 25	19	16	9	4	3	52,63	22,00	10,00	7,88
4	Calafat	5	3	0	1	2	0,00	0,00	0,00	0,00
5	Ucraina 1	24	18	11	5	2	45,83	6,10	6,50	7,81
6	Olteni	7	2	0	0	2	0,00	0,00	0,00	0,00
7	Ichinose	5	4	1	2	1	40,00	6,00	4,00	6,00
8	Bulgaria 2005	2	4	1	1	2	50,00	24,00	7,00	13,00
9	Moretti	2	2	1	0	1	50,00	6,50	2,50	11,00
10	Comanesti 1-7	17	10	4	4	2	23,53	5,2	4,50	6,80
11	China 2	8	2	0	0	2	0,00	0,00	0,00	0,00

REFERENCES

1 Brailoiu Tanase Doina, Rosu Ana, Mocanu Raluca – Clonarea "in vitro" a unor genotipuri valoroase de dud, (2002), a 31-a Sesiune de Comunicari Stiintifice a Facultatii de Zootehnie – U.S.A.M.V. Bucuresti – Noiembrie 2002 –12-13 Dec. 2002, Targoviste, p 78.

2 Brailoiu Tanase Doina, Ana Rosu, Georgiana Negru, Silvana Danaila Guidea (2007), " Biotehnologia de multiplicare *"in vitro"* a unor soiuri de dud utilizate in programul de ameliorare" – al XVI-lea Simpozion National de Culturi de Tesuturi si Celule Vegetale – Academia si Institutul de Biologie Bucuresti.

3 Rober D. Hall – „Plant Cell Culture Protocols" vol 1, (1999), Humana press.

4 Thorpe, T. A., Harry, I. S., and Kumar P. P. (1991) Application of micropropagation to forestry, in *Micropropagation* (Debergh, P. C. And Zimmerman, R. H., eds.), Kluwer Academic, Dordrecht, pp. 311-336.

5 Zimmerman, R. H. (1986) Regeneration in woody ornamental and fruit trees, in *Cell Culture and Somatic Cell Genetics of Plants*, vol. 3, (Vasil, I. K., ed.), Academic, New York, pp. 243-258.

6 Harry, I. S. And Thorpe, T. A. (1994) *In vitro* methods for forest trees, in Plant Cell and Tissue Culture (Vasil, I. K. And Thorpe, T. A., eds.), Kluwer Academic, Dordrecht, pp. 539-560.

Different kind of mulberry's seed's economical fitness define to get rootstock

By

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To multiply mulberry with vegetation way-grafting confers great importance to select rootstock. Following work's task represents to great work to select of resistant rootstocks, wich are necsessery for grafting best silkworm feeding, decorative and froit varieties. By of young sericulture scientist-collaborators group of Georgian Scientific-Research Institute has held research work for different kinds of mulberry multiplying and spread of sericulture in Georgia. For experiment was selected different kind and shape of mulberry's seed on the territory of Georgian Sscientific-Research Institute of Sericulture. It was also selected seed's activity, its blowing energy percent and qualitative indicator's laboratory analysis has shown that quantity of „Tatarika" seed is 802 piece in one gram, blowing is 98%, germinate is 96%, Variety „Gruzia" seed's quantity is 675 in one gram, blowing is 90%, germinate is 90%. The poorest results had variety of „Chroga", which germinate is 55%, blowing –61,5%. Seed elaborated with biostimulator-bioragi 10% solution and sowed in the sowing seeding part. For experiment is also sowed seed which was elaborated in the biostimulator. In order to get high sowing part, seed's quality define and its economical fitness establish help us to define sowing really rate, also according kinds we can define seed's blowing energy percent, activity and others. With biometrial and qualitative indicators define it may be select the best kinds and shapes which seed is high activity, it has great capacity of germinate and it is hardy for disease. Getting root stocks from this seed can apply for different kinds of mulberry multiply what bring great profit to farmers who are interested in this branch.
Keywords: mulberry, seed, rootstock.

Mulberry Phytoplasmal Disease Mey Be Transmissed by Soil Fungy

By

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Mulberry (*Morus)* phytoplasmal dwarf disease is transmissed from plant to plant by leafhoppers: *Hishimonus sellatus Uhler., H. onoides sellatiforms Ishiara, H.discituttus Walker.*

Ouar research works of last years show us, that the disease mey be transmissed by means soil fungi *Phialophora fistigiata (Lagreb et Melin) Conant*. *P. fistigiata* we have exude from mulberry plants with dwarf disease simptoms (strane 208). In result of artificial fungal contamination mulberry seedleangs had dwarf disease's simptoms: yellow-green, small, defformed leavs with reduced internal phloem and positive reaction to Dinesse reagent.

In our opinion phytoplasma mey be transmissed by soil fungy lke virus.

Key words: mulberry, dwarf disease, phytoplasma, soil fungi, transmission.

Effect of Bio-stimulator ASMA # 1 on Mulberry Leaf Curl

By

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The disease, mulberry leaf curl belongs to mycoplasmatic diseases. Japan is declared its homeland (1821). It is more than a century that this disease is distributed in Japan and its immune breed has not been created yet

This disease of mulberry leaf was first noticed in Georgia in 1964. Scientists of the Scientific Research Institute of Sericulture realized measures against the above stated disease. These were agrotechnical, preventive, chemical and biological ones. In recent years the bio stimulator ASMA # 1 was developed at the Institute (Patent No 8686, 2005. Authors: N.Baramidze, Z.Putkaradze), which, being the anti-bacterial preparation, improves the immunity of live organism. It is characterized by the selective effect with respect to cell and subdues the growth of cells infected by bacteria and viruses.

Mulberry seed was treated in 0,01% solution of ASMA # 1 and the laboratory experiments were carried out to determine the energy of seed swelling and germination. The following results were obtained: swelling energy of the seed treated in the solution of the bio stimulator exceeded by 7,2% that of the seed not treated in the preparation. Likewise the germination energy of the seed treated in the solution was higher by 9,1% than that of the untreated one.

Part of the treated seed was sown in pots and its development was watched. The obtained results were as follows: growth of height of the seedlings obtained from the seed treated in the solution of the preparation exceeded that of the untreated one by 32%, diameter of seedlings – by 4%, leaf length – by 8%, leaf width – by 3,6%, leaf weight – by 32%.

Likewise the root system of grafts grown in the infected zone was treated by 0,01% solution of the bio stimulator ASMA # 1. Percentage of cases of diseases of mulberry leaf curl compared with the control one was decreased by 33.3% and the spreading of disease decreased correspondingly.

Thus, the bio stimulator ASMA # 1 contributes to the increase of plant immunity, heightens the stability to bacterial and mycotoid diseases and thanks to these properties is recommended for treating of seed before its sowing and for treating of root system of perennial plants.

Key words:mulberry, leaf curl, biostimulator

Utilization of salt affected soils through reclamation and growing alkali tolerant genotypes

By

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ABSTRACT

As the transfer of viable technologies in the field is very slow due to various constraints, increase in silk production depends on horizontal growth. However, the growing pressure on arable land due to demand for production of food grains and creation of Special Economy Zones for industrial development in India, the only alternative is to explore utilization of wastelands like salt affected soils, which are apparently not suited for growing agricultural crops. Out of estimated 10 million hectares salt affected soils in India, 5.5 million hectares are alkali soils, which are increasing further owing to the continuing process of alkalisation. Soil alkalinity reduces plant growth, survival and economic yield by osmotic stress, ion toxicity, and nutritional disturbance. In order to extend intensive cultivation in such marginal environment, development of an integrated approach of growing tolerant mulberry genotypes and the technology for the reclamation to increase the sericultural productivity in alkali soils, is discussed. Reclamation was carried out with organic amendment (pressmud @ 50 MT/ha.) and inorganic amendments (gypsum @ 8MT/ha. + sulphur @ 1MT/ha.), separately. Chemical properties, macro-nutrient and micro-nutrient status were studied before and after reclamation. Study involved five mulberry genotypes already considered to be relatively tolerant under alkali soil along with a high yielding genotype under normal soil conditions as an entry and two other ruling check genotypes. Yield data was collected for two years, after initial establishment of plants followed by bio-assay studies carried out during the second year of the study. Yield data indicated that the yield is dependent on both reclamation and the mulberry genotypes. Though the improvement in yield was evident with the change of reclamation treatments, yet the ranking of genotypes remained mostly the same in each of the treatments, independently. Genotypic variation among the test genotypes in alkali soils with or without reclamation is discussed. Mulberry genotype suitable for alkali soils and suitable reclamation process for improvement in soil condition for better expression of genetic potential of the genotypes due to the salt stress, are suggested. Future strategies for effective utilization of alkali soils for mulberry cultivation are also discussed.

Keywords: Horizontal growth, alkali soils, reclamation, integrated approach, genotypic variation

INTRODUCTION

Mulberry sericulture is considered as one of the important agro-based enterprises in India, playing a major role in the socio-economic development of rural masses by providing employment and offering high returns leading to better standard of living. Though slightly acidic (6.2-6.9 pH) soils are ideal for mulberry cultivation, keeping in view the need for rapid expansion of sericulture industry in India, and pressure on the available arable agriculture lands, there is a need for utilization of wastelands like salt affected soils where normal agricultural crops cannot be raised very profitably. It has been estimated that an area of 10 million ha. is salt affected in India, comprising 5.5 million ha. of alkali soil and 4.5 million ha of saline soils, which are increasing further owing to the continuing process of salinization and alkalization.

Soil alkalinity reduces plant growth, survival and economic yield by osmotic stress, ion toxicity, and nutritional disturbance. Alkali soils can be effectively utilized either by reclamation or by growing alkali tolerant genotypes. As adoption of reclamation at farmer's level is either slow or partial and achieving the maximum genetic potential of the mulberry genotypes under salt stress is difficult, development of an integrated approach for growing tolerant mulberry genotypes and to envisage the technology for the reclamation to increase the sericultural productivity was taken up.

MATERIALS AND METHODS

Study covered a series of field experiments conducted at the farm of Central Sericultural Research and Training Institute, Mysore situated at village Kinakahalli in the Southern Indian State of Karnataka. Experimental site was of black cotton soil with pH of 9.5, electrical conductivity in the range of 0.32 - 0.84, Exchangeable Sodium Percentage of 42 and Sodium Adsorption ratio of 30%, clearly indicating its alkali nature.

Five mulberry genotypes viz., AR-12, AR-14, AR-10, AR-08 and AR-29 were considered in the study along with V1, a high yielding genotype under normal soil conditions as an entry, S34 as improved check and Mysore Local, as normal check. 64 plants were maintained per genotype per replication excluding border plants, in a Randomized Block Design (RBD). Three replications considered were unreclaimed alkali soil, alkali soil reclaimed with organic amendments (pressmud @ 50 MT/ha.) and alkali soil reclaimed with inorganic amendments (gypsum @ 8MT/ha. + Sulphur @ 1MT/ha.).

Chemical properties, Macro-nutrient status and micro-nutrient status were studied before and after reclamation. Plantation was maintained by following recommended package of practices. Yield data of the mulberry genotypes was collected for two years, after initial establishment of mulberry plants for one year. Comparative rearing performance through bioassay studies considering various parameters was carried out during the second year of the study. Statistical analysis was carried out by appropriate statistical procedures.

RESULTS AND DISCUSSION

The object of the present study was to recommend a functional integrated approach by growing mulberry genotypes tolerant to alkalinity and by reclamation of soil by different amendments for utilizing vast alkaline areas of South India where mulberry is considered to be one of the most profitable cash crops. Among soil characteristics (**Table-1**), maximum soil pH of 9.5 was recorded in case of unreclaimed alkali soils followed by soils reclaimed with organic amendments (8.3) and soils reclaimed with inorganic amendments (7.9). Likewise, improvement in electrical conductivity (Ec), exchangeable sodium percentage (ESP) and sodium adsorption ratio (SAR) was recorded with reclamation. With respect to macronutrient status, Organic carbon and Phosphorous content were found to be highest in soils reclaimed with organic amendments and inorganic amendments, respectively. Reclamation has not affected Potassium content, positively.

Table-1: Soil properties before and after reclamation with amendments

Parameters	**Un-reclaimed alkali soil**	**After reclamation with**	
		inorganic amendments #	**organic amendment $**
pH	9.50	7.90	8.30
Electrical Conductivity (mmhos/cm)	0.58	0.63	0.40
Exchangeable Sodium Percentage (%)	42.00	12.00	18.60

Sodium Adsorption Ratio (%)	30.00	8.00	14.00
Macro-nutrient status :			
Organic Carbon (%)	0.33	0.54	0.76
Potassium (kg/ha.)	363.00	360.00	327.00
Phosphorous (kg/ha.)	7.00	9.00	6.70
Micro-nutrient status (ppm) :			
Copper	0.16	0.38	0.31
Zinc	0.96	1.40	1.61
Manganese	27.70	35.40	38.40
Iron	0.97	6.20	4.30

 # Gypsum @ 8 MT/ha. + Sulphur @ 1MT/ha.
$ Pressmud @ 50 MT/ha.

Among micronutrients, while maximum levels of Copper and Iron were recorded in soils reclaimed with inorganic amendments, Zinc and Manganese contents were higher in case of soils reclaimed with organic amendments. Micronutrient content was least in unreclaimed alkali soils.

Reclamation of alkali soils involves reversing of the process, which caused deterioration of these soils i.e., replacing excess exchangeable sodium with calcium supplied either through outside source or mobilizing precipitated calcium carbonate present in soil. Improvement of soil properties with decrease in soil pH, Ec, ESP, SAR in soil reclaimed with inorganic and organic amendments was is in accordance to the findings of Subbaswamy *et. al*., (1990), Bose *et. al*., (1992) and Bose *et al*., (1995). Maximum reduction was noticed in soil reclaimed with gypsum+sulphur and pressmud with respect to pH, ESP & SAR and Ec, respectively compared to alkali soil with no reclamation as reported in Annual report of CSRTI, Mysore (Anonymous, 1992) and also by Subbarayappa *et. al*., (1993), who observed best results by reclamation with Sulphur (1MT/ha.) + Gypsum (8MT/ha.) in reducing soil pH. Pressmud was found to be the most economic reclamant in reducing pH, Ec and increasing organic carbon and available phosphorous, which resulted in maximum leaf yield.

Highest Organic carbon, zinc and manganese contents were recorded on soil reclaimed with pressmud, whereas improvement with respect to potassium, phosphorous, copper, manganese and iron content was more on reclamation with gypsum+sulphur. These results are in line with finding of Deo *et. al.,* (1968) who observed decrease in total uptake of N, P, Ca, Fe and Mn with increasing concentration of the sodium salts. Reclamation effect through gypsum may be attributed to the increased solubility of soil calcium carbonate which replaces sodium salts in soil, with a resultant decrease in the soil pH and ESP of the soil and increase in the availability of nutrients (Singh and Abrol, 1988), which brings in the growth and quality of mulberry. Improvement in macro and micronutrients in soils reclaimed with gypsum + sulphur is due to synergistic effect of sulphur in the uptake of nutrients (Ishwari *et. al*., 1987).

Superior reclamation nature of pressmud in the present study is supported by the findings of Somani & Totawat (1993) who also reported the efficacy of pressmud due to relatively more soluble calcium and its organic-acidic (pH 5.62) nature bringing in accumulation and movement of micronutrients, as reported by Kapur and Kanwar (1989). With initial reclamation, improvement in the soil properties and nutrient status were found to sustain during the study period, which is supported by Chand *et. al*., (1980) who observed improvement in soil properties even after four years after reclamation of alkali soil.

Though the breeder has the freedom to choose any environment for breeding alkali tolerant mulberry genotypes, it is obvious that if reclaimed soil conditions are chosen, the genetic potential of the genotype will be expressed because of better managerial practices due to improved soil properties. In addition, plants may exhibit growth reduction, largely on account of energy expenditure for uptake and synthesis of solute, under salt stress conditions, resulting in the inability of the genotype to express its genetic potential.

Year-wise leaf yield of different mulberry genotypes under reclaimed and unreclaimed soil conditions was recorded for two years (5 crops per year). Pooled data of the two years (in MT/ha./year) at **Table-2** revealed that AR-12 was significantly superior over all the test genotypes, followed by AR-14 and AR-29 with significant difference between them. Minimum leaf yield was observed in case of Mysore Local.

Table-2: Average leaf yield (MT/ha./Year) of mulberry genotypes

Sl. No.	Mulberry Genotype	Unreclaimed Alkali Soil	Soil reclaimed with inorganic amendments	Soil reclaimed with organic amendments	Average
1	AR-12	16.87	20.43	23.01	20.10
2	AR-14	14.72	17.73	20.82	17.76
3	AR-10	11.35	13.13	15.11	13.20
4	AR-08	12.65	14.74	16.34	14.58
5	AR-29	14.24	16.95	18.87	16.69
6	V1	12.09	14.73	16.86	14.56
7	S34	11.18	13.30	14.81	13.10
8	Mysore Local	9.12	10.71	11.72	10.52
	Average	12.78	15.22	17.19	15.06

CD at 0.05 for:	
Treatment (Reclamation)	*0.28*
Mulberry Genotype	*0.45*
Reclamation x Mulberry Genotype	*0.78*

In most tolerant forage crops, yield of forage is more sensitive to salt stress than other parameters like seed production (Ayers and Hayward, 1948). In plants, where harvestable yield is composed of vegetative parts such as leaves, leaf yields are generally reduced under salt stress conditions in proportion to decrease in plant size (Bernestein, 1964). Various workers reported the varietal variability under salt stress in different crop plants including forage crops. They observed that the economical yield of crop plants (grain yield or forage yield) was less at higher salt concentrations (Lunin *et. al*., 1963).

Similarly, genotypic variation with respect to mulberry leaf yield within the treatments was observed, which is in agreement with the findings of Raja Indira and Raja (1980) and Bose & Majumder (1999). Performance of the different mulberry genotypes in different reclamation treatments indicated that the expression of leaf yield of genotypes is dependent on both reclamation treatment and the mulberry genotypes. Treatment x genotype interaction was also found to be significant. Though leaf yield varied significantly among mulberry genotypes in the same reclamation treatments, yet the effect of different reclamation treatments was evident by average increased gain in the yield in reclamation treatment with organic amendment followed by reclamation treatment with inorganic amendment. Though the leaf yield level increased with the change of reclamation treatments, yet the ranking of genotypes remained the same in each of the treatments, independently.

Table-3: Percentage of improvement in the most promising mulberry genotype (AR-12) under integrated package with initial soil reclamation with pressmud @ 50 MT/ha.

Characters	Un-reclaimed Alkali soil	Reclaimed with organic amendment	Improvement (%)
Leaf yield (MT/ha./yr.)			
First year	15.96	20.7 *	29.70
Second year	17.77	25.32 *	42.49
Average of two years	16.87	23.01 *	36.40
Weight of larvae (g)	32.509	34.652 *	6.59
ERR by number	8742.8	8961 **NS**	2.50
ERR by weight (kg)	15.183	16.047 *	5.69
Single cocoon weight (g)	1.822	1.881 *	3.24
Single shell weight (g)	0.326	0.349 *	7.06
Shell ratio (%)	17.88	18.59 *	3.97

** Significant over unreclaimed treatment at 5% level*
NS Not significant over unreclaimed treatment at 5% level

In view of the importance attributed to bioassay (Krishnaswami *et. al.,* 1971; Benchamin, 1989; Benchamin and Anantharaman, 1990; Lou Chengfu, 1994), to test mulberry leaf quality, same was studied taking in to consideration, weight of 10 matured larvae, ERR/10000 larvae (by number and weight), Single cocoon weight, Single shell weight and Shell ratio percentage for five crops during third year of plantation. Bioassay results indicated superiority of the genotype AR-12 under reclaimed conditions over other genotypes and treatments, which supported the findings of Anas and Vivekanandan (1997), who found significant varietal differences in all the parameters of bioassay, reflecting the differences in leaf quality of different mulberry genotypes grown in saline soils. Improvement in cocoon yield and economic characters of cocoons confirms the better quality of mulberry genotypes under reclaimed conditions, is in agreement with the findings of Li and Sano (1984), Tayade and Jawale (1984) and Chaluvachari and Bongale (1995).

Integrated package for raising profitable mulberry culture in alkali soils: The study indicates that genotypic variation exists in mulberry genotypes in alkali soils with or without reclamation. As the soil properties improve significantly with application of amendments particularly pressmud, makes the intercultural operations easy and economical for a marginal farmer. Genotype AR-12 has registered an increase of 29.70% and 42.49% in leaf yield during first and second year of the study, respectively (**Table-3**). Out of the test genotypes and checks employed in the present study, it was observed that response of the genotype, AR-12 was superior with respect to all traits including bioassay parameters, except for ERR by number, where improvement was non-significant. This infers suitability of AR-12 in alkali soils before and after reclamation with pressmud, beyond doubt.

RECOMMENDATIONS

- Organic amendment, pressmud is the best source to correct the soil alkalinity and improve the soil characteristics for increased production from tolerant genotypes in the alkali soil.

- Variable tolerance of different mulberry genotypes leads to identification of superior genotype like AR-12 in the present study, for growing under alkali soil.

- AR-12 is the suitable genotype for growing in alkali soil with the best rearing performance. The cocoon characters were further improved with organic amendment.

- The adaptability of different mulberry genotypes in different reclamation environment indicated that AR-12 has the capacity to improve significantly with improvement in soil conditions.

Proper planning for multiplication of alkali tolerant mulberry genotype AR-12 and the adoption of reclamation package as suggested is expected to result in effective utilization of hitherto untapped alkali soils for mulberry cultivation. Further, efforts should be made to utilize the genetic variability in mulberry to identify species-specific markers for alkalinity stress condition. Also, empirical testing in hot spots for alkali soil is the best way to screen promising mulberry germplasm accessions tolerant to such soils.

REFERENCES

Anas, S. S. M. and Vivekanandan, M. (1997) Nacl salinity tolerance in mulberry genotypes. *In Nat. Conf. Mori. Physio. Biochem and Mol. aspects of stress tolerance*, Tiruchirapalle, Feb 22-23,1997, p. 20-21.

Anonymous (1992) Annual Report, Central Sericultural Research and Training Institute, Mysore, p.13.

Ayers, A. D. and Hayward, H. E. (1948) A method for measuring the effects of soil salinity on seed germination with observations on several crop plants. *Soil Sci. Soc. Am. Proc*., **13**: 224-226.

Benchamin, K. V. (1989) Bioassay technique for evaluation of mulberry leaf quality. *I: Genetic resources of mulberry and utilization.* K.Sengupta and S.B. Dandin (Eds). Central Sericultural Research and Training Institute, Mysore, India, pp. 159-174.

Benchamin, K. V. and Anantharaman, K. V. (1990) Standardization of 'Moulting Test' to evaluate mulberry leaf quality under tropical conditions. *Indian J. Seric*., 29(2): 255-262.

Bernestein, L. (1964) Effect of salinity on mineral composition and growth of plants. *Plant analysis and fertilizer problems*. **4**: 25-45.

Bose, P. C.; Majumder, S. K. and Datta, R. K. (1992) Effect of amendments on chemical properties of alkali soils of mulberry garden and its yield. *Ind. J. Seric.* **31(2):** 147-150.

Bose, P. C.; Majumder, S. K. and Datta, R.K. (1995) Effect of different amendments on growth and quality of mulberry in salt affected soils. *Sericologia,* **35(2)**: 331-336.

Bose, P. C. and Majumder, S. K. (1999) Effect of Blue green algae on chemical and nutritional properties of salt affected soil of mulberry garden, productivity of mulberry and its economics. *Sericologia,* 39(3): 459-465.

Chaluvachari and Bongale, U.D. (1995) Evaluation of leaf quality of some germplasm genotypes of mulberry through chemical analysis and bioassay with silkworm, *Bombyx mori* L. *Ind. J. Seric.* **34(2):** 127-132.

Chand, M.; Randhawa, N. S. and singh, M. K. (1980) Effect of gypsum, pressmud, fulvic acid and zinc sources on yield and zinc uptake by rice crop in a saline sodic soil. *Pl. soil*. **50**: 17-24.

Deo, R.; Baser, B. L. and Ruhal, D. V. S. (1968) Effect of sodium salts on the growth and mineral composition of bajra (*Pennisetum typhoides*) *Ann. Arid Zone.* **7**: 100-104.

Ishwari.; Singh, R. S. and Tiwari, U. S. (1987) Effect of nitrogen and sulphur on yield and nutrient uptake by wheat. *J. Indian Soc. Soil Sci.,* **35(1)**: 152-154.

Kapur, M. L. and Kanwar, R. S. (1989) Effect of sulphitation and carbonation pressmud cakes and farmyard manure on the accumulation and movement of nitrogen, phosphorous and potassium. *J. Indian Soc. Soil Sci.*, **37(1):** 56-60.

Krishnaswami, S.; Kumar Raj, S.; Vijayaraghavan, K. and Kasiviswanathan, K. (1971) Silkworm feeding trials for evaluating the quality of mulberry leaves as influenced by variety, spacing and nitrogen fertilization. *Ind. J. Seric.* **10(1):** 797-786.

Li, R. and Sano, Q. (1984) the relationship between quality of mulberry leaves and some economic characters during the later larval stage. *Canye Kexue*, 10(4): 192-201

Lou Chengfu (1994) *Mulberry physiology and Ecology*. Zhejiang Agricultural University publication, Hangzhou, P.R. China.

Lunin, G.; Gallatin, M. H. and Bachelder, A. R. (1963) Salinity irrigation of several vegetable crops at various growth stages. I. Effect on yields. *Agron. K.,* **55**: 107-110.

Raja Indira, M. and Raja, D. (1980) Note on influence of pressmud application on ragi yield in an alkali soil. *Madras. Agric. J.*, **67**:204-206.

Singh, S. B. and Abrol, I. P. (1988) Long-term effect of gypsum application and rice-wheat cropping on changes in soil properties and crop yield. *J. Indian Soc. Soil Sci.,* **36(2)**: 316-319.

Somani, L. L. and Totawat, K. L. (Eds.) (1993) Use of amendments for reclamations of alkali soils *In: Management of Salt-affected soils and waters*, Agrotech Publishing Academy, Udaipur. p. 38.

Subbarayappa, C. T.; Bose, P. C.; Sinha, R. K.; Mallikarjuna, B. and Datta, R. K. (1993) Effect of some amendments on pH, electrical conductivity, organic carbon and available phosphorous of black cotton alkali soil. *Ind. J. Seric.* **32(2):** 208-210.

Subbaswamy, M. R.; Munirathnam Reddy, M.; Mallikarjuna, B. and Sengupta, K. (1990) Effect of amendments on soil properties and mulberry crop yield in an alkali soil. *Ind. J. Seric.,* **29(2)**: 279-281.

Tayade, D. S. and Jawale, M. D. (1984) Studies on the comparative performance of silkworm races against different varieties of mulberry under Marathwada conditions. *Sericologia*, 24: 361-364.

STUDIES ON THE STATUS OF BIOCHEMICAL CONSTITUENTS IN FOUR MORPHOTYPES OF MUGA FOOD PLANT SOM (*Persea bombycina*)

By

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ABSTRACT

In Assam, India majority of the Muga farms are under rainfed condition, where, the soil nutrients are providing the main source for the growth and development of food plants. In the present study four local morphotypes of Som plant (Persea bombycina) Viz- Ampatia, Kathalpatia, Naharpatia and Belpatia are cultivated in Khanapara Muga farm, Guwahati, Assam, India. Samples of tender, semimature and mature leaves from the above mentioned four morphotypes were collected and screened through chemo and bioassays. The results indicated that amount of total protein in the mature leaves of Ampatia was higher then the other three morphotypes. The moister content is high in the tender leaves of all the four morphotypes. The mineral content is high in the mature leaves of Kathalpatia. The sugar content was high in the mature leaves of Ampatia.

Introduction:

The muga silk worm, *Antheraea assama* is a polyphagous insect which is reared on primary food plant Som (*Persea bombycina* King). *Antheraea assama* is a polyvoltine in nature having 5-6 generations in a year and seasons affect the commercial characters. (Barah et.al, 1988). Nutritional value of food plants either alone or in combination plays an important role in the larval growth and silk productivity. The growth, development and economic characters are influenced to a great extent by the nutritional content of the leaf (Krishnaswami et.al, 1971). A good number of literature is available in the field of eri and mulberry culture. (Pillai and Jolly, 1985; Saratchandra and Joshi, 1988). *Persea bombycina* shows various morphotypes within the species. This morphotypes are locally named as – **Ampatia, Kathalpatia, Naharpatia and Belpatia.**

Less work has been done for chemo and bioassays of the morphotypes of the Muga host plant Som (*Persea bombycina*). The present study was undertaken to find out the moisture content, minerals, total protein and sugar content in four different morphotypes of primary Muga food plant Som (*Persea bombycina*).

Materials and Methods:

Four morphotypes of *Persea bombycina* were selected for this investigation from the Muga farm Khanapara, Guwahati, Assam, India. Tender, semimature, mature leaves of four morophotypes (1g in each) were collected randomly to find out the different constituent of the leaves Viz- moisture content, mineral content, total protein and sugar content. Percentage of ash contents were measured for each leaf types for the determination of mineral contents as per the procedure of Motiramani and Wankhade (1970). The total protein and sugar contents were measured by the methods used by Gupta and Varshaney (1989).

Table-1: Variation in Biochemical constituents of leaves in four Morphotypes of Som (*Persea bombycina*)

Morphotypes	Types of leaves	Moisture %	Minerals %	Total protein %	Total sugar %
Ampatia	Tender	69.2	6.15	21.2	7.8
	Semimature	64.8	7.35	21.7	8.5
	Mature	60.2	7.45	22.4	11.1
Kathalpatia	Tender	69.11	5.7	20.15	7.1
	Semimature	65.2	6.8	20.7	7.6
	Mature	60.6	8.45	20.75	8.3
Naharpatia	Tender	68.8	6.6	18.35	7.8
	Semimature	65.5	7.5	18.65	8.9
	Mature	59.8	8.5	19.75	10.8
Belpatia	Tender	68.6	6.25	18.2	6.85
	Semimature	64.4	6.85	18.5	7.65
	Mature	60.9	7.9	18.6	9.45

Results and discussion:

The moisture contents, minerals, total protein and total sugar contents are shown in the Table-1. The moisture contents of the leaves play an important role for the growth of the muga silkworm. Among the four morphotypes the tender leaves of Ampatia shows more moisture content then the other three morphotypes. The moisture content of the tender leaves was more than that of semimature and mature leaves of all the four morphotypes. Similar results were also observed in Tasar food plants (Jolly *et.al*, 1979) and Eri food plants (Pathak, 1988). The mineral contents were found to be rich in mature leaves. The mineral contents were comparatively high in Naharpatia morphotypes. This finding is in conformity with the findings of Yadav and Goswami (1987), Thangavelu and Sahu (1986).

The total protein and the sugar content was comparatively higher in all the four mature morphotypes of Som leaves. However, the protein and sugar showed an increasing trend from tender to mature leaves. The protein contents in different sericigenous plant is highly variable and is greatly influenced by environment and heredity.(Agarwal *et.al*, 1980; Pathak,1988) . It is clearly established that the quality of leaves particularly their moisture content, mineral content, protein content and sugar content play a significant role in proper growth and development of Silkworm.

References

Barah, A, Phukan, S. M and Samson, M.V. (1988): Variation in cocoon characters on *Antherea assama* Ww during different seasons. Sericologia **28**(2):215-218.

Krishnaswami, S, Kumara, S. Vijayaraghavan, K. and Kasiviswanathan, K (1971): Silkworm feeding traits for evaluating the quality of mulberry leaves as influenced by variety, spacing and nitrogen fertilization. Indian J Seric. **10**, 70-90.

Pillai, S. Venugopala and Jolly, M.S. (1985): An evaluation of the quality of mulberry varieties raised under hill condition and the crop result of *Bombyx mori*L. India J.Seric.**24**(2), 48-52.

Saratchandra, B and Joshi, K,L (1988): A note on the rearing of eri silk worm *Philosamia ricini* (Saturniidae: Lepidoptera) on different varieties/ cultivars of Tapioca (*Manihot Utilissima*) Sericologia **28(**3): 425-427.

Motiramani, D.P. and Wankhada, R.D. (1970): Laboratory manual in agricultural Chemistry. Assain publishers, Muzafarnagar (U.P.) 80-129.

Gupta, A.K. and Varshaney, M. L. (1989): Practical manual for agricultural chemistry. Kalyani Pub. New Delhi.

Jolly, M.S, and Prasad, G.K. (1979): FAO Agricultural Service Bulletin, Sericultural manual vol 4. **29** pp 121- 126.

Pathak, A.K. (1988): Studies on the nutrition , growth and cocoon characters of Eri silkworm *Philosamia ricini* Huff. fed on different varities of leaves. M.Sc. Thesis. Asam Agricultural University, Jorhat, India. pp 18 – 65.

Yadav, G.S. and Goswami B.C. (1987): Golden Muga Silk in Mizoram. Indian Silk, **26**(2) pp 14-15.

Thangavelu, K and Chakrabarty, A.K(1986): Present Status and future prospects of Muga silk Industry, India Silk **24** pp 23-26.

Agarwal, S.C. Jolly M.S and Sinha ,A.K (1980): Foliar constituent of secondary food plants of Tasar silkworm (*Antherea mylitta* D) Indian forester, **106**(12) pp 847-851.

Prognostics of Economic Indices of Mulberry by Correlated Selection Indices

By

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Process of mulberry selection is characterized by a series of peculiarities, the most important of which is recurrence of evaluation of selection material according to economic indices. Therefore estimation of selection material at the starting stage of ontogenesis development is most urgent, before heavy physical work, time and material capital investments are made for their growing.

We have determined the productivity, leaf nutritive value and plant resistance to mulberry leaf curl of new forms of mulberry breed, those of # 104, # 608 and # 158 taking into consideration preliminary diagnostic and selection correlated indices such as intensity of plant leafing, ratio of growing and non-growing sprouts on a branch, leaf index, sprout formation speed and intensity after plant exploitation, starting moisture balance in a leaf, withering speed, total content of organic acids, proteins and carbohydrates in a leaf and their ratio, anatomical structure of a sprout and leaf mesophyll, quantity of excess bast in leaf petiole medulla, term/period of fruit ripening etc.

Certain regularities were revealed between quality of leafing of the above stated mulberry forms and the resistance to mulberry leaf curl disease, between xeromorphic structure of sprout and petiole and resistance to harmful organisms, between soft bast in medullar section of petiole and resistance to diseases, between ratio of leaf proteins and carbohydrates and leaf nutritive value, between sprout formation, intensity and productivity after plant exploitation, which outlines certain perspectives in selection activity with the view of application of the above referred mulberry forms..

Key words: economic indices, prognostics, mulberry breeds

Fruit Capacity and Leaf Intensity of New Mulberry Breeds In Feeding of Mulberry Silkworm of Upper Ages

By

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One of the most important indices of mulberry breeds is their economic index in spring. It is the rate of leaf mass formation in the period of mulberry silkworm feeding, leaf's physical and chemical perfection, time of fruit ripening and dropping.

With this in view, in male plants of the studied new forms of mulberry, # 411 and # 415, branch leafing starts at the end of blossoming and reaches complete physiological maturity in the first decade of June (according to the data of 2005-2007). By this period most distinguished by the leafing rate are # 415 (♂) and female forms # 10, # 25, while the speed of leafing of the forms # 6 (♀) and # 7 (♀) and # 213 (♀) is hindered by abundant fruit capacity. In # 6 the complete ripening and falling of fruit occurs before its mass using is started and for the moment of feeding of the 5th age mulberry silkworm only 3.6% of fruit is preserved, while # 213 form by that time preserves – 35.2 %.

In the same period the balance of leaf moisture and dry matter in # 6, #7, #10, # 25 and # 213, # 411, # 415 studied forms of mulberry breeds by its most optimal ratio is presented in #6 and # 215 plants.

The above stated biological peculiarities of mulberry forms should be taken into consideration while feeding mulberry silkworm. In the first place the early-maturing mulberry ♀ form # 6 and male # 411, # 415 leaf should be used.

Key words: mulberry leafing, fruit capacity, silkworm feeding

History of Mulberry Selection and Perspectives in Georgia

By

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ABSTRACT

History of scientific selection of mulberry in Georgia counts almost a century. Rather rich experience was accumulated on the base of scientific research work carried out during this period and the principal provisions were developed for leading the work in this sphere, especially in immune selection. The present work offers the results of activity of Georgian selectionists in this sphere, and these results can be used by coming generations as the guide and bridge in the further activity in this sphere..

Key words: economic indices, prognostics, mulberry breeds

INTRODUCTION

Mulberry is one of the oldest crops in Georgia. Its wide distribution was conditioned by very favorable soil and climatic conditions. Its wild forms, in the form of wood massifs are still met in various regions of Georgia: on the Black Sea coast, on the banks of river Mtkvari, in the zones of Sagarejo, Tsnori, Lagodekhi, Khobi, Chaladidi. There is a big massif of Lezhbadini in Marneuli region, where the 100-200 years old mulberry trees are still observed (Gr. Japaridze, 1948; G.Zviadadze, 1969). Mulberry tree is used in Georgia not only as irreplaceable fodder for sericulture in the form of its leaf, but as a fruit-bearing tree giving very precious fruit used in food-canning industry, as well as a tree giving very strong timber for making furniture and national musical instruments. Decorative forms of mulberry tree – are used for making souvenirs and for decoration of parks and squares. In high mountain regions (up to 1200-1600 meter above the sea level) some mulberry tree forms can be used for building woods for strengthening sliding and eroded earth. Mulberry in Georgia is found in 56 regions, on 3421.7 ha territory, in the form of massifs as well as unit planting. It forms 48.4% of territory of the republic of Georgia, greater part (55%) of which comes on East Georgia, while the remaining part on West Georgia.

The significant share of local mulberry genofund is presented by the breeds created by means of folk selection. These are: Dadiani Mulberry. Shaumiani, Kvareli Mulberry, Sea Bzhola et al. In the 30s of the last century, more highly-productive leaf and fruit mulberry breeds such as Gruzia, hybrid Tbilniish-7, Tbilisuri, Adreuli, Hybrid-2 and Kutaturi were created on the base of the above listed breeds. In the same period (1930-1937) the field study of breed composition of mulberry distributed in Georgia was performed under supervision of the pioneer of Georgian selectionists Grigol Japaridze. Up to 600 morphologically distinguished mulberry forms were described. Alongside with it, the introduced mulberry breeds such as Kokuso-13, Oshima, Lu, Kataneo, Yoshino et al were tested.

In the period that followed (1945-1965) the selection activity Georgian researchers led their activity towards artificial hybridization and clone selection, mutagenesis and polyploidosis and fruit-void and small-fruit bearing mulberry breeds, as well as the breeds resistant to bacteriosis were obtained. These were: Gruzniish-4, Gruzniish-5, Kartlu, Samgoruli, Hybrid-68 and Iveria. The productivity level in these breeds was increased and nutritive value was elevated. Correspondingly the theoretical issues such as biology of mulberry blossoming and fruit bearing were developed and dependence of morphological characteristics on quality indices of leaf and breed productivity was determined and established (G.Aleksidze). Heredity regularities of certain marks of breed were determined (M.Shablovskaya, V.Nikuradze). Methodology of breed testing was perfected (Al. Kapiani, G.Aleksidze) et al.

In 1965 (from the moment of spreading the leaf curl disease, rugosity in Georgia) the new stage of activity started in the sphere of mulberry selection. It dealt with breeding of new breeds, which would be resistant to this disease. At the Scientific-Research Institute of Sericulture, in cooperation with S/R Institute of Plant Protection the work was intensified for the study of the above-referred disease, rugosity and the causes inciting it. Selection process was carried out in two directions: a) exposure of breeds and forms resistant to the disease, leaf curl (passive selection) and b) creation of new tolerant breeds on their base (active selection).

In the zone of infection, at the Kutaisi Zonal Experimental Station of Sericulture testing of the local genofund existing for that period and testing of introduced breeds was organized (up to 500 breeds and forms) to determine their resistance to disease. The resistance category of the tested breeds was determined (M. Kakulia, 1983) and the breeds which exposed high resistance were given recommendation for their distribution and for their using in selection work carried out on mulberry immunity.

Results of immunity estimation of local mulberry breeds and forms

I category immune	II category resistant, up to 10% is infected	III category relatively resistant, up to 25% is infected	IV category Moderately infected, up to 50% is infected	V category sensitive infected at more than 50% intensity
-	No 4, No 51, No 109 No 112 No 119	Iveria, Tbilisuri Hybrid-2 Gruzniish-4 No 14, No 15, No 35, No 77, No 88, No 113, No 115, No 117, No 160	Ukhvi" Kutaturi Gruzniish-5 Selektsia-26 No 1, No 3, No 99 No 116	Gruzia Mtskheturi Samgoruli Selektsia-2 Selectsia-4 Gruzniish-7

From the second and third categories the breeds and forms were revealed which are infected at 10-12% intensity, but retain stable yield of leaf for years, while productivity of breeds of the fifth category on the second year of disease decreases by 50% and on the third year the tree dies.

The scheme of selection work was developed (M.Shablovskaya). Starting material was created by hybridization of highly resistant breeds, by chemical and physical mutagenesis. By combination of starting material with the introduced breeds of Japanese, European, Indian, Uzbekian, Ukrainian, Azerbaizanian and other origin, in the beginning of 80s the new, relatively resistant to mulberry leaf curl, highly productive breeds were obtained. These breeds included: Imeruli-1, Imeruli-2, Kolkheti-85, Guria-10, Guria-20, Tbilisuri-2, Dighmuri-126 and Rioni, while by means of passive selection – Egrisi, Saamo, Hereti, Racha-9, Racha-10 – were obtained. The listed breeds are recommended for distribution in the zone of mulberry leaf curl. These breeds form the basic material for mulberry selection for immunity. These are mainly the representatives of species such as: Morus alba Linn (2n, 3n, 4n), Morus bombycis Koidz (2n), Morus multicaylis Perr (2n), Morus Kagayamae K. (2n) and Morus nigra Linn (22n). Alongside with the above stated we meet also representatives of the species, mostly forms such as: Morus acidosa Gry and Morus boninensis Koidz

The work is continued on the base of the above stated mulberry genofund for strengthening of the immunity, towards elevation of productivity, for the study of cyto-genetic, physiological, anatomical-structural and biochemical bases conditioning the resistance. Artificial hybridization was carried out for the study of hereditary transmission of major economic indices (productivity, immunity) of mulberry breeds. F_1 generation was analyzed and on the base of 10 year observation the following was defined (see Scheme).

- According to the character of growth and progress of plants in F_1 hybrids the heredity of father dominates, while in the resistance to diseases – heredity of mother prevails.

Results of selection and immune estimation of mulberry F_1 hybrids obtained by artificial hybridization (T.Dalalishvili, E.Choladze)

Evaluation	Disease intensity 0-2% I	Disease intensity up to 10% III	Disease intensity from 10 to 24% V
Positive sel indices	Russkaya x Oshima Japanese x Oshima No 13 x Oshima No 24 x Gruzniish-4 No 14 x Tbilisuri Japanese-2 x Tbilisuri Rioni x Oshima Imeruli-2 x Imeruli-1	Imeruli-2 x Oshima Iveria x Oshima No 35 x Oshima Imeruli-2 x Tbilisuri Russkaya x Tbilisuri	Imeryli-2 x Gruzniish-4 Iveria x Gruzniish-4 Iveria x Imeruli-1
Average negative selection in	II Japanese-2 x Oshima Rioni x Tbilisuri Ichinose x Tbilisuri Rosso x Tbilisuri Japanese-2 xGruzniish-4 Rioni x Gruzniish-4 No 14 x Gruzniish-4	IV Nezumigauri x Oshim Iveria x Tbilisuri Guria 20 x Tbilisuri Kutaturi x Gruzniish-4 Kutaturi x Tbilisuri Kolkheti-85 x Tbilisur Rioni x Imeruli-1 Kolkheti-85 x Oshima	VI Kutaturi x Oshima Kolkheti-85 x Imeruli-1

- Genes of resistance to leaf curl should be searched in the forms: Morus bombycis K, Morus multicaylis Perr and Morus alba Linn, while the breeds of the specie Morus Kagayamae Koidz should not be inserted in the program of breeding of new breed, since they are very sensitive to leaf curl.
- In selection work for immunity to leaf curl the priority should be given to breeds (or forms), which possess small-cellular anatomical structure, great additional quantity of soft bast in medullar section of petiole (<10), necessary balance of live cells in bark and wood (D.Shalamberidze).
- For obtaining high resistant hybrids and mother stocks for the zone of distribution of leaf curl most efficient components to be crossed are: ♀ Russkaya , ♀ Japanese –2, ♀ Kolkheti-85 and ♀ Tbilisuri, Oshima, Gruzniish-4
- Relatively balanced generation with the view of high resistance and phenotype signs is obtained by the use of breeds: Japanese-1, Russkaya, Rioni and forms No 14, No 35, at free pollination
- In the selection for leaf productivity the hybrids, which possess high regeneration capacity, that is which are apt to restore thoroughly anatomical structure after exploitation - should be given

preference. Such forms preserve stable yield of leaf even in case of disease (breeds Gruzniish-4, Oshima, Katlaba, No 158, No 6, No 90)

- Picking of starting material for selection is made according to preliminary diagnostic signs – by iso-electrical focusing of bud protein, by high index of leaf monose / saccharose and excess of soft bast in petiole medulla .

New perspective hybrids, radio- and chemo-mutant forms are subjected to testing at the Institute. Abundance of these forms certain perspectives for development of the oldest and traditional branch – sericulture in Georgia.

REFERENCES:

1. Aleksidze G. – Results of the study of leaf quality of major mulberry breeds distributed in Georgia - Transactions of the Institute of Agriculture of Georgia, vol. 8, Tbilisi, 1962, p. 301-308;
2. Dalalishvili T. Obtaining of starting material for mulberry selection by physical mutagenesis. Thesis for Candidate's Degree, Tbilisi, 1994
3. Dalalishvili T., Sakandelidze B. Mulberry genofund of Georgia and history of its study. Methodological Instructions, Tbilisi, 2006
4. Zviadadze G, Mulberry selection. Methodological Instructions, Tbilisi, 1978
5. Shalamberidze D. Picking of new, resistant to mulberry leaf curl forms according to anatomical structure. Collection of Scientific Papers of Georgian Agrarian University, Tbilisi, 1998, p. 36-48
6. Choladze E. Feasibility of application of mulberry hybrids for mother stocks in the zones of distribution of mulberry leaf curl. Thesis for Candidate's Degree, Tbilisi, 2006.
7. Japaridze Gr. Moriculture. Tbilisi, 1948, pp.30

EVALUATION OF SOM (*PERSEA BOMBYCINA*) GERMPLASM ACCESSIONS THROUGH BIOASSAY FOR REARING PERFORMANCE AND BIOCHEMICAL ANALYSIS OF LEAVES

By

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ABSTRACT

Eight Som accessions were evaluated through bioassay for rearing performance and leaf nutrient status. Leaves of these accessions were utilized to the Muga silkworm (Antheraea assamensis Helfer) from brushing till spinning during Spring and Autumn seasons of 2005 and 2006 under the agro-climatic conditions of Jorhat, Assam, India. Data on rearing performance were recorded. Ranking of the varieties done by the method of Arunachalam and Bandyopadhyay (1984) revealed accession nos. 8 and 2 as the best accessions for Muga silkworm rearing. The leaves of the accessions were further analyzed for nine biochemical constituents, viz., moisture, moisture retention capacity, total minerals, crude protein, total soluble protein, crude fibre, reducing sugar and starch. Leaf analysis for these biochemical constituents revealed Accession No. 8 as the best among the evaluated varieties.

Keywords: Muga silkworm, Som (*Persea bombycina*), Germplasm accessions, leaf quality, rearing

INTRODUCTION

Antheraea assamensis Helfer, the producer of glittering golden yellow coloured silk feeds on the leaves of a number of host plants. Most of these food plants are perennial tree and are available in wide range of geographical region. Among the numbers of food plants of muga silkworm, Som (*Persea bombycina*) and Soalu (*Litsea monopetala*) are the primary; Diglotti (*Litsea salicifolia*) and Mejankori (*Litsea citrata*) are the secondary food plants. Other food plants *viz*., *Cinnamomum glaucescens, Actinodaphnae obovata, Michelia champaca, Zizyphus zuzuba, Xanthozylum rehsta, celastrus monosperma etc*. are tertiary food plants.

Som, *Persea bombycina* Kost. belongs to family 'Lauraceae' is a principal host plant for Muga silkworm. This plant is distributed all over Assam and mostly utilized for commercial crop rearing. The cocoons are golden brown in colour. Hooker (1885) described 16 species of Som, but only four eco-types of som are preferred by Muga silkworm. This has got no specific varieties so far been developed, but all the available Som genotypes have been grouped into eight genotypes and termed as S1 to S8. Tetraploid plants of four genotypes *viz*. S-3, S-4, S-5 and S-6 were developed through colchicines treatment (Gogoi *et al*., 2006).

The nutritive value of leaf has a considerable influence on the growth and development of silkworms. The importance of good nutrition in mulberry silkworm rearing has been widely recognized both within and outside India (Takeuchi, 1960; Krishnaswami *et al*., 1970; Fonseca *et al*., 1993; Sarkar *et al*., 1997). Hence, several attempts have been made to assess the nutritional potential of popular mulberry varieties by bioassay (Bongale and Chaluvachari, 1995). Such studies are very rare in case of Muga silkworms. This paper deals with the rearing performance of the selected Som genotypes of Muga silkworm with an attempt to initiate such systematic study in relation to the nutritive value of leaves.

MATERIALS AND METHODS

The experimental materials in the present investigation was consisted of the eight genotypes, which were diploid (2n) and tetraploid (4n) plants of four Som genotypes designated as Acc. No. 1 (2n), Acc. No. 2 (4n), Acc. No. 3 (2n), Acc. No. -4 (4n), Acc. No.-5 (2n), Acc. No. -6 (4n), Acc. No. -7 (2n) and Acc. No. 8 (4n). These plants were raised by air-layering technique in the experimental field of CMER&TI, Lahdoigarh, Jorhat following RBD method with three replications of nine plants of each genotype at a spacing of 3m x 3m. N : P : K and FYM were applied to each plant as per recommended doses and were maintained following recommended package of practices (Chakravorty *et. al*., 2005). After 3 years of initial establishment, freshly hatched Muga silkworm larvae were brushed into the plants @ 25 worms per plant considering the quantity of leaf so as to complete the larval instars from brushing till maturation. The experiment was conducted in two rearing seasons, *viz*., spring (March-April : Season-1) and autumn (October-November : Season-2) of 2005 and 2006. Rearing parameters like ERR (Effective Rate of Rearing *i.e*., no. of mature worms collected out of total silkworms brushed and expressed as percentage), body weight of mature larvae, dry and green cocoon weight, shell weight and Silk Ratio percent were recorded in all the seasons.

Tender (3^{rd} and 4^{th} leaves), semi-tender (8^{th} and 9^{th} leaves) and mature (13^{th} and 14^{th} leaves) leaves of above mentioned twelve Som accessions were collected from each plant separately. Leaf samples were dried at 80°C, powdered, sieved and used for estimation of biochemical constituents. Total nitrogen was estimated by the method of Willits and Ogg (1950) and Crude protein was estimated by multiplying the estimated value of the total nitrogen by 6.25; crude fibre by Maynard (1970) and total carbohydrate by Hedge and Hofreiter (1962). For the estimation of total free amino acid, method described by Misra *et al.* (1975) was followed. All estimations were done on dry weight basis. Moisture, moisture retention capacity and Crude fibre were estimated following the method of A.O.A.C (1970). Anthrone method (Yem and Willis, 1954) was followed to estimate reducing sugar, total soluble sugar and starch. Method suggested by Arunachalam and Bandyopadhyay (1984) was followed to decide the ranking of the Som accessions in respect of the rearing performance and six different biochemical constituents.

Data recorded during the course of investigation were statistically analyzed of “Analysis of Variance” technique given by Snedechor and Cochran (1967). The significance of difference was done by ‘F’ test. When ‘F’ value was found significant, Critical Difference (CD) was calculated by multiplying S. Ed. (Standard Error) with corresponding‘t’ value at 5% level of probability. When mean difference among the treatments (varieties) were greater than the CD value the difference was considered as significant.

The standard error of mean S. Ed. Was calculated using the following expression:

$$\text{S.Ed.} (\pm) = \sqrt{\frac{\text{2X Error mean square}}{\text{Number of replication}}}$$

RESULTS AND DISCUSSION

Rearing performance of the Som accessions

Data on analysis of variance for different characters for rearing performance in different Som accessions are presented in Table 1.

i) Effective Rate of Rearing (ERR): The ERR obtained from feeding of leaves of Acc. No. 08 (74.06%) was significantly higher over other accessions. This was followed by Acc. No. 04 (68.78%) and Acc. No. 02 (64.77%) while lowest ERR (55.75%) was observed in Accession No. 01.

ii) Single larval body weight: The maximum single male larval body weight was recorded in Acc. No. 08 (9.30 g) which was at par with that of Acc. Nos. 01, 02, 05 and 07 (9.05 to 9.25 g) and lowest in Acc. No. 03 (7.96g). In case of female, significantly higher larval weight was recorded in Acc. No. 02 (13.84g) and lowest in Acc. No. 03 (10.80g).

iii) Single cocoon weight: Maximum cocoon weight was recorded in those larvae which were fed on the leaves of Acc. No. 02 (6.64g). It was followed by that of Acc. No. 04, 03 and 05 (5.89 to 6.28g). The minimum cocoon weight (4.86 g) was recorded in Acc. No. 07.

iv) Single shell weight: The maximum single shell weight (0.74 g) was recorded in Acc. No. 02 this was followed by Acc. No. 06, 08 and 05 (0.58 g to 0.60 g). The lowest single shell weight was recorded in Acc. Nos. 01, 03 and 04 (0.49 g).

v) Silk Ratio percent (SR %): Silk ratio percent was found significantly the highest in Acc. No. 06 (12.49%) and the lowest in Acc. No. 03 (7.85%).

Except ERR, the other rearing parameters exhibited at par in both the rearing seasons of Muga silkworms. Ranking of the accessions for rearing performance by the method of Arunachalam and Bandyopadhyay (1984) indicated that Acc. No. 02 was the best. Accession No. 08 ranked second, followed by Acc. No. 05 and Acc. No. 03 ranked on lower positions (Table 3).

Biochemical constituents

Data presented in Table 2 showed pooled average values of the biochemical constituents of leaves of different maturity collected during the two rearing seasons. All the Som accessions differ significantly from one another in respect of all the biochemical characters taken into study. A declining trend in moisture, crude protein, total soluble protein, reducing sugar and total soluble sugar was observed from tender to mature leaves in all the accessions while contents of moisture retention capacity, total mineral, crude fibre and starch were in increasing trend.

Dietary water plays a very important role in silkworm metabolism as it regulates the rate of ingestion by muga silkworm. It acts as diluents of nutrients, but not as a phagostimulant. Hazarika *et al*., (1994) found that, higher the moisture content of leaves, higher the blood volume in different instars of muga silkworm body, but lower the total haemocyte count and vice versa. Highest moisture content was recorded in the leaves of Acc. No. 08 (71.10%), which was at par with that of Acc. No. 02 (69.85%); while moisture retention capacity was significantly the highest in Acc. No. 02 (74.95%) over other genotypes. In case of total mineral also, significantly highest mineral was estimated from the leaves of Acc. No. 08 (12.73%).

Crude fibre is the ash free material and reduction in the fibre content had been established as an advantage for better silkworm crop yield (Vasuki and Basavanna, 1969). On this basis, among the accessions of Muga silkworm Host plant Som, Acc. No. 04 and Acc. No. 06 (17.59% and 17.99%, respectively) was found to be the best followed by Acc. No. 08 (19.43%) and Acc. No. 03 (19.11%) with respect to this constituent. The highest crude fibre (25.45%) was recorded in Acc. No. 01 compared to rest of the genotypes evaluated in the present study.

The role of protein in silkworm nutrition has been emphasized by Fukuda *et al*. (1959) and Takeuchi (1960). Acc. No. 08 (15.68%) and Acc. No. 07 (15.71%) recorded higher value for this parameter. Moreover, Acc. No. 08 recorded the highest total soluble protein content (12.82 mg/100 g) in its leaves and therefore, can be considered as desirable food plant for Muga silkworm. Among the Som accessions taken into study, Acc. No. 05 and Acc. No. 03 recorded the lowest values of total protein (10.81%) and soluble protein content (8.29mg/100 g), respectively.

Carbohydrates, particularly total soluble sugars, reducing sugars and starch are also very important for growth and development of silkworms. In the present investigation, total soluble sugars of leaves varied from 3.97% in Acc. No. 03 to 6.42% in Acc. No. 08. Content of reducing sugar was highest in Acc. No. 08 (1.96%) and starch in Acc. No. 04 (7.72%). Chakravorty *et al.* (2004) reported 2.41% reducing sugars, 5.09% total soluble sugars and 5.87% starch in the leaves of Som plant.

Ranking of the Accessions for leaf biochemical constituents by the method of Arunachalam and Bandyopadhyay (1984) indicated that Acc. No. 08 was the best among eight Som genotypes in respect of the tested biochemical constituents. Acc. No. 02 ranked second followed by Acc. No. 04. The genotype Acc. No. 03 ranked the lowest position (Table 4).

Thus, it is inferred leaf biochemical constituents have influence on the rearing performance and Acc. No. 02 and Acc. No. 08 are the best among the tested accessions for rearing of Muga silkworms. The present study also indicated superiority of tetraploid genotypes over diploid plants in terms of rearing performance as well as in contents of biochemical constituents as both the best accessions were tetraploid.

REFERENCES

Association of Analytical Chemists (A.O.A.C.)(1970) Official Methods of Analysis (11th edition)., Washington D.C., pp. 34-58.

Arunachalam V. & Bandyopadhyay A. (1984) A method to make decisions jointly on a number of dependent characters. *Indian Journal of Genetics*, **44**(3), 419-424.

Bongale U. D. and Chaluvachari K. (1995) Evaluation of eight mulberry varieties by leaf biochemical and bioassay moulting studies. *Sericologia*. **35** (1): 83-94.

Chakravorty, R., Neog, K., Suryanarayana N. and Hazarika, L.K. (2004). Feeding and moulting behaviour of muga silkworm (*Antheraea assama*) on different food plants. *Sericologia*, **44**(2) 145-152.

Chakravorty, R., Barah, A., Neog, K., Rahman, S. A. S. and J. Ghose (2005) *Package of practices of Muga, Eri and Mulberry Sericulture for North Eastern Region of India,* Published by Central Muga and Eri Research and Training Institute, Central Silk Board, Lahdoigarh, Jorhat.

Fonseca T. C., De Almeida J. E., Okamoto F. & Da Cunha E. A. (1993) Nutritive value of some mulberry clones (*Morus alba* L.). *Sericologia*, **33**(4), 631-633.

Fukuda T., Suda M., Matsuda M., Mayashi T., Kuroso T., Horiushi Y. & Florrin M. (1959) Formation of the silk protein during the growth of the silkworm. *Biochemistry*, **12**, 90-112.

Gogoi, S.N., Chakravorty, R., Neog, K. and Ghosh, P. L. (2006) Induced autotetraploidy in som *Persea bombycina* Kost. and its rearing performance of muga silkworm *Antheraea assamensis* Helfer, Perspective in Cytology and Genetics, 2006, 12: 169-183

Hazarika, L.K., Bordoloi, S. and Kataky, A. (1994). *Sericologia*, 34(2), 301-306

Hedge J. E. and Hofreiter B. T. (1962) In: Carbohydrate Chemistry. Vol.17. Whistler, R. L. and Be Miller, J. N. (Eds.). Acad. Press, New York, 423-432.

Hooker, J.D. (1885). The Flora of British India. Williamn Clowes and Sons Ltd., London, England, 5: 861.

Krishnaswami S., Noamani M. K. R. and Ahsan M. (1970) Studies on the quality of mulberry leaves and silkworm cocoon crop production. I. Quality differences due to varieties. *Indian Journal of Sericulture*. **9**, 1-10.

Maynard A. J. (1970) Methods in Food Analysis. Acad. Press, New York, pp. 176.

Misra P. S., Mertz E. T., Glover D. V. (1975) *Cereal Chemistry*, **53**: 844.

Sarkar A. A., Haque M. R., Rab M. A. and Absar N. (1997) Studies on crude protein and amino acid contents of mulberry (*Morus alba* L.) leaves in relation to cocoon production of silkworm *Bombyx mori*. *Sericologia*, **30**(1), 17-22.

Snedechor G. W. and Cochran W. G. (1967) *Statistical Methods*. Oxford and IBH Publ. Co. Pvt. Ltd., New Delhi.

Takeuchi Y. (1960) Ability of silkworm (*Bombyx mori* L.) to recover from malnutrition. *The Silk News Letter*, **5**(8): 6-7.

Vasuki K. and Basavanna H. M. (1969) Variety difference in the content of total and soluble minerals of mulberry leaves. *Silkworm Information Bulletin*, **I**: 31-35.

Willits C. O. and Ogg C. L. (1950). Report on standardization of Microchemical Methods, Microkjeldahl Nitrogen Determination. *Journal of Association of Official Agricultural Chemists*, **33**, 179-88.

Yem E.W. and Willis, A.J. (1954) The estimation of carbohydrates in plant extracts by anthrone. Biochem J., 57, 508.

Table 1. Rearing performance of Som accessions

Accessions	**ERR (%)**	**Body weight (g)**		**Cocoon weight (g)**	**Shell weight (g)**	**Silk Ratio (%)**
		Male	Female			
01	55.75 e	9.24 a	11.11 bc	5.21 d	0.49 c	9.41 c
02	64.77 c	9.25 a	13.84 a	6.64 a	0.74 a	11.11 b
03	59.10 de	7.96 c	10.80 c	6.18 b	0.49 c	7.85 d
04	68.79 b	8.34 bc	11.44 bc	6.28 ab	0.49 c	7.86 d
05	57.77 e	9.22 a	11.94 b	5.89 bc	0.58 b	9.97 bc
06	62.46 cd	8.67 ab	11.95 b	4.89 d	0.60 b	12.49 a
07	59.15 de	9.05 a	11.07 bc	4.86 d	0.53 c	10.29 bc
08	74.06 a	9.30 a	11.66 bc	5.66 c	0.58 b	10.77 b
S.Ed.±	**1.88**	**0.28**	**0.42**	**0.19**	**0.02**	**0.56**
CD $_{(0.05)}$	**3.83**	**0.57**	**0.86**	**0.39**	**0.04**	**1.15**
Season - 1	64.38 a	8.98 a	11.87 a	5.72 a	0.56 a	10.03 a
Season- 2	61.09 b	8.77 a	11.58 a	5.68	0.56 a	9.90 a
S.Ed.±	**0.94**	**NS**	**NS**	**NS**	**NS**	**NS**
CD $_{(0.05)}$	**1.92**	**NS**	**NS**	**NS**	**NS**	**NS**

Figures with any common alphabet does not differ significantly, NS=Non-significant

Table 2. Pooled average values of leaf biochemical composition of Som accessions

Accessions	Moisture (%)	Moisture Retention Capacity (%)	Total Mineral (%)	Crude Fibre (%)	Crude Protein (%)	Total Soluble Protein (Mg/100 g)	Reducing Sugar (%)	Total Soluble Sugars (%)	Starch (%)
01	67.46 b	73.60 b	11.48 c	25.45 a	13.65 c	10.02 d	1.60 cd	4.32 d	6.30 e
02	69.85 a	74.95 a	12.12 b	21.94 b	14.57 b	11.92 b	1.71 b	5.11 b	6.93 c
03	63.79 de	71.95 c	9.21 e	19.11 d	12.53 de	8.29 e	1.50 d	3.97 e	7.41 b
04	66.06 c	73.30 b	10.23 d	17.59 e	13.01 d	9.63 d	1.76 b	5.23 b	7.72 a
05	63.40 de	72.23 c	10.00 d	20.40 c	10.81 f	9.87 d	1.51 d	4.17 d	6.59 d
06	62.74 e	71.30 c	11.80 bc	17.99 e	12.24 e	10.74 c	1.75 b	4.76 c	7.30 b
07	64.33 d	71.89	11.57 c	21.62 b	15.71 a	10.51 c	1.66 bc	4.59 c	4.04 g
08	71.10 a	73.95 b	12.73 a	19.43 d	15.68 a	12.82 a	1.96 a	6.42 a	5.31 f
S.Ed.±	**0.68**	**0.43**	**0.21**	**0.23**	**0.31**	**0.19**	**0.05**	**0.09**	**0.10**
CD (0.05)	**1.34**	**0.86**	**0.41**	**0.46**	**0.62**	**0.39**	**0.09**	**0.18**	**0.20**
Effect of leaf maturity									
Tender	70.77 a	70.58 c	8.88 c	18.12 c	15.61 a	12.03 a	2.16 a	5.67 a	5.70 c
Semi-tender	66.02 b	72.87 b	11.30 b	20.60 b	13.54 b	10.51 b	1.59 b	4.83 b	6.55 b
Mature	61.48 c	75.25 a	13.25 a	22.61 a	11.43 c	8.89 c	1.29 c	3.97 c	7.09 a
S.Ed.±	**0.17**	**0.13**	**0.09**	**0.10**	**0.11**	**0.09**	**0.04**	**0.06**	**0.07**
CD (0.05)	**0.33**	**0.27**	**0.18**	**0.20**	**0.23**	**0.18**	**0.09**	**0.12**	**0.13**
Effect of seasons									
Season- 1	66.09 a	73.50 a	11.10 a	20.44 a	13.67 a	10.57 a	1.77 a	4.94 a	6.60 a
Season- 2	66.21 a	72.89 a	10.84 a	20.67 a	13.52 a	10.72 a	1.60 b	4.69 b	6.30 b
S.Ed.±	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**0.02**	**0.05**	**0.05**
CD (0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**0.05**	**0.09**	**0.10**

Figures with any common alphabet does not differ significantly; NS=Non significant

Table 3. Ranking of Som accessions based on rearing performance

Accessions	ERR (%)	Body weight (g)		Cocoon weight (g)	Shell weight (g)	Silk Ratio (%)	Total Scores	Rank
		Male	Female					
01	1.00	0.33	0.84	1.00	1.00	0.75	4.92	VII
02	0.60	0.33	0.33	0.25	0.33	0.50	2.34	I
03	0.90	1.00	1.00	0.50	1.00	1.00	5.40	VIII
04	0.40	0.84	0.84	0.32	1.00	1.00	4.40	VI
05	1.00	0.33	0.67	0.62	0.67	0.32	3.61	III
06	0.70	0.50	0.67	1.00	0.67	0.25	3.79	IV
07	0.90	0.33	0.84	1.00	1.00	0.32	4.39	V
08	0.20	0.33	0.84	0.75	0.67	0.50	3.29	II

Table 4. Ranking of Som accessions based on leaf biochemical composition

Accessions	Moisture (%)	Moisture Retention Capacity (%)	Total Mineral (%)	Crude Fibre (%)	Crude Protein (%)	Total Soluble Protein (Mg/100 g)	Reducing Sugar (%)	Total Soluble Sugars (%)	Starch (%)	Total Scores	Rank
01	0.40	0.67	0.60	1.00	0.50	0.80	0.88	0.80	0.43	6.08	V
02	0.20	0.33	0.40	0.80	0.33	0.40	0.50	0.40	0.71	4.07	II
03	0.90	1.00	1.00	0.40	0.75	1.00	1.00	1.00	0.87	7.92	VIII
04	0.60	0.67	0.80	0.20	0.67	0.40	0.50	0.40	1.00	5.24	III
05	0.90	1.00	0.80	0.60	1.00	0.40	1.00	0.80	0.57	7.07	VII
06	1.00	1.00	0.50	0.20	0.83	0.60	0.50	0.60	0.87	6.10	VI
07	0.80	1.00	0.60	0.80	0.17	0.60	0.63	0.60	0.14	5.34	IV
08	0.20	0.67	0.20	0.40	0.17	1.00	0.25	0.20	0.29	3.38	I

Effect of micro nutrients on seed cocoon floss production

By

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Production of silk and activity of silk gland depend on a number of factors. The production of floss depends on major three factors viz, the inherent genetic characters of the silkworm to spin, the quality of feed , the mulberry leaf and the a-biotic components the mountages and the environment. The quality of leaf being fortified with additional inputs by application of micro-nutrients either at soil or at foliar level has an impact on the floss production. The experiment was conducted by feeding mulberry leaf to silkworm Bombyx mori, L. The leaves were obtained from mulberry field which was deficient in micronutrients like Boron, Zinc and Copper. After the rearing of the silkworm, the cocoons were harvested and the floss was recorded in each treatment which indicated that the production of the floss was significantly minimum in seed cocoons produced through feeding leaves sprayed with of foliar application of copper compared to Zinc and Boron.
Key words: Micronutrients, Copper, Zinc and Boron, floss production.

STUDIES ON LEAF PRODUCTIVITY IMPROVEMENT IN MULBERRY THROUGH COST EFFECTIVE TECHNOLOGIES IN 21 ST CENTURY.

By

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ABSTRACT

Sericulture is an important economic activity popular among large marginal and small land holders in enhancing their income in tropical countries with little investment and creating employment for family labor all-round the year. The status of the sericulture industry, when viewed from a stable rearing of silkworms cannot be merely judged only on the basis of massive leaf crop, as more emphasis has to be laid on cost of cocoon production. Since the 60% of cost of cocoon production is incurred on growing mulberry, the productivity and profitability in sericulture depends mainly on maximization of leaf productivity per unit area. If silkworm rearing productivity is to be remunerative, it is imperative that the mulberry productivity to be cost effective with profitability. The growth And development of sericulture industry depend on the rapidity with which the low cost technologies are developed and adopted in the farmer's fields. The water use efficient varieties are need of the world sericulture industry to enhance the economic conditions of the small and medium farmers. The ferity management and environment management are two important factors to be taken care in mulberry cultivation. Therefore, simple cost effective technologies were developed, viz., cultivation of water use efficient varieties, in-situ organic farming through mulching of neem leaves followed by green crop cultivation, usage of biofertilizer and cultivation of mulberry as small tress. Surrounding the mulberry gardens. These technologies will help world sericulture industries to enhance the economic conditions of sericulturists.

INTRODUCTION

India has taken rapid strides in sericultural development in recent years due to introduction of innovations to farmer's field (Dolli et al, 1993). Mulberry varieties which require less water for their leaf productivity with high nutritional efficiency are required to meet the challenges of world sericulture in 21^{st} century (Susheelamm and Dandin, 2006). The cost effective sericulture technologies are to be introduced to farmer's fields. The mulberry pests and diseases are to be taken care, as the mulberry crop loss is increasing day by day in 21^{st} century. Therefore, improvement of mulberry leaf yield through the introduction of high leaf productivity, water use efficient varieties which are nutritionally superior followed by simple economically viable agronomical packages to be introduced to fields which will help to improve the sericulture industry in 21^{st} century. Water use efficient varieties have the genetic potentiality to absorb water from the soil and utilize soil nutrients in better way in comparison to inefficient water use varieties (Megnavaca, 1998).

The quantity and quality of silk is directly dependent on the leaf quality, which influences the healthy growth of silkworm larvae and there by affects the over all cocoon production (Singal and Mala, 1998 and Susheelamm et al, 2002).

The environment management and control of environmental pollution are very important aspects to be taken care to have good prosperity in sericulture. Due to continuous application of high doses of chemical fertilizers to mulberry fields has resulted in increase of soil pH followed by unhealthy soil with less fertility. This affected the plant growth and also polluted the environment by causing various foliar diseases and pests. The important leaf productivity traits responsible for higher cocoon productivity are leaf thickness, total chlorophyll content, colour of the leaf, moisture content and moisture retention capability of excised leaves (Slansky and Scriber, 1985 and Susheelamma et al; 2002). The chlorophyll content has shown interrelationship with important qualitative traits and highly significant positive correlation with all the nutritional characters of foliage and also with economic characters of silkworm (Susheelamma et al;: 2007). The water holding capacity of the soils of South India differs significantly in different places from 20% to 50%. Neem leaf is having high antibiotic property and it is used as anti fungal and anti insecticidal in many crops ((Nandagopal, 1990; Ventarao and Alice 1981and Chewande, 1995). Therefore, effective utilization of neem leaf mulching in mulberry cultivation will help to control the various foliar diseases and pests and thereby control of environment pollution with better environment management. The in-situ organic farming by mulching of neem leaf and green manure crops mixed with bio fertilizer will help to improve the humus formation in the soil which will enhance the water holding capacity of the soil. The cultivation of green manure crop in the mulberry fields will help to reduce the tukra disease incidence (Cromartrie, 1993).

OBJECTIVES

1. Development of cost effective technologies for mulberry cultivation
2. Improvement of soil health, soil fertility and water holding capacity.
3. Environment management to control pests and diseases.
4. Improvement of leaf productivity and sericulture productivity.

METHDOLOGY

The present research work was carried out in sericulture fields of South India during 2000-2006. The low cost technologies advocated to farmers of South India are in-situ organic farming through cultivation of green manure crop. The sun hemp was cultivated as green manure crop @15 kg/acre/year. By mulching sun hemp as green manure crop 87.17% nitrogen will be made available to mulberry plants. Application of neem leaf @1000 kg/acre/year mixed with 8 kg biofertilizer and 4 MT of organic manure. The cultivation of mulberry as small trees on the bunds of mulberry garden and total number of farmers adopted for study was 40.

RESULTS

The leaf productivity and qualitative traits of leaf was improved in plots advocated cost effective technologies due to improvement of soil fertility and better environment management due to control of various foliar diseases and pests. The check plots, where cost effective technologies were not advocated had less leaf productivity due to non-fertile soil and high infestation of foliar diseases. The tukra disease, which is common menace in mulberry fields was with high incidence. To control disease and pests, various fungicides and pesticides were sprayed, which in turn polluted environment. The plots with in-situ organic farming through neem leaf were helpful in control of various foliar diseases and tukra disease also. Therefore, insecticides were not sprayed to technology adopted plots, which in turn was helpful for better management of environment. The cultivation of small trees in bunds of mulberry gardens fetched additional income to sericulturists by good leaf productivity. Therefore, mulberry cultivation was cost effective. The data pertaining to leaf productivity and cocoon productivity is presented in table 1 and 2. Figures 1 to 6 depict the farmer's gardens where cost effective technologies were advocated with cultivation of water use efficient varieties.

CONCLUSION

The cost effective technologies advocated in the farmers' fields were very useful for control of various diseases and pests. The low cost technologies are very much in need to help farmers to have economic benefit from sericulture. Development of sericulture industry in 21st century depends on simple cost effective technologies coupled with nutritionally rich water use efficient mulberry varieties.

REFERENCES

Dolly, S.S., Kalappa, H.K., Subramaniam, R.K. and Chikkanna (1993). Extent of adoption of improved sericultural practices by sericulturists. Ind. Silk. **31** : 35-40.

Cromartrie, Jr.W.J. (1993). The environmental control of insects using crop diversity. In CRC handbook of pest management of agriculture Ed. By D.Pimentel, Vol.I. CSB. New Delhi, pp-183-216.

Megenavaca. (1998). Adoptation of plants to soil constraints and better nutrient utilization to improve crop productivity. In "Crop productivity and sustainability shaping the future". Chopra et al;(eds)Icar. New Delhi. pp:335-341.

Slansky, F. and Scriber J.M. (1985). Food consumtion and utilization in "Comprehensive physiology, biochemistry and formicology. G.A.Kerkut and Gilbert (eds). 3:87-263.

Singhal, B.K.and Mala, V.R.(1998). In insight into silkworm's food. The Indian Textile Journal. **108** :86-88.

Susheelamma,B.N., Bhagya, R, Dandin, S.B. and Rekha, M. (2002). Studies on association of nutritional components of mulberry leaf with economic characters of biovoltine silkworm Bombyx mori, L. Proceedings of XIX international Sericulture Congress. Bangkok, ISC. Lyon. Pp:51-60.

Susheelamma,B.N. and Dandin, S.B.(2006). Improvemnet for qualitative traits and leaf productivity in mulberry (Morus spp.) and its effect on bivoltine cocoon production. Ad. Plant. Sci. 19:23-28.

Susheelamma,B.N., Keshavacharyulu, K, Prithiviraje Urs and Balakrishna, R. (2007). Chlorophyll content as leaf quality determinant trait in mulberry (Morus India L). Ad. Plant Sci.20 : 113-115.

Nandagopal, S (1990). Studies on utilization of neem shoot for control of various diseases and pests in horticulture crops. Agri. J:50:831-835.

Chevande. (1995). Effect of neem resources on various pests in grain crops. J. Agric. Phil. 20:31-36.

Ventarao, M and Alices. (1981). Studies on neem shoot as pesticides and insecticides in rice. Ind. J.Agric.30:75-80.

Table 1: Data on soil properties, leaf and cocoon productivity with and without adoption of technologies at farmer's fields (Average of 20 farmers/region).

Region	Soil pH	Organic carbon	Chlorophyll content %	Leaf yield (kg/ac/year)	Cocoon yield/100 dfls	Foliar disease incidence %
	Technologies Adopted					
Karnataka	7.8	0.850	35.00	24000	75.00	5.00
Tamilnadu	7.5	0.840	30.00	23000	70.00	3.00
	Non-adopted					
Karnataka	8.5	0.440	20.00	19500	58.00	25.00
Tamilnadu	8.8	0.390	21.00	19000	56.00	20.00

Table 2: Leaf productivity and cocoon productivity traits in cost effective technologies adopted and non-adopted farmer's fields of South India. (Average of 20 farmers from Karnataka and Tamilnadu)

		Technologies adopted					
Region	Total Chlorophyll content (mg/gfw)	Leaf thickness (um)	Moisture retention capacity (%)	Fiber content (%)	Filament length (m)	Shell ratio (%)	Raw silk (%)
Karnataka	3.920	174.89	69.00	15.84	1091	23.08	17.00
Tamilnadu	4.023	178.03	69.85	16.00	1185	23.60	17.80
		Non-adopted					
Karnataka	2.800	160.30	64.30	11.85	850	21.67	14.23
Tamilnadu	2.950	164.18	65.50	12.30	890	22.00	14.60
C.D (5%)	0.311	2.300	1.420	1.356	27.08	0.416	2.96

Fig.1

Fig.2

Fig,1: Formation of deep furrows for mulching of neem leaves
Fig.2: Neem trees cultivated near the mulberry field
Fig.3: Mulching of neem leaves
Fig.4: Cultivation of sunhemp as green manure crop
Fig.5& 6: Wateruse efficient varieties in the farmers' field

Technology for preliminary selection of mulberry genotypes at nursery stage

By

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Survival and growth of the plant is essential for the establishment of a crop. The role of plant height in screening F1 population for its superiority over other characters is established since it is highly correlated character with the yield of mulberry. Accordingly data on plant height along with rootability was used for shortlisting of genotypes at nursery stage. The technique is aimed to reduce the time and labour for identification of genotypes at nursery stage for inclusion in primary yield trial. Joint scoring technique was adopted for the analysis and to arrive at conclusion of shortlisting the genotypes. Analysis on rootability (%) and height resulted in the formation of 18 and 22 groups based on the technique. Fourteen genotypes were identified out of fifty six genotypes raised in nursery. Also desirable visual characters were used to assist in identification of genotypes particularly with reference to tree cultivation of mulberry.

Keywords: Mulberry, shortlisting, plant height, rootability, joint scoring technique, visual characters, mulberry tree cultivation.

Biochemical methods of testing of economic-useful attributes forming productivity and nutritiousness of mulberry

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ABSTRACT:
Alongside with system engineering of optimum conditions of agricultural techniques of cultivation, feeding and maintenance of animals and plants, with a view of increase of their efficiency huge value gets studying hereditary caused preconditions of their economic resources. The present stage in research of polymorphic protein systems at agricultural crops and animals is characterized by opening increasing quantity of genetic systems and their use as markers in selection. In connection with an intensification of researches in the field of new biochemical markers search and their use for deducing the consolidated lines, an estimation of parental individuals and forms, drawing up of optimum programs of crossing on their basis and forecasting of heterosis effect remain actual and duly. From here we have aimed to study activity of one of key enzymes in a metabolism - peroxidase, to establish correlation interrelations between its isozymes activity and economic-valuable parameters of mulberry. On the basis of the received results it is necessary to develop the most effective ways of definition of economic-valuable attributes interaction at selection deducing highly productive grades and forms of mulberry. Researches were carried out on the grades differed to some attributes: distance between sheet plates and thickness of the sheet plate, forming mulberry productivity. As model plants were used next grades: Oktiabrskiy with short distance, Pionerskiy with long distance, Uzbekskiy with thick leaf plates and Selection number A-9-73 with thin leaf plates. With a view of highly effective biochemical methods of research, have been received results at various by origin grades of mulberry by revealing specific activity of peroxidase enzymes. According to the received results by comparison of isozyme activity with the basic economic-useful attributes of model grades of mulberry, according to preliminary results the direct correlation interrelation between isozyme activity with Rf 0,35 ; 0,40 is established and total activity of peroxidase enzyme and phenotipic attributes: weight of a leaf plate, average shoot length and the general leaf productivity.
Keywords: mulberry, heterosis, peroxidase, isozymes, mulberry productivity, economic-useful, correlation, genotypic, phenotypic.

INTRODUCTION

Alongside with system engineering of optimum conditions of agricultural techniques of cultivation, feeding and maintenance of animals and plants, with a view of increase of their efficiency huge value gets studying hereditary caused preconditions of their economic resources. The present stage in research of polymorphic protein systems at agricultural crops and animals is characterized by opening increasing quantity of genetic systems and their use as markers in selection. Polymorphic protein systems are successfully applied at the analysis of allelofund of grades, forms, lines and breeds of agricultural crops and animals [1, 2, 3, 4], at the control over an origin of breeding animals, specification of paternity that allows to raise reliability of genetic qualities estimation of manufacturers [5, 6, 7, 8, 9, 10]. Enough data on inside and interpedigree distinctions on frequencies of those genes or other polymorphic systems [5,11], and also about genetic distinctions between the elementary populations which are part of local populations that is shown on many kinds of fishes [12, 13, 14, 15, 16] are saved up. Use of allozimes has strengthened notion of population as of genetically stable system consisting of components [13] subject to variability, and promoted studying of dependence of population genofund from periodically varying conditions of an environment.

By means of protein polymorphic systems the opportunity of heterosis forecasting is established at crosses of genetically close and remote populations in connection with this it was offered to use factors of correlations between frequencies of genes for identification or distinction between grades and breeds, so-called " indexes of similarity " [6, 8, 9, 10, 17, 18, 19, 20]. Many researchers have tried to find out direct correlation communications between phenotypes of polymorphic fibers and enzymes and economic valuable attributes of animals and plants.

Notwithstanding what genetically caused variability is found out in more than 20 fermental systems of tissues and organs of agricultural animals and plants, only some of them (amilase, acid and alkaline phosphotase, esterases, aspartat-aminotransferase) have found practical application. Thus, many experimental data, as well as theoretical reasons of some researchers testify on absence of unequivocal communications between phenotypes of polymorphic fibers and attributes of efficiency, and also their instability and often different directory at some animals and plants. Nevertheless, it is difficult to overestimate work on detection of those or other locus connections, to study mechanisms of correlation interrelations, as the received information is an original key to drawing up of chromosomal maps and understanding of all circuit of the biochemical transformations participating in formation of attributes during ontogenesis of an alive essence. In connection with an intensification of researches in the field of new biochemical markers search and their use for deducing the consolidated lines, an estimation of parental individuals and forms, drawing up of optimum programs of crossing on their basis and forecasting of heterosis effect remain actual and duly.

From here we have aimed to study activity of one of key enzymes in a metabolism - peroxidase, to establish correlation interrelations between its isozymes activity and economic-valuable parameters of mulberry. On the basis of the received results it is necessary to develop the most effective ways of definition of economic-valuable attributes interaction at selection deducing highly productive grades and forms of mulberry.

MATERIALS AND METHODS

Researches were carried out on the grades differed to some attributes: distance between sheet plates and thickness of the sheet plate, forming mulberry productivity. As model plants were used next grades: Oktiabrskiy with short distance, Pionerskiy with long distance, Uzbekskiy with thick leaf plates and Selection number A-9-73 with thin leaf plates.

During vegetative period of mulberry development, agricultural care of experimental material was carried out. Following parameters have been received: growth and development of shoots; the area of a leaf plate; weight of a leaf and its output.

With a view of highly effective biochemical methods of research, have been received results at various by origin grades of mulberry by revealing specific activity of peroxidase enzymes.Studying of enzymes activity were carried out according to the following technique:

Definition of isozymes structure

Various isozymes are present at extracts from vegetative tissues. During electrophoresis divisions of extracts and fibers on gels activity of enzymes is kept. Developing of electrophoregrammes on gels with specific reagents allows to reveal the separate enzymes which are not blacked out by other protein components of studied object. Thus it is possible to separate clearly enzymes with identical specificity to a substratum, but differing in molecular features and received the name isozymes.

For extraction of enzymes and revealing their isozyme structure from leaves of mulberry it is possible to take advantage of various ways. One of them is reduced to the following. Example of leaves weighting 1 g pound in a mortar about 0,1 M the tris-HCl-buffer with pH 8,0, containing 0,5 M of saccharose, 0,006 M of an ascorbic acid, 0,006 M cistein [18]. For the objects rich with phenolic connections, apply polyamide (V_2 of example weight). A parity between example and buffer 1:10 or another (find by experimental way). Extraction is carried out during 1 hour at 4 °C, periodically stirring up. Then an extract is centrifugated for 30 mines at 8000-12000 rev/min. In supernatante protein is defined by Loury and put on gel paths in quantity of 100-400 mkg.

After carrying out electrophoresis fibers for revealing isozymes the last place in corresponding incubatory environments. According to the listed below ways enzymes and their isozymes in a leaf of various grades of mulberry [21] are found out.

Division and definition of peroxidase isoenzyme activity

Peroxidase, as a rule, consists of plural forms (isozymes) which differ on molecular weight, charge and other properties. Variability of isozyme structure is defined by an accessory of enzyme system to a concrete tissue, organ, organ age, and also influence of various stressful factors of abiotic and biotic origins.

At studying peroxidase isozymes of different parts of plants it is important to know their activity variability character. The last became possible after wide introduction in practice of biochemical researches of an electophoresis method of isoperoxidase divisions.

Reactants: 1) tris-glicine buffer (see in the text); 2) sephadex G-25; 3) polyacrylamid gels; 4) bensidine.

Course of the analysis.

Allocation of peroxidase. Peroxidase extraction was carried out by tris-glicine buffer with pH 8,3. Depending on enzyme activity take 400 mg of tissue, pound in a mortar on cold, degrease with a mix of *н*-butanol - water (4:1) during 1 hour. Then after centrifugation at 7000 g during 15 minutes supernatante is rejected. The received deposit is filled in with 10 ml tris-glicine buffer with pH 8,3 (tris-0,6 g; glicine-2,88 g; saccharose - 340 g; water up to 1000 ml) and at constant agitation during 20 minutes on cold receive peroxidase . An extract is centrifugated at 7000 g for 15 minutes. centrifugate is concentrated by sephadex G-25 (to 5 ml of an extract add 1 g of dry sephadex, mix and leave to settle for 15-20 minutes). Further centrifugate at 5000-6000 g for15 minutes, centrifugate merge into a dry test tube.

Carrying out electrophoresis. For electrophoresis on columns of polyacrylamid gel consisting of three solutions A, B, C (A- acrylamid-3 g, bisacrylamid -0,08 g, tris -0,1 g, glicine -0,48 g, water -up to 30 ml; B-ammonium persulphate -0,075 g, water-up to 10 ml; C-TEMED - 0,2 ml), put 0,05 - 0,15 ml (depending on the general activity of enzyme) of extract. Electrophoresisis carried out in the electrode buffer (tris-0,6 g, glicine-2,88 g, water-up to 1000 ml) with pH 8,3 for 30 min preliminary at 4 mA on each gel path for removal of persulphate ammonium surpluses from gel, and then after replacement of the bottom buffer continue electrophoresis from minus to plus (anode). Duration of electrophoresis for anode isozyme 1 – 1,5 hour, at force of a current 4 mA per path.

Revealing peroxidase isozymes after electrophoresis is carried out with bensidine reagent in acetate the buffer with pH 4,7 (0,5 g muriatic bensidine is dissolved in 100 ml acetate buffer consisting of 2,3 ml of ice acetic acid; 5,45g acetic sodium and water - up to 200 ml). Gel plate is placed for 20 minutes in bensidine reagent, and then transfer to 0,1 % water solution of hydrogen peroxide. In some minutes depending on activity, peroxidase isoforms in the form of the precise dark blue strips turning after a while into brown could be seen.

RESULTS

Peroxidase (1.11.1.7) plays a great role at plants respiration, as a rule, consists of plural forms (isozymes) which differ on molecular weight, charge and other properties.

With the purpose of deepening researches on establishment of biochemical markers determining genotipical and phenotipical attributes of mulberry, studying of peroxidase isozymes in preliminary prepared samples of mulberry leaves by electrophoresis method in polyacrylamid gel was carried out. By results of researches in polyacrylamid gel for the first time in a mulberry leaf have revealed 11 peroxidase isozymes, differing on the physical and chemical property and electrophoretic mobility (fig.1).

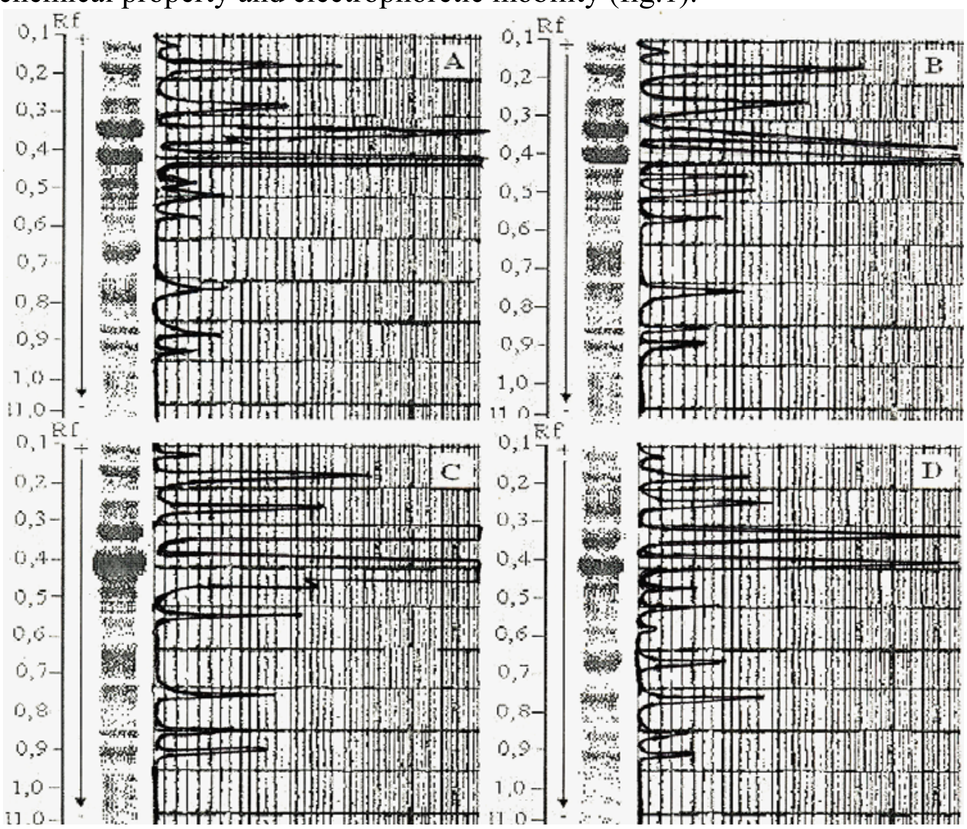

Fig. 1. Densitogramme, received with electrophoregramme of peroxidase isozymes at various grades of mulberry

Where: A)Octiabrskiy; B)Pionerskiy; C)Uzbekskiy; D) Selection № A-9-73.

The analysis of densitogramme, taken from electrophoregramme of peroxidase isozymes various on efficiency of mulberry grades, outlines specificity of their displays (table 5).

Table 1. Activity of peroxidase isozymes in comparison with economic-valuable parameters of mulberry and result of test silkworm feeding.

Grade name	Protein fractions	Rf	Activity of peroxidase, mkg/mg/min	Economic-valuable parameters					Cocoon shell weight,mg	Cocoon productivity from 1g of silkworm, kg
				Leaf plate weight, g	Leaf size, sm		Average shoot length, sm	Leaf crop from one plant, kg		
					Length	Width				
1	2	3	4	5	6	7	8	8	10	11
Oktiabrskiy	1	0,11	$0,013\pm3.10^{-3}$	1,61	14,1	11,8	217,1	1,890	347,0	3,37
	2	0,18	$0,0920\pm4.10^{-3}$	1,61	14,1	11,8	217,1	1,890	347,0	3,37
	3	0,27	$0,071\pm6.10^{-3}$	1,61	14,1	11,8	217,1	1,890	347,0	3,37
	4	0,35	0,137±2.10-2	1,61	14,1	11,8	217,1	1,890	347,0	3,37
	5	0,40	$0,140\pm5.10^{-3}$	1,61	14,1	11,8	217,1	1,890	347,0	3,37
	6	0,45	$0,041\pm3.10^{-3}$	1,61	14,1	11,8	217,1	1,890	347,0	3,37
	7	0,52	$0,046\pm2.10^{-3}$	1,61	14,1	11,8	217,1	1,890	347,0	3,37
	8	0,58	$0,027\pm1.10^{-3}$	1,61	14,1	11,8	217,1	1,890	347,0	3,37
	9	0,78	$0,048\pm3.10^{-3}$	1,61	14,1	11,8	217,1	1,890	347,0	3,37
	10	0,88	$0,045\pm4.10^{-3}$	1,61	14,1	11,8	217,1	1,890	347,0	3,37
	11	0,92	$0,035\pm2.10^{-3}$	1,61	14,1	11,8	217,1	1,890	347,0	3,37
Total activity			**$0,695\pm8,7.10^{-2}$**	**1,61**	**14,1**	**11,8**	**217,1**	**1,890**	**347,0**	**3,37**
Pionerskiy	1	0,11	$0,014\pm2.10^{-3}$	2,32	15,2	13,4	215,0	2,096	372,0	3,29
	2	0,18	$0,0980\pm5.10^{-3}$	2,32	15,2	13,4	215,0	2,096	372,0	3,29
	3	0,27	$0,081\pm3.10^{-3}$	2,32	15,2	13,4	215,0	2,096	372,0	3,29
	4	0,35	$0,167\pm1.10^{-2}$	2,32	15,2	13,4	215,0	2,096	372,0	3,29
	5	0,40	$0,152\pm4.10^{-3}$	2,32	15,2	13,4	215,0	2,096	372,0	3,29
	6	0,45	$0,053\pm4.10^{-3}$	2,32	15,2	13,4	215,0	2,096	372,0	3,29

	7	0,52	$0,050\pm3.10^{-3}$	2,32	15,2	13,4	215,0	2,096	372,0	3,29
	8	0,58	$0,032\pm2.10^{-3}$	2,32	15,2	13,4	215,0	2,096	372,0	3,29
	9	0,78	$0,058\pm1.10^{-3}$	2,32	15,2	13,4	215,0	2,096	372,0	3,29
	10	0,88	$0,056\pm2.10^{-3}$	2,32	15,2	13,4	215,0	2,096	372,0	3,29
	11	0,92	$0,038\pm3.10^{-3}$	2,32	15,2	13,4	215,0	2,096	372,0	3,29
Total activity			**$0,799\pm4,3.10^{-2}$**	**2,32**	**15,2**	**13,4**	**215,0**	**2,096**	**372,0**	**3,29**
Uzbekskiy	1	0,11	$0,013\pm3.10^{-3}$	3,12	14,9	12,7	220,2	2,212	339,0	3,32
	2	0,18	$0,120\pm4.10^{-3}$	3,12	14,9	12,7	220,2	2,212	339,0	3,32
	3	0,27	$0,091\pm6.10^{-3}$	3,12	14,9	12,7	220,2	2,212	339,0	3,32
	4	0,35	$0,200\pm2.10^{-2}$	3,12	14,9	12,7	220,2	2,212	339,0	3,32

Table 1 continuation

1	2	3	4	5	6	7	8	8	10	11
	5	0,40	$0,160\pm5.10^{-3}$	3,12	14,9	12,7	220,2	2,212	339,0	3,32
	6	0,45	$0,061\pm3.10^{-3}$	3,12	14,9	12,7	220,2	2,212	339,0	3,32
	7	0,52	$0,056\pm2.10^{-3}$	3,12	14,9	12,7	220,2	2,212	339,0	3,32
	8	0,58	$0,037\pm1.10^{-3}$	3,12	14,9	12,7	220,2	2,212	339,0	3,32
	9	0,78	$0,063\pm3.10^{-3}$	3,12	14,9	12,7	220,2	2,212	339,0	3,32
	10	0,88	$0,055\pm4.10^{-3}$	3,12	14,9	12,7	220,2	2,212	339,0	3,32
	11	0,92	$0,045\pm2.10^{-3}$	3,12	14,9	12,7	220,2	2,212	339,0	3,32
Total activity			**$0,901\pm8,7.10^{-2}$**	**3,12**	**14,9**	**12,7**	**220,2**	**2,212**	**339,0**	**3,32**
Selection №A-9-73	1	0,11	$0,011\pm3.10^{-3}$	2,10	14,8	12,7	193,3	1,750	329,0	3,25
	2	0,18	$0,0720\pm4.10^{-3}$	2,10	14,8	12,7	193,3	1,750	329,0	3,25
	3	0,27	$0,066\pm6.10^{-3}$	2,10	14,8	12,7	193,3	1,750	329,0	3,25
	4	0,35	$0,112\pm2.10^{-2}$	2,10	14,8	12,7	193,3	1,750	329,0	3,25
	5	0,40	$0,126\pm5.10^{-3}$	2,10	14,8	12,7	193,3	1,750	329,0	3,25

	6	0,45	$0,035\pm3.10^{-3}$	2,10	14,8	12,7	193,3	1,750	329,0	3,25
	7	0,52	$0,036\pm2.10^{-3}$	2,10	14,8	12,7	193,3	1,750	329,0	3,25
	8	0,58	$0,023\pm1.10^{-3}$	2,10	14,8	12,7	193,3	1,750	329,0	3,25
	9	0,78	$0,040\pm3.10^{-3}$	2,10	14,8	12,7	193,3	1,750	329,0	3,25
	10	0,88	$0,038\pm4.10^{-3}$	2,10	14,8	12,7	193,3	1,750	329,0	3,25
	11	0,92	$0,031\pm2.10^{-3}$	2,10	14,8	12,7	193,3	1,750	329,0	3,25
Total activity			**$0,530\pm5,3.10^{-2}$**	**2,10**	**14,8**	**12,7**	**193,3**	**1,750**	**329,0**	**3,25**

From the presented data it is visible, that total peroxidase isozymes activity at mulberry grades sharply differ from each other. The highest activity of enzymes $0,901\pm8,7.10^{-2}$ mkg/mg/min is observed at the Uzbekskiy grade, a leaf differing by high productivity, thus at a Selection № A-9-73 grade with smaller leaf productivity, total activity of enzymes makes $0,530\pm5,3.10^{-2}$ mkg/mg/min. Continuing the analysis of the received data on activity of individual peroxidase isozymes, hyperactivity of isozymes with Rf 0,18, 0,27, 0,35 and 0,40 is found out, most hyperactivity is established at isozymes with c Rf 0,35 ($0,112\pm2.10^{-2}$) and 0,40 ($0,126\pm5.10^{-3}$).

In table 2. the correlation interrelation between activity of peroxidase isozymes with the basic economic-valuable parameters of mulberry and result of test silkworm feeding is presented.

Table 2. Factor of correlation (r) between activity of peroxidase isozymes with the basic economic-valuable parameters of mulberry and result of test silkworm feeding

Grade name	Protein fractions	*Rf*	Economic-valuable parameters					Cocoon shell weight,mg	Cocoon productivity from 1g of silkworm, kg
			Leaf plate weight, g	Leaf size, sm		Average shoot length, sm	Leaf crop from one plant, kg		
				Length	Width				
1	2	3	5	6	7	8	8	10	11
Oktiabrskiy	1	*0,11*	0,34	0,21	0,11	0,33	0,23	0,33	0,21
	2	*0,18*	0,30	0,12	0,21	-0,23	0,34	0,22	0,34
	3	*0,27*	0,21	0,34	0,13	0,34	0,34	0,31	0,32
	4	*0,35*	0,67	0,34	0,14	0,83	0,76	-0,45	0,51
	5	*0,40*	0,81	0,23	0,23	0,91	0,81	-0,52	0,45

	6	*0,45*	0,22	0,28	0,23	0,34	0,31	0,12	0,32
	7	*0,52*	-0,34	0,12	0,34	-0,43	-0,21	-0,11	0,21
	8	*0,58*	0,31	0,11	0,27	0,21	0,12	0,34	0,12
	9	*0,78*	0,22	0,14	0,23	0,12	0,14	-0,11	0,10
	10	*0,88*	0,12	0,31	0,32	0,23	0,33	-0,32	0,23
	11	*0,92*	0,22	0,12	0,12	0,12	0,21	0,23	0,22
Total activity			**0,67**	**0,28**	**0,23**	**0,77**	**0,87**	**-0,42**	**0,29**
Pionerskiy	1	*0,11*	0,32	0,12	0,14	0,31	0,22	0,31	0,11
	2	*0,18*	0,30	0,17	0,22	-0,32	0,31	0,27	0,30
	3	*0,27*	0,24	0,34	0,13	0,34	0,34	0,30	0,32
	4	*0,35*	0,69	0,39	0,12	0,87	0,72	-0,41	0,55
	5	*0,40*	0,83	0,26	0,23	0,99	0,80	-0,56	0,45
	6	*0,45*	0,29	0,34	0,29	0,34	0,32	0,22	0,31
	7	*0,52*	-0,30	0,17	0,34	-0,42	-0,22	-0,14	0,21
	8	*0,58*	0,33	0,11	0,22	0,22	0,22	0,37	0,19
	9	*0,78*	0,22	0,12	0,29	0,23	0,21	-0,18	0,12
	10	*0,88*	0,22	0,21	0,30	0,27	0,30	-0,32	0,21
	11	*0,92*	0,29	0,12	0,21	0,32	0,21	0,32	0,27
Total activity			0,70	0,26	0,22	0,76	0,85	-0,44	0,30
Uzbekskiy	1	*0,11*	0,32	0,22	0,15	0,33	0,22	0,30	0,27
	2	*0,18*	0,37	0,11	0,22	-0,25	0,34	0,27	0,32
	3	*0,27*	0,27	0,30	0,33	0,34	0,37	0,37	0,37
	4	*0,35*	0,77	0,34	0,14	0,80	0,75	-0,40	0,52

Table 2 continuation

1	2	3	5	6	7	8	8	10	11
	5	*0,40*	0,88	0,21	0,23	0,81	0,87	-0,50	0,44
	6	*0,45*	0,25	0,28	0,25	0,34	0,32	0,20	0,30

	7	*0,52*	-0,30	0,15	0,30	-0,33	-0,27	-0,22	0,27
	8	*0,58*	0,30	0,19	0,21	0,21	0,23	0,22	0,22
	9	*0,78*	0,20	0,12	0,23	0,29	0,18	-0,31	0,17
	10	*0,88*	0,11	0,30	0,31	0,22	0,30	-0,30	0,21
	11	*0,92*	0,29	0,12	0,11	0,12	0,21	0,23	0,28
Total activity			0,72	0,30	0,20	0,79	0,88	-0,37	0,32
Selection №A-9-73	1	*0,11*	0,24	0,20	0,09	0,39	0,20	0,33	0,20
	2	*0,18*	0,32	0,11	0,19	-0,34	0,34	0,1	0,30
	3	*0,27*	0,25	0,30	0,14	0,36	0,37	0,21	0,30
	4	*0,35*	0,62	0,31	0,17	0,80	0,78	-0,55	0,55
	5	*0,40*	0,71	0,21	0,25	0,81	0,82	-0,42	0,42
	6	*0,45*	0,21	0,22	0,27	0,24	0,41	0,22	0,37
	7	*0,52*	-0,37	0,11	0,30	-0,53	-0,31	-0,21	0,27
	8	*0,58*	0,37	0,22	0,29	0,31	0,22	0,32	0,17
	9	*0,78*	0,20	0,24	0,21	0,22	0,14	-0,21	0,15
	10	*0,88*	0,22	0,21	0,22	0,13	0,23	-0,42	0,21
	11	*0,92*	0,11	0,22	0,11	0,22	0,31	0,13	0,26
Total activity			0,60	0,21	0,13	0,67	0,85	-0,44	0,32

According to the received results by comparison of isozyme activity with the basic economic-useful attributes of model grades of mulberry, according to preliminary results the direct correlation interrelation between isozyme activity with Rf 0,35 ; 0,40 is established and total activity of peroxidase enzyme and phenotipic attributes: weight of a leaf plate, average shoot length and the general leaf productivity.

The received results give the basis to recognize peroxidase isozymes as biochemical markers for intensification of selection process at an estimation of parental forms, deducing consolidated lines of mulberry and drawing up optimum programs of their crossing.

REFERENCES

1. Smirnov O.K. Activity of blood enzymes and their role in a problem of early efficiency diagnostics of agricultural animals: Dr. dissertation, - Dubrovitsi, 1970. –pp. 421

2. Mashurov A.M. Genetic markers in animals selection: Dr. dissertation -M.-1981. – pp.53

3. Starodumov I.N., Dubrovskaya R.M. XУI International conference on groups of blood and biochemical polymorphism of animals: Theses of reports. - VASHNIL,-1978, - p.155-156.

4. Moiseyeva I.G.Success of modern genetics. - 1978. - Vol.7.-p.I98-206.

5. Kushner K.F., Zubareva L.A., etc. Polymorphism of proteins and its value in genetics and selection of animals. - M.: - 1968.-p.128.

6. Stakan G.A., Glazko V.I.Reports of VASHNIL,-1978 - №II.-p.25-28.

7. Braend M., Efremov J. –J.Tord.Vet.Med, , 1965 - v. 17, n2 . p. 585-589

8. Egorova T.A., Vasileva L.E., Nasirillaev U.N. Biochemistry of insects M. - 1978, - Issue 103.-p.65-72.

9. Egorova T.A., Khomidy KH.S. Clearing and properties of membrane-connected forms of tregalase in silkworm eggs. //Biochemistry-1991.-Vol.56.-Issue.8.-p.1374-1384.

10. Egorova T.A., Khomidy KH.S.Tregalaza of silkworm *Bombyx mori* L. //J General biology.-1992.-Vol.53.-№ 4.-p.615-632.

11. Eydrigevich E.V. Works of Odessa Agricultural Institut. - 1969.-Vol.18.-Issue.7.-p.4-11.

12. Altukhov U.P.,Richkov U.G.//J.General biology,-1970.-Vol.31. -p.507-626.

13. Altukhov Y.K. Populational genetics of fishes. M: the Food-processing industry,-1974. – p. 246

14. Salamenkova V.A. Successes of modern biology - 1973.-Vol.75. - № 2. p.217-228.

15. Bogdanov L.V. Materials of the I All-Union. meeting. Biochemical genetics of fishes. - L.-I973.-p.24-36.

16. Kirpichnikov V.S. Genetic bases of fishes selection. - L.: Science, 1979. -pp. 391

17. Tikhonov V.K. Problems of theoretical and applied genetics. - Novosibirsk: Institute of cytology and genetics AS of the USSR, 1973,-p.328-350.

18. Stakan G.A., Глазко V.I. Reports of VASHNIL,-1978 - № 11.-p.25-28.

19. Titok T.G. Genetic protein polymorphism of blood and eggs of hens in connection with efficiency. Kiev, 1970. –pp. 122.

20. Bojkov A.I. Feature of genetic information realization at animals of different age and a genotype in connection with heterosis effect. Kharkov, 1981. –pp. 172.

21. Korochkin L.I. Interaction of genes in development,-M: Science, 1977. -pp.278

Morphological characteristics of the leaves from local Bulgarian mulberry varieties

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ABSTRACT

Main morphological characters of the leaves of 66 Bulgarian varieties from SES Vratza mulberry gene-bank have been examined with a view to complete studying of mulberry bio-diversity in Bulgaria. Some significant differences in values of most important morphological characters were established from the results obtained. According their shape mulberry leaves are cordate, ovate, triangle and lozenge shaped. Shape of mulberry blade could be determined also as index - ratio of lamina length with lamina width. Blade index of tested Bulgarian varieties was varied from 1.1 to 1.7. A great many of Bulgarian mulberry varieties were characterized with green colour of the leaves - 34 sp., followed by these with dark green colour - 17 sp. and light green colour - 15 sp. 43 of the specimens possess coetaneous leaf structure and 23 - paper structure. Mulberries with sharp apex are predominating in SES Vratza mulberry gene bank (48 specimens), followed by these with tailed apex - 18. Most of the tested varieties have cordate leaves (44 sp.) and scabrous leaves (22 sp.). The length of the leaves from tested mulberry varieties was varied from 10.73 cm for No 14 variety to 21.62 cm for Vesletz variety. Vesletz, Vratza 1, Vratza 18, No 59 and No 59 varieties were characterized with the biggest leaves. Three of tested varieties have leaves width from 6 to 9 cm, 29 varieties from 9 to 12 cm, 25 - from 12 to 15 cm and 8 above 15 cm. A great many of Bulgarian mulberry varieties were characterized with average petiole length (3-5 cm) - 51 sp., followed by these with shorter petiole (till 3 cm) - 15 sp.

Key words: mulberry, biodiversity, morphological characters, leaves

INTRODUCTION

Mulberry belongs to *Moraceae* family, genus *Morus*. Trees from some species, *Morus Alba, Morus Bombycis, Morus Multicaulis and Morus Nigra* are widespread in Bulgaria.

The leaf is the organ where the physiological activities of photosynthesis, transpiration and respiration take place. The leaf is the part that is harvested for silkworm rearing and the quantity and quality of mulberry leaf yield directly affect cocoon production. Therefore acquaintance with the nature and characteristics of the mulberry leaf is of importance to the selection and cultivation of varieties. (Dandin et Jolly, 1986; Lazarov, 1988, 1989; Ting-zing et all, 1988).

The aim of the present study was to analyze the main morphological characters of the leaves of Bulgarian mulberry varieties, preserved at SES Vratza mulberry gene bank.

MATERIAL AND METHODS

The study was carried out in SES Vratza mulberry gene bank. Experiment plantation was cultivated under standard cultivation (Penkov, 1971).

66 Bulgarian mulberry varieties and forms were the object of our investigation and 10 trees per every variety were examined.

Representative samples were picked up according to different character and analyzed. The colour of the shoots was determined by eyes.

A method for investigation of mulberry plant resources, established at SES Vratza was used for characterization of tested characters (Petkov, 2000).

RESULTS AND DISCUSSION

Data from our investigation are presented in figures 1-5.

Leaves are the most important organ of mulberry because are the only one food for silkworm *Bombyx mori* L. Besides this leaf characters occupy bigger part at classification of different mulberry species and varieties.

Tested 66 Bulgarian mulberry varieties are characterized with different qualitative and quantitative morphological characters of their leaves.

The mulberry leaf consists of three sections - the petiole, the stipule and the blade. Its shape and structure vary according to variety and environment conditions.

The stipule grows on the two sides of the base of the petiole. It is deciduous early and will come off while the leaf is maturing.

The blade is the main part of the leaf and is characterized with it size, shape and colour. It can have one of two basic shapes, called entire leaf and incised leaf. Most of the tested Bulgarian mulberry varieties possess entire leaves (50 sp.) and 16 have entire, lobed and serrated leaves together.

The entire leaf can be further classified into cordate, elliptic, ovate, etc. According to the blade shape varieties with cordate shape are predominated (42 sp.), followed by triangle-shaped leaves (24 sp.).

The morphological characteristics of the tip, margin, base and vein of the blade vary with varieties. Its size, thickness and colour are changeable since they depend on external factors.

Leaf margin of Bulgarian mulberry varieties is crenate in a different degree. The most of the varieties were characterized with toothed with different size and shape of tooth (37 sp.), followed with saw-toothed leaves with equal shaped tooth (29 sp.).

Leaf tip in local mulberry varieties is acute in 48 specimens and caudate in 18 specimens.

Distribution of tested varieties according to leaf colour is presented at fig 1.

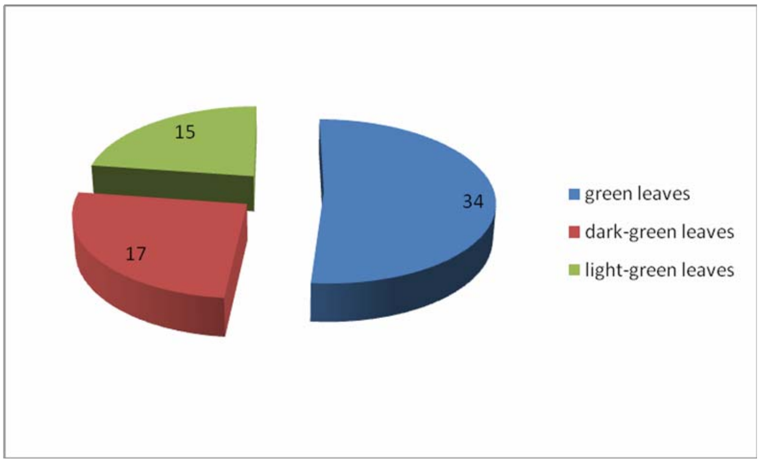

Fig. 1. Colour of mulberry leaves

It is evident that the most of Bulgarian mulberry varieties have green coloured leaves (34 sp.), followed by these with light-green and dark green leaves, 17 and 15 specimens, respectively.

In relation to leaf structure of tested mulberry varieties, varieties with skin structure are predominated (43 sp.).

Distribution of tested varieties in accordance to leaf texture is presented at fig 2. It was established that Bulgarian varieties are separated uniformly according to this character, but varieties with coarse leaves are predominated.

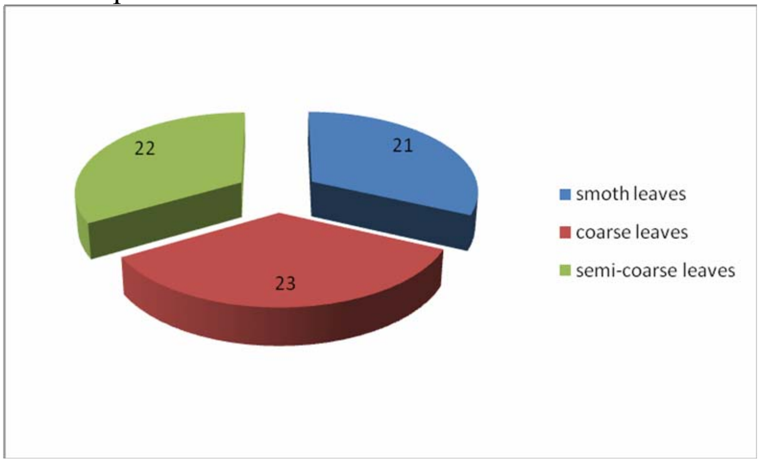

Fig. 2. Type of mulberry blade

Bulgarian varieties are characterized with comparatively glazed upper part of the leaf blade.

Leaf length and width are important mulberry economical characters. It was established that mulberry leaf length of tested varieties was varied in wide limits, from 10.14 cm for No 14 to 21.62 cm for Vesletz varieties (fig. 3).

The most of Bulgarian mulberry varieties have leaves with length between 16-18 cm (26 sp.) and between 14-16 cm (23 sp.).

Vesletz, Vratza 18, Vratza 1, No 59 and No 3 varieties are characterized with the biggest leaves. Three specimens have leaves with width from 6 to 9 cm, 29 with width from 9 to 12 cm, 25 with width from 12 to 15 cm and 8 specimens with leaf width above 15 cm. (fig 4)

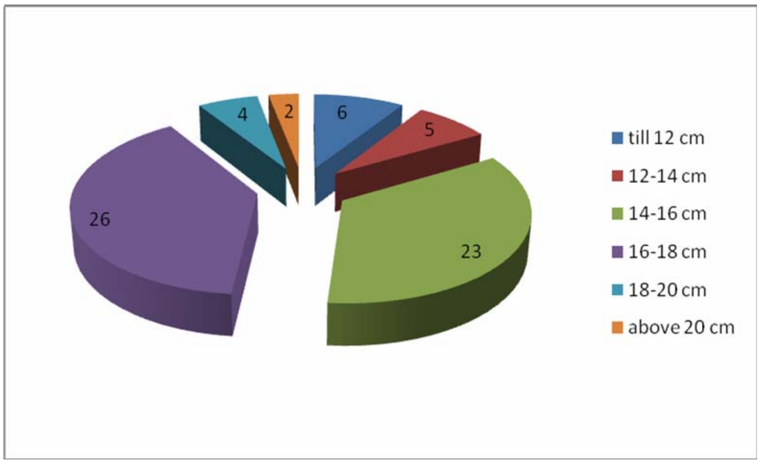

Fig. 3. Length of mulberry leaves

The shape of mulberry leaf could be determined also as index – relation of leaf length with leaf width; witch was varied from 1.1 to 1.7 for tested Bulgarian mulberry varieties.

The petiole, which is the juncture of the leaf and the branch, shoot and twig is the passage for water and food. Morphological characters of mulberry leaf petiole have their meaning at characterization and description of different mulberry varieties and forms. Mulberry petiole is characterized with it shape, length and color.

Most of Bulgarian varieties have average length of their petiole (from 3 to 5 cm.) – 51 specimens.

In accordance to leaf petiole shape varieties with cylinder-shaped petiole are predominated (35 sp.), followed by these with wing-shaped and semi-cylinder shaped petiole, 22 and 9 specimens, respectively.

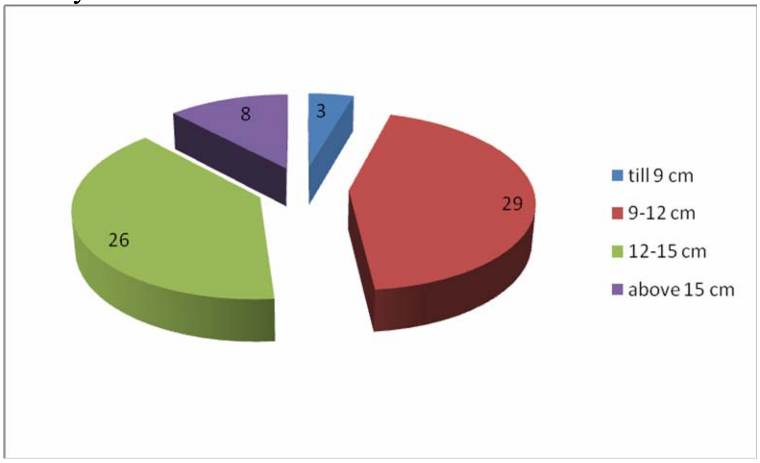

Fig. 4. Width of mulberry leaves

Certain variation of petiole color of Bulgarian varieties from SES Vratza mulberry gene bank was determined (fig 5). 30 varieties have light-green coloured petioles, followed by these with green-yellow and green colored petiole, 25 and 11 varieties, respectively.

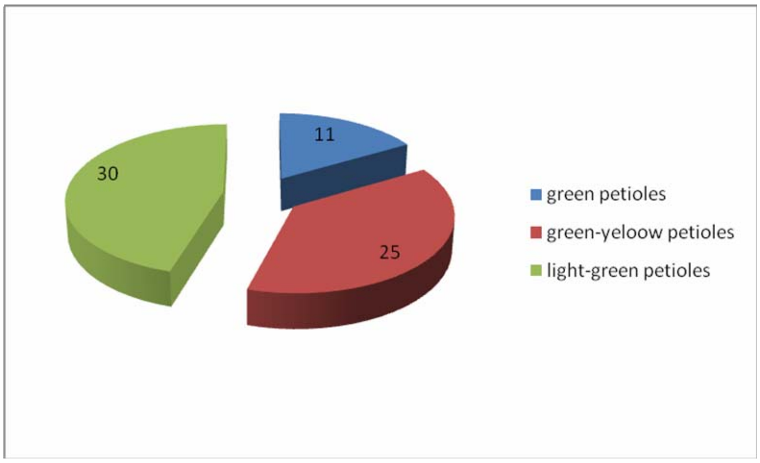

Fig.5. Colour of mulberry petiole

CONCLUSIONS

Some significant differences in values of most important morphological characters of leaves from tested Bulgarian mulberry varieties were established. According their shape mulberry leaves are cordate, ovate, triangle and lozenge shaped. Blade index of tested Bulgarian varieties was varied from 1.1 to 1.7. A great many of Bulgarian mulberry varieties were characterized with green colour of the leaves – 34 sp., followed by these with dark green colour – 17 sp. and light green colour – 15 sp. Most of the varieties have cordate leaves (44 sp.). The length of the leaves from tested mulberry varieties was varied from 10.73 cm for No 14 variety to 21.62 cm for Vesletz variety. Vesletz, Vratza 1, Vratza 18, No 59 and No 59 varieties were characterized with the biggest leaves. Three of tested varieties have leaves width from 6 to 9 cm, 29 varieties from 9 to 12 cm, 25 – from 12 to 15 cm and 8 above 15 cm. A great many of Bulgarian mulberry varieties were characterized with average petiole length (3 - 5 cm) – 51 sp., followed by these with shorter petiole (till 3 cm) – 15 sp.

REFERENCES

Dandin S., M. Jolly, 1986. Mulberry descriptor, Sericologia, 26, 4, 264 - 267.

Lazarov, L., 1988. Methods for description of mulberry varieties. 1. Shelk, 4 - 7.

Lazarov, L., 1989. Methods for description of mulberry varieties 2, Shelk, 3, 5 - 8.

Penkov, I., 1971. Moriculture researches, "75 years of SES Vratza, Sofia, 14 -17.

Petkov, Z., 1998. Investigation of mulberry species and varieties (*Morus* sp) and influence of some of them on silkworm (*Bombyx mori* L.) development and productivity, PhD thesis, Sofia,

Petkov, Z., 2000. About new methods for mulberry vegetative resources investigation, Bulgarian journal of agricultural science, 6, 481 - 284

Ting-zing, Z., T. Yun-fang, H. Guang-xian, F. Huaizhong, M. Ben (1988) Mulberry cultivation. FAO Agricultural Services Bulletin, 73/1, FAO, Rome.

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Morphological characteristics of the shoots and buds from local Bulgarian mulberry varieties

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ABSTRACT

Main morphological characters of the shoots and buds of 66 Bulgarian varieties from SES Vratza mulberry gene-bank have been examined with a view to complete studying of mulberry bio-diversity in Bulgaria. Some significant differences in values of most important morphological characters from tested varieties were established due to their origin. According to the shape and growth, shoots of tested varieties are curved in a certain extend. Their length was varied from 63.18 cm in P6 to 188.42 cm in Vratza18. 10 varieties have longer than 170 cm shoots, P2, P17, Vesletz, P22, P29, Vratza1, Vratza18, Hybrid2, No51 and No106. It was established that inter node distance varies in wide limits, from 3.24 cm in P6 to 6.38 cm in P30. Mulberries with sticked in different degree to the shoots buds are predominating in SES Vratza mulberry gene bank. A great many of Bulgarian mulberry varieties have acute triangle shape (31 sp.), followed by these with obtuse triangle shape (17 sp.). Mulberry buds are flat or convex (swollen) in different degree. Specimens with swollen mid part buds are predominating (26 sp.) followed by these with swollen top part (13 sp.) and flat ones (17 sp.). In SES Vratza mulberry gene bank bud base size was varied from 2.85 cm to 6.65 cm, and in average bud height was smaller. A great many of Bulgarian mulberry varieties have buds with size from 3 to 4 cm and from 4 to 5 cm, 26 and 19 specimens, respectively. A bigger part of Bulgarian mulberry varieties have brown buds (38 sp.) and light brown buds (19 sp.).

Keywords: mulberry, biodiversity, morphological characters, shoots, buds

INTRODUCTION

Development of sericulture in every country is impossible without establishment of effective mulberry forage base which could ensure enough mulberry leaves with good nutritive value and low prime cost for silkworm rearing. The meaning of mulberry variety at establishing of sericulture forage base is definitive.

The main requirements towards mulberry varieties are high leaf yield, good nutritive values of the leaves and good adapting at local climate conditions (Gatin, 1970).

13 local and introduced mulberry varieties are introduced into practice nowadays in Bulgaria but 66 Bulgarian varieties are preserved at SES Vratza mulberry gene bank (Penkov, 1971).

First for Bulgaria method for description and classification of mulberry form has been established (Petkov, 1998, 2000). Full classification of existed mulberry varieties and forms was started also. Good knowing of main morphological and economical characters of mulberry varieties will allow to use the best of them in selection programs and in practical sericulture as well (Susheelama, 1990).

Mulberry tree is a perennial woody plant consisting of vegetative and reproductive organs. The trunk, branches (shoots) and twigs of the mulberry tree are called the stem. Their principle function is transporting water and mineral salt upwards and products of photosynthesis and other organic matter downwards. (Ting-zing et al., 1988). Shoots are the basis of the mulberry's output.

The bud is the initial body of the branch, the leaf and the flower. Asserting the kind, characteristics and morphological structure of the buds is of great importance for the cultivation, selection and breeding of varieties.

The aim of the present study was to analyze the main morphological characters of the branches (shoots) and buds of Bulgarian mulberry varieties, preserved at SES Vratza mulberry gene bank.

MATERIAL AND METHODS

The study was carried out in SES Vratza mulberry gene bank. Experiment plantation was cultivated under standard cultivation.

66 Bulgarian mulberry varieties and forms were the object of our investigation and 10 trees per every variety were examined.

Representative samples were picked up accordingly analyzed characters. The colour of the shoots and buds was determined by eyes.

Methods for investigation of mulberry plant resources, established at SES Vratza was used for characterization of tested characters (Petkov, 2000).

RESULTS AND DISCUSSION

Data from our investigation are presented in figures 1-6.

Tested 66 Bulgarian mulberry varieties are characterized with different qualitative and quantitative morphological characters of their shoots and buds.

Under normal conditions, the length, size and color of mulberry shoots and the length of their nodes are stable, and sufficiently so to be a basis for identifying mulberry varieties (Lazarov, 1988, 1989).

Shape of the base of mulberry shoots is oval or round and in the most of them is oval (42 sp).

In accordance to shape of the shoots they have straight or curved in different degree shoots. Varieties with curved shoots were predominated (39 sp.).

From fig 1 it is evident that most of Bulgarian varieties possessed grey colored shoots (24 sp.), followed by these with ash-colored, grey-brown and brown colored shoots, 21, 13 and 8 specimens, respectively.

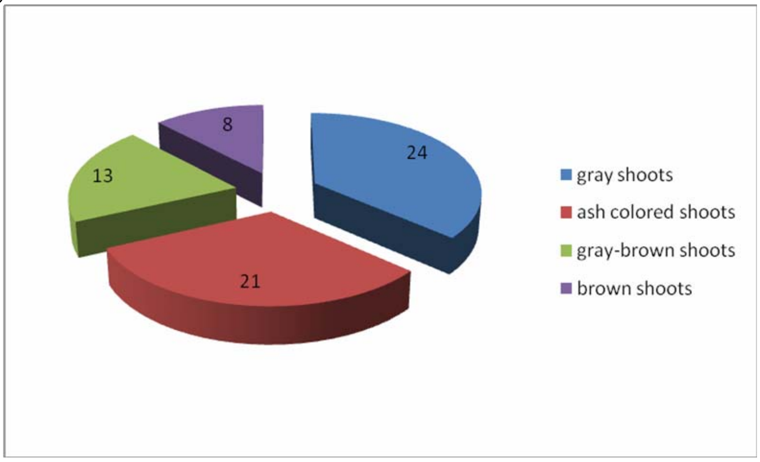

Fig 1. Colour of mulberry shoots

The length and size of mulberry shoots and twigs depend on variety, differences deriving from the age of the trees, the soil they are planted in, changes of climate, of pruning and cutting, method of fertilizers application and management.

The length of mulberry shoots is a quantitative morphological character witch is determined not only from the genetic origin of the varieties but from environmental conditions, cultivation applied and from the term for leaves harvesting for silkworm rearing, which in our conditions is the end of May and the beginning of June.

It was established also that this characters was varied in wide limits, from 63.18 cm in P 6 to 188. 42 cm in Vratza 18 variety. Distribution of tested varieties with respect to the length of the shoots is presented in fig 2. The most of Bulgarian mulberry varieties have shoots with length between 140 and 150 cm (17 sp.), followed by these from 150 to 160 cm (16 sp.) and between 160 and 170 cm (15 sp.). 12 of the varieties were characterized with longer than 170 cm shoots, No 3 - 176.35 cm, No 24 - 183.42 cm, P 2 - 170.55 cm, P 17 - 170.81 cm, P 22 - 171.58 cm, P 29 - 170.61 cm, Vesletz - 185.13 cm, Vratza 1 - 173.12 cm, Vratza 18 - 188.42 cm, No 51 - 171.38 cm, No 106 - 170.56 cm and Hybrid 2 -171.71cm.

Morphological characters of the lenticels of mulberry shoots were analyzed also. Their shape is prolonged or rounded and their size was varied from less than 1 mm to over than 4 mm.

In accordance to leaf position in tested mulberry varieties it was determined that it is mostly consecutively, and rang 1/3 was predominated.

Internodes distance is another important variety distinctive character of mulberry, which also has been influenced by growing conditions. We found that average value of this character was varied in wide limits, from 3. 24 cm in P 6 to 6.38 cm in P 30.

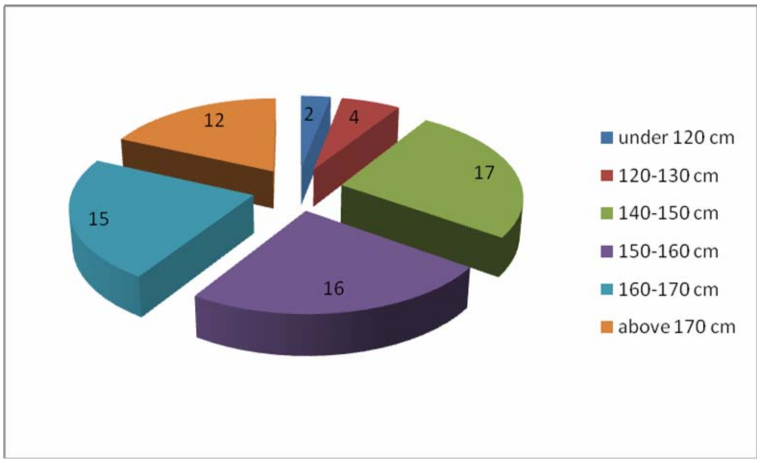

Fig. 2. Length of mulberry shoots

Morphological characters of buds also find special place in classification of different mulberry species and varieties. They are characterized mainly by their shape, colour, size and position toward mulberry shoots. Buds are divided into terminal buds and lateral buds according to their growing position on the branches. According to position of mulberry buds the varieties with adhered in different ways buds and these with tilt to one side buds were predominated.

Shape of mulberry buds is triangle shaped and genetically determined. The most of tested Bulgarian varieties possess acute-triangle shape (31 sp.), followed by these with obtuse-angled triangle shape and regular triangle shape, 18 and 17 specimens, respectively (fig 3). Their shape is an important basis for identifying mulberry varieties

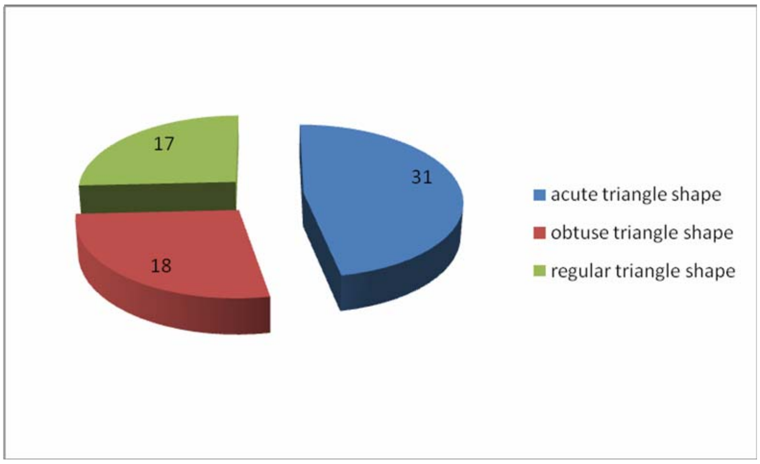

Fig. 3. Shape of mulberry buds

Mulberry buds could be flat or projected (swollen) in a different degree or in different place. Most of Bulgarian mulberry varieties have buds with projected middle part (26 sp.), followed by these with projected apex and flat bud, 13 and 17 specimens, respectively (fig 4).

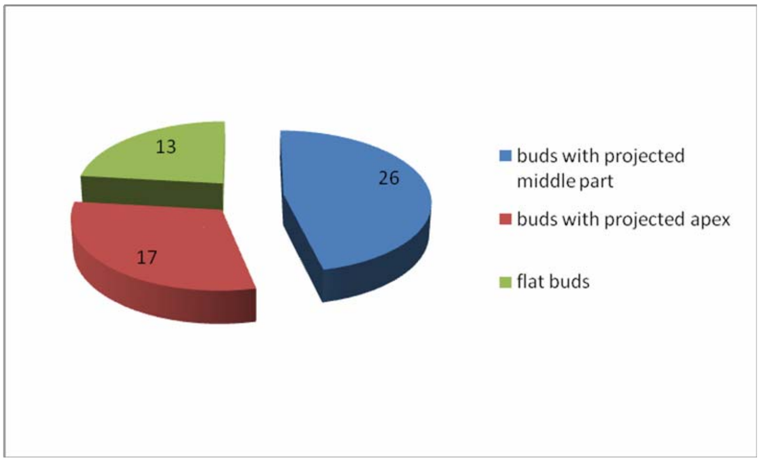

Fig. 4. Shape of mulberry buds

The size of mulberry buds is an important variety distinctive character of mulberry, which in a certain degree has been determined by ecological and growing conditions. It was determined that width of the bud base in tested varieties was varied from 2.85 to 6.65 cm, and their height is a lower as rule. Distribution of varieties in respect of bud base width is presented in fig 5. It is evident that most of Bulgarian varieties possessed buds with base width from 4 to 5 cm (19 sp.) and between 3 - 4 cm (26 sp.)

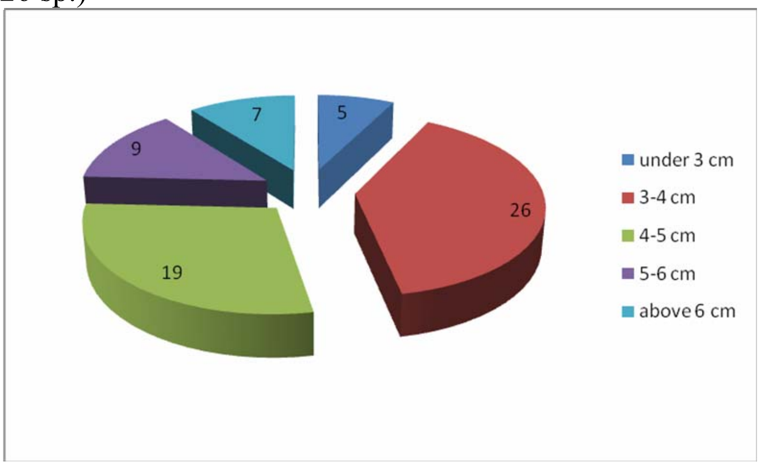

Fig. 5. Width of mulberry buds

34 from tested varieties were characterized with 1-2 additional (accessory) buds. Presence of these buds has important sense because if the main buds are killed, the terminal growing points stop growing and slough off, and the accessory buds become terminal. According to their physiology buds are either active or dormant. Auxiliary buds appear green at first and after that they take own size and color. They will present their inherent colors from the several varieties. These are called winter buds which sprout the following year and are called also active buds. Another division of buds is that into leaf buds, flower buds and mixed buds

In SES Vratza mulberry gene bank the most of the Bulgarian varieties have brown colored buds (38 sp.), followed by these with light brown and beige colour, 11 and 14 specimens, respectively (fig 6)

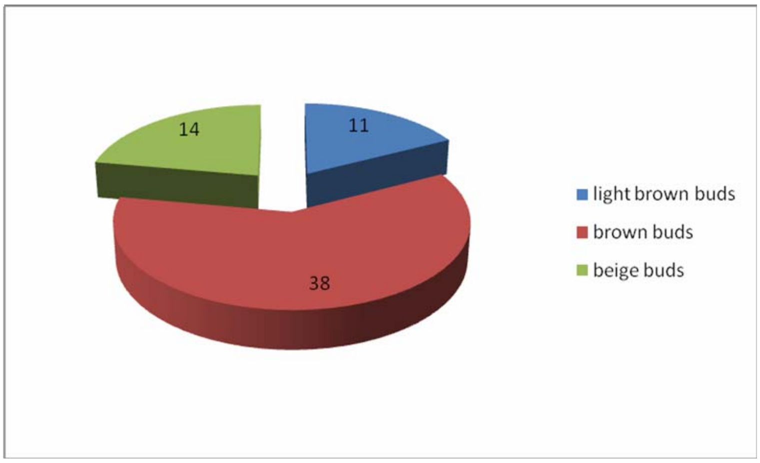

Fig 6. Colour of mulberry buds

CONCLUSIONS

Some significant differences in values of most important morphological characters of shoots and buds from tested Bulgarian mulberry varieties were established. According to their shape shoots of Bulgarian varieties are curved in a certain extend. Their length was varied from 63.18 cm in P6 to 188.42 cm in Vratza18. 10 varieties have longer than 170 cm shoots, P2, P17, Vesletz, P22, P29, Vratza1, Vratza18, Hybrid2, No51 and No106. Inter node distance was varied in wide limits, from 3.24 cm in P6 to 6.38 cm in P30. A great many of Bulgarian mulberry varieties have acute triangle shape (31 sp.), followed by these with obtuse triangle shape (17 sp.). Mulberry buds are flat or convex (swollen) in different degree. Specimens with swollen mid part buds are predominating (26 sp.) followed by these with swollen top part (13 sp.) and flat ones (17 sp.). In SES Vratza mulberry gene bank base size of buds was varied from 2.85 cm to 6.65 cm, and in average bud height was smaller. A great many of Bulgarian mulberry varieties have buds with size from 3 to 4 cm and from 4 to 5 cm, 26 and 19 specimens, respectively. A bigger part of Bulgarian mulberry varieties have brown buds (38 sp.) and light brown buds (19 sp.).

REFERENCES

Dandin S., M. Jolly, 1986. Mulberry descriptor, Sericologia, 26, 4, 264 - 267.

Gatin, F., 1970. Prolonged growth of spring and autumn mulberry leaves. SANIISH, 27 - 29.

Lazarov, L., 1988. Methods for description of mulberry varieties. 1. Shelk, 4 - 7.

Lazarov, L., 1989. Methods for description of mulberry varieties 2, Shelk, 3, 5 - 8.

Penkov, I., 1971. Moriculture researches, "75 years of SES Vratza, Sofia, 14 -17.

Petkov, Z., 1998. Investigation of mulberry species and varieties (*Morus* sp) and influence of some of them on silkworm (*Bombyx mori* L.) development and productivity, PhD thesis, Sofia,

Petkov, Z., 2000. About new methods for mulberry vegetative resources investigation, Bulgarian journal of agricultural science, 6, 481 - 284

Susheelama, B., 1990. Breeding of mulberry genotypes for tropics, Indian Silk, 29, 1, 25 - 27.

Ting-zing, Z., T. Yun-fang, H. Guang-xian, F. Huaizhong, M. Ben (1988) Mulberry cultivation. FAO Agricultural Services Bulletin, 73/1, FAO, Rome.

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Efficacy of different plant extracts as antifeedant against mulberry mealy bug *Maconellicoccus hirsutus*

By

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ABSTRACT

Five plant extracts were evaluated for their antifeedancy against mealy bug Maconellicoccus hirsutus under laboratory condition. Among the plant extracts tested, a significant increase in the antifeedancy was found after treatment with methanol extract of Lantana camara followed by Allium sativum, Zingiber officinale compared to aqueous extracts of the same. Least anttifeedancy was noticed with methanol extracts of Azadirachta indica and Vitex negundo.

Keywords: Antifeedant, Plant extracts, Maconellicoccus hirsutus

INTRODUCTION

In sericulture industry, production of quality mulberry leaves plays an important role in silkworm crop success, by way of producing healthy cocoons of desired norms and finally the end product - the lustrous, quality silk filament. In nature, mulberry encounters lot of natural hazards, which have to be curtailed to the extent possible in order to produce nutritious mulberry leaves. One of the major hazards to be tackled is the infestation by different kinds of pests of which the mulberry pest *Maconellicoccus hirsutus* commonly known as “mealy bug” plays a major role in crop loss by causing the infestation and changes in morphological and anatomical characters like curling of leaves, thickening and flattening of stems at the growing of plants (Sriharan et al.,1979). The pests were found in various stages of development in the folds and knots of the leaves and on the apical shoots. The mealy bugs feed on the sap by sucking on tender leaves and shoots. The symptoms were a direct result of the colonization and infestation of the plants by these coccids, which is called “Tukra”. The pest attacked plants show retarded growth in apical portions and distorted stems and leaves. Hence growth and leaf yield are severely affected.

Choice of a chemical to control harmful crop insects/pests without altering the chemical composition of the mulberry leaves or causing health hazards to humans or animals, is of great importance. This could be possibly achieved by using the extracts of plants having pesticide properties. The higher plants were identified as the richest source for renewable bioactive chemical with multifacial effects on insect (Arnason *et al*.,1989). Anti-insect chemicals from plants may be variously toxic, repellent, cause sterility, modify behaviour or reduce feeding (Feeny,1983). Any one of these properties is useful to regulate the pest population. Antifeedants of plant origin, in general, have the additional advantage of quick biodegradability and safety to non target organisms. Majority of the studies to demonstrate the feeding inhibition of pests by insecticidal plants are devoted to leaf extracts**.** Significant feeding deterrency has been observed from the leaf extracts of *Calotropis procera*, *Datura metel* and *Azadirachta indica* in sucking pests (Meshram, 1995). The present study is aimed at using biodegradable biological control method to mitigate the problems caused by the mealy bugs to the mulberry leaves.

MATERIALS AND METHODS:

A) Plant Material:

The plants namely *Lantana camara* (Lantana), *Azadirachta indica* (Neem), *Vitex negundo* (Vitex) (leaves), *Allium sativum* (Garlic) (bulb) and *Zingiber officinale* (Ginger) (Rhizome) were selected for the study.

B) Insects:

The test insect mealy bugs were reared in the laboratory on pumpkin at 27±2º C and 70±5% relative humidity. Two stages namely nymphal and adult stages of mealy bug *Maconellicooccus hirsutus* were considered for the study on antifeedancy against the medicinal plant extracts.

C) Extraction:

The crushed material of different plants was extracted following different methods mentioned below:

Aqueous extraction:

100 gm of each plant material i.e. leaves of lantana, neem and vitex, bulbs of garlic, rhizome of ginger were collected, washed and extracted in 100 ml water individually and kept as a stock solution.

Soxhlet extraction:
The leaves of lantana, neem and vitex, bulbs of garlic, rhizome of ginger were collected, washed, dried and finely ground in to powder and used for extract preparation. 100 gm of plant powdered material was mixed in 100 ml. methanol and extracted in the Soxhlet apparatus for 16 hours. The methanol extract was concentrated using a water bath at 60 deg C. and the residue was maintained as a stock solution.

D) Biological Testing

Treatment of mealy bugs with plant extract:
In the present study, for treatment of mealy bugs with the plant extracts, required quantity of stock solution was added in to each beaker and diluted to different required concentrations 0.5%, 2%, 4%, 6%, 8% and 10% by mixing with water. Control medium was also maintained with water. Leaf disc bioassay method by Wada and Munkata (1968) modified by Reena et al (1983) was adopted for testing the antifeedant activity of a plant extracts. Leaf discs of a uniform area were made from mulberry plant and were then dipped for 2 minutes in the different concentrations of the plant extracts and then transferred to petri dishes of 10 cm diameter. After allowing the extract to dry up, twenty numbers of nymphal and adults of mealy bugs were separately released on each treated leaf kept in the petri dish. Nymphs and adults of mealy bugs were also released on the leaf discs dipped in water which served as control. Five replications were kept for each treatment. The nymphal/ adult mealy bugs were allowed to feed on the leaf discs for 24 hours and the antifeedency of the mealy bugs was assessed based on their settlement of mealy bugs on the treated mulberry leaves as well as outside the mulberry leaves.

RESULTS AND DISCUSSION

The observations recorded on the antifeeding properties of plant extracts used in the present study on the nymph and adult mealy bugs have been presented in Tables 1 and 2. There were significant variations in the percentage by nymphs and adults of mealy bugs which were affected due to the antifeedant activity of all the plant extracts tested.

Nymph:

Mean data revealed that the plant extract of Lantana was found to possess the highest antifeedant property. This was shown by the percentage of specimens it affected in different treatment concentrations (24-61%) compared to garlic (16-57%), ginger (12-57%), neem (9-52%) and vitex (8-49%).

Among the methanol and aqueous extracts, it was found that methanol extract gave comparatively better results in all the plant extracts and concentrations. The values ranged between 14-31% and 8-24% in 0.5 percent concentration, 16-36% and 9-27% in 2 percent concentration, 30-40% and 19-31% in 4 percent concentration, 34-45% and 24-35% in 6 percent concentration, 37-55% and 27-44% in 8 percent concentration and 49-61% and 39-50% in 10 percent concentration respectively.

Among different concentrations of plant extracts, 10 % methanol extract was found to give the best antifeedancy in all the plant extracts tested namely lantana (61%), garlic and ginger (57%), neem (52%) and vitex (49%). The analyzed data revealed that the aqueous and methanol extract are significant between the five plants after 24 hours, however extract of garlic at 0.5%, ginger at 2% and 10%, lantana at 4% and 10%, vitex at 10% showed insignificant.

Adult:

Mean data revealed that the plant extract of lantana was found to possess the highest antifeedant property in case of adults also. The percentage of adults affected ranged is as follows (12-58%) compared to garlic (10-54%), ginger (10-53%), neem (9-47%) and vitex (7-45%).

Among the methanol and aqueous extracts, it was found that methanol extract was found to give comparatively better results in all the plant extracts and concentrations. The values ranged between 12-22% and 7-12% in 0.5 percent concentration, 15-29% and 9-19% in 2 percent concentration, 21-32% and 15-24% in 4 percent concentration, 26-42% and 15-32% in 6 percent concentration, 29-50% and 22-42% in 8 percent concentration and 45-58% and 37-47% in 10 percent concentration respectively.

Among different concentrations of plant extracts, 10% methanol extract was found to give the best antifeedancy in all the plant extracts tested namely lantana (58%), garlic (54%), ginger (53%), neem (47%) and vitex (45%). In this case, the aqueous and methanol extracts are significant between five plants after 24 hours at 0.5%, 2%, 4% and 6%. However lantana at 8% and 10%, ginger at 8%, neem at 10% and vitex at 8% and 10% are insignificant.

A perusal of the table reveals that the feeding was inhibited significantly in both the stages of mealy bugs, in all the concentration studied, over control (0.00) and correspondingly increased the percentage of protection. With increase in concentration there was a decrease in percent food consumption. Among the plant extracts tested, the lantana leaf extract treatment caused tremendous antifeedancy in mealy bug followed by garlic, ginger, neem and vitex. The least concentration, for the antifeedant activity, was recorded at 0.5%.

This correlates with the findings of Kulkarni et al (1997) who reported that the extracts of Lantana reduced feeding and it was found to be more effective. Chitra et al (1990) has tested the leaf extract of lantana against Henosepilachana vigintioctopunctata and found better. The present activity exhibited by lantana may be due to the active toxic groups like lantadene A (Majekodunmi et al.,2002) present in the leaves. It is therefore concluded that the garlic, ginger, neem and vitex are effective in decreasing order to control the damage due to mealy bug. The feeding deterrency of neem recorded antifeedant and Insect Growth Regulatory (IGR) effect are among the most widely reported actions of azadirachtin and neem products on insects (Mordue Luntz and Blackwell,1993). The antifeeding effects of neem leaf powder, neem oil and neem seed kernel emulsions were investigated by Abdul Kareem (1980) against Spodoptera litura on sweet potato. Ketkar (1976) listed 95 publications on insect and antifeedant effects of neem derivatives. This study further reveals the antifeedant properties of five plant which needs to be further explored.

CONCLUSION

The present study on the antifeedant property of different plant extracts showed that lantana plant extract exhibited highest antifeedant property against both nymph and adult mealy bug *Maconellicoccus hirsutus* in comparison to other plant extracts.

REFERENCES

Abdul Kareem,A. (1980) Neem as an antifeedant for certain phytophagous insects and a bruchid on pulses. Proc.Ist Int.Neem Conf.Rottach.Egern,1980 pp.223-250.

Anonymous (1985) The Wealth of India (Raw material) Vol.1A C.S.I.R.New Delhi pp. 513.

Arnason, J.T., Philogene.B.J.R and Morand,P. (1989) (Eds.) Insecticides of plant origin. American Chemical Society Series 387,Washington, DC. pp.213.

Bai,K.S and Kandaswamy,C.1985 Laboratory induced mortality of *Spodoptera litura* (F.) fed on the discs of castor treated with the extracts of *Vitex negundo* Linn. and *Starchy tarpheta urticaeflia* (Satish). Indian J.Agric.Sci.55(12):760-761.

Chitra,K.C., Venkata Rami Reddy.P and Kameshwara Rao,P. (1990) Effect of certain plant extracts in the control of brinjal spotted leaf beetles *Henosepilachna vigintioctopunctata* Br. J.Appl.Zool.Res.1(10):39-41.

Fenny,P.(1983) In Natural products for Innovative Pest Management (D.I.Whitehead and W.S.Bowers,Eds) Pergamon press, Oxford. Pp.167.

Jilani,G. and Malik,M.M. (1973) Studies on neem plant as repellent against stored grain insects. Pak.J.Sci.Ind.Res. 16:251-254.

Ketkar,C.M. (1976) Utilisation of neem and its byproducts. Directorate of non-edible oils and soap industry, Khadi and Village Industries Commission, Bombay,pp.234.

Kulkarni,N., Joshi,K.C. and Gupta,B.N.(1997) Antifeedant property of *Lantana camara* var.*aculeata* and *Aloe vera* leaves against teak skeletoniser, *Eutectona machaeralis* Walk. (Lepidoptera:Pyralidae) Entomon 22(1):61-65.

Majekodunmi,O. Fatope, Labaran Salihu, Stephen K.Asante, Yoshio Takeda (2002) Larvicidal activity of extracts and triterpenoids from *Lantana camara* Pharmaceutical Biology 40(8) pp.564-567.

Meshram,P.B. (1995) Evaluation of some medicinal and natural plant extracts against teak skeletoniser *Eutectona machaeralis* Walk. Indian Forester 121(6):528-532.

Mordue(Luntz),A.J., and Blackwell,K.1993. Azadirachtin:an update. J.Insect Physiol 39(11):903-924.

Pandey,N.D., Shiv Raj Singh and Tiwari,G.C (1976) Use of some plant powders, oils and extracts as protectants against pulse beetle, *Callosobruchus chinensis* Linn. Indian J.Ent.38(2):110-113.

Reena, C.J., Afzal,K.G. Das and Sukumar,K. 6,7 Dimethoxy – Isochroman –3-one; antifeedant for castor semilooper *Achaea janata* L. Indian J.Farm Chem.7:63.

Sriharan,T.P., Samson.M.V. and Krishnaswami,S. (1979) Studies on the tukra disease (*Maconellicoccus hirsutus*) of mulberry. 18: 78-80.

Wada,K. and Munakata,K.1968. Naturally occurring insect control chemicals J.Agri.Fd.Chem.16(3):471.

Wan Yee Chiam, Yan Huang, Saho Xing Chen and Shuit Hung Ho. (1999) Toxic and antifeedant effects of allyl disulfide on *Tribolium castaneum* (Coleoptera:Tenebrionidae) and *Sitophilus zeamais* (Coleoptera: Curculionidae). J.Econ.Entomol. 92(1):239-245.

Yan Huang, Shao Xing Chen and Shuit Hung Ho (2000) Bioactivities of methyl allyl disulfide and diallyl trisulfide from essential oil of garlic to two species of stored product pests, *Sitophilus zeamais* (Coleoptera:Curculionidae) and *Tribolium castaneum* (Coleoptera:Tenebrionidae) J.Econ Entomol. 93(2):537-543.

Table-1 Antifeedant activity of some medicinal plant extracts on nymph mealy bug *Maconellicoccus hirsutus (After 24 hours)*

Plant extract	**0,50%**		**2%**		**4%**		**6%**		**8%**		**10%**	
	aqu.	**meth.**	**aqu.**	**meth.**	**aqu.**	**meth.**	**aqu.**	**meth.**	**aqu.**	**meth.**	**aqu.**	**meth.**
Lantana	4.8±.0.08 (24)	6.2±0.08 (31)	5.4±0.1 (27)	7.2±0.1 (36)	6.2±0.14 (31)	8±0.14 (40)	7±0.07 (35)	9±0.07 (45)	8.8±0.14 (44)	11±0.14 (55)	10±3.6 (50)	12.2±3.6 (61)
Garlic	3.2±0.1 (16)	4.6±0.1 (23)	4.4±0.1 (22)	6.2±0.1 (31)	4.4±0.09 (22)	6.4±0.09 (32)	5.8±0.10 (29)	8.2±0.11 (41)	7.8±0.09 (39)	10±0.09 (50)	9.4±0.14 (47)	11.4±0.14 (57)
Ginger	2.4±0.06 (12)	4±0.06 (20)	3.4±0.14 (17)	5.2±0.14 (26)	4.6±0.09 (23)	6.6±0.09 (33)	5.4±0.11 (27)	7.6±0.11 (38)	6.2±0.09 (31)	8.4±0.09 (42)	9.2±0.17 (46)	11.4±0.17 (57)
Neem	1.8±0.07 (9)	3±0.07 (15)	2.8±0.08 (14)	5.2±0.08 (26)	4.4±0.08 (22)	6.5±0.08 (32.5)	5.4±0.11 (27)	7.6±0.11 (38)	6±0.07 (30)	8±0.07 (40)	8.4±0.11 (42)	10.4±0.11 (52)
Vitex	1.6±0.07 (8)	2.8±0.07 (14)	1.8±0.11 (9)	3.2±0.11 (16)	3.8±0.09 (19)	6±0.09 (30)	4.8±0.11 (24)	6.8±0.11 (34)	5.4±0.09 (27)	7.4±0.09 (37)	7.8±0.15 (39)	9.8±0.15 (49)

Control 0,00

Note - values are mean ± SD; values in paranthensis are in terms of %

Table-2 Antifeedant activity of some medicinal plant extracts on adult mealy bug *Maconellicoccus hirsutus (After 24 hours)*

Plant extract	0,50%		2%		4%		6%		8%		10%	
	aqu.	meth.	aqu.	meth.	aqu.	meth.	aqu.	meth.	aqu.	meth.	aqu.	meth.
Lantana	2.4±0.8 (12)	4.4±0.8 (22)	3.8±0.7 (19)	5.8±0.7 (29)	4.8±0.5 (24)	6.4±0.5 (32)	6.4±1.3 (32)	8.4±1.3 (42)	8.4±1.9 (42)	10±1.9 (50)	9.4±0.17 (47)	11.6±0.17 (58)
Garlic	2±0.9 (10)	3.8±0.95 (19)	2.8±0.7 (14)	4.8±0.7 (24)	4±0.5 (20)	6±0.5 (30)	5±0.5 (25)	7±0.5 (35)	7.6±1.55 (38)	9.4±1.55 (47)	9.2±1.2 (46)	10.8±1.2 (54)
Ginger	1.8±0.95 (10)	3.6±0.9 (18)	2.6±0.65 (13)	4±0.65 (20)	3.2±0.7 (16)	5.2±0.7 (26)	4.8±1.7 (24)	6.8±1.7 (34)	5.6±1.5 (28)	7.2±1.5 (36)	9±0.9 (45)	10.6±0.9 (53)
Neem	1.8±0.45 (9)	3.2±0.45 (16)	1.8±0.7 (9)	3.2±0.7 (16)	3±0.6 (10)	4.2±0.6 (20)	4.4±1.5 (22)	6.2±1.5 (31)	4.6±2.4 (23)	7±2.4 (35)	8.2±2 (41)	9.4±2 (47)
Vitex	1.4±0.3 (7)	2.4±0.3 (12)	1.8±0.6 (9)	3±0.6 (15)	2±0.5 (15)	4±0.5 (21)	3±0.6 (15)	5.2±0.6 (26)	4.4±1 (22)	5.8±1 (29)	7.4±5.4 (37)	9±5.4 (45)
Control	0,00											

Note - values are mean ± SD; values in paranthensis are in terms of %

Section 2. Silkworm Bombyx mori L.

2.1.Silkworm rearing and feeding

Result of influence the biostimulator - Biorag on quantity of Albumens in a mulberry's leaf and mulberry silkworm's hemolymphe

By

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ABSTRACT
Albumens carry out a huge role in ability to live a plant. The mulberry is exacting enough to nourishing matter. A feed of a silkworm highly nourishing leaves is increased with average weight of cocoons and quantity of unwinding string. Action nitric fertilizer the quantity of fibers in leaves of a mulberry that is one of the obligatory a condition for formation of silk raises. We determined the influence of Biorag of maintaining albumens as in leaves of a mulberry (in the spring and autumn) and in hemolymph caterpillars of a silkworm. Quantity of albumens are in leaves of a mulberry so in hemolymph of caterpillars considerably rises by of influence of Biorag, in particular, in skilled spring leaves quantity of fibers on 3, 6 % more, than in control variant. In autumnal leaves on 88,4%. Quantity of albumens in hemolymph of caterpillars V-th age of a test variant on the albumens 3-rd day on 10,4 %, and on the 8-th day on 21,5 % to surpass a control variant. According to this, influence of Biorag the quantity of albumens a mulberry and in hemolymph of silkworm significant increasing bio-technological parameters.
Key words: Biostimulator-Bioragi, Albumens, hemolymph

INTRODUCTION

Plants includes little aluminous matters than carbon hydrates, but they implement a huge role, because albumen is a basic of protoplasm and all ferment is albumen. Albumen has important matter in nourishment of humans and animals.

Albumens carry out a huge role in ability to live a plant. The mulberry is exacting enough to nourishing matter. A feed of a silkworm highly nourishing leaves is increased with average weight of cocoons and quantity of unwinding string.

Action nitric fertilizer the quantity of fibers in leaves of a mulberry that is one of the obligatory a condition for formation of silk raises.

In Georgian sericulture institute we determined the influence of Biorag of maintaining albumens as in leaves of a mulberry (in the spring and autumn) and in hemolymph caterpillars of a silkworm.

Early spring we carry into soil the bioragi's 10% solution and with getting leaf made silkworm feed. As know hemolymph shows the physiological situation of silkworm.

The silkworm maximum adsorbs of nourish reach on the second to eight day of fifth age. Then adsorbs of nourish decreasing, this period increasing mass of gland for silk production (before V-VIII day). mass of gland shows quality of silk's albumen (fibroin 70-80%).that is defendant on adsorb for nourish and ability for synthesize.

By us, using the Kieldalis's method were determined Quantity of albumens in leaves and in silkworm's hemolymph.

Results have shown 1 and 2 tables.

Table 1

#	variant	in spring's leaf			
		common nitrogen, %	unalbumunous nitrogen,%	albumunous nitrogen,%	quantity of albumen, %
1	control	3,09	0,48	2,61	16,3
2	test	3,26	0,56	2,71	16,9
%- at control					
	test	105,5	116,6	103,8	103,6
in autumn's leaf					
1	control	1,68	0,3	1,38	8,62
2	test	2,9	0,3	2,6	16,25
	%- at control				
	test	172,6	100	188,4	188,5

Table 2

In the 5-th age silkworm's hemolymph	days	quantity of albumens		% at control
		Control	test	
	3-rd	9,48	10,47	110,4
	8-th	10,21	12,41	121,5

Albumens in hemolymph determined on 3-rd and 8-th days of 5-th age. Using the Filipovich's method, by refractometer,

Quantity of albumens are in leaves of a mulberry so in hemolymph of caterpillars considerably rises by of influence of Biorag, in particular, in skilled spring leaves quantity of fibers on 3, 6 % more, than in control variant. In autumnal leaves on 88, 4%.

Quantity of albumens in hemolymph of caterpillars V-th age of a test variant on the albumens 3-rd day on 10,4 %, and on the 8-th day on 21,5 % to surpass a control variant.

According to this, influence of Biorag the quantity of albumens a mulberry and in hemolymph of silkworm significant increasing bio-technological parameters.

REFERENCES

1. Kafiani A. G. – Methodical instruction on carrying out of silkworm's nourishing.
2. Zegin G. – Growth-promoting materials of plant.

COMPARISON OF HAEMOLYMPH PROTEIN PROFILES BETWEEN MULTIVOLTINE AND BIVOLTINE SILKWORM BREEDS UNDER TEMPERATURE STRESS

By

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ABSTRACT

A simple method was used to study the differential response of two different silkworm breeds, namely, Nistari (thermo-tolerant) and CSR2 (non-tolerant) exposed to different temperatures for varying periods, followed by successive recovery periods of various duration. Haemolymph from the control and treated larvae were collected and protein profiles were analyzed in 10% SDS-PAGE. The third instar larvae were affected by long duration treatments rather than the different temperature levels. As far as fourth instar larvae are concerned, the effect of temperature was little more than third instar larvae of both the races. The sensitivity of fifth instar to high temperature was more pronounced in females, especially for long duration exposure. Appearance of new heat shock protein (hsp) band of approx. 32 kDa size in both the races, specific bands at 96kDa region in Nistari and between 97 and 205 kDa regions in CSR2, in addition to the proteins between 68-97kDa regions seems to have a role in thermo tolerance. Results suggest that the thermal response manifested by the appearance of novel proteins were earlier in the thermo-tolerant Nistari, when compared to the temperature susceptible CSR2 silkworm breed.

Keywords: Thermo-tolerance, heat shock proteins, silkworm breeds

INTRODUCTION

Exposure to high temperature is always lethal for any living organism and the rate of lethality depends upon the exposure period and the magnitude of the temperature. Thermo tolerance is attributed to the appearance of a new set of proteins called heat shock proteins (Craig, 1985) and they provide protection against lethal effects at elevated temperatures(Lindquist, 1986). Heat shock response is an adaptive cellular response that is linked to the ecological conditions in which an organism lives (Bijlsma and Loeschecke, 1997). The requirement of HSPs for thermo tolerance and its role in protein folding, assembly and transport support the hypothesis that the thermo tolerant state is dependent on one or all of these HSP-related functions, especially through the management of both denatured protein and of partially synthesized protein fragments (Mosley, 1997).

Extensive literature is available on the role of HSPs in insects such as fruit fly, *Drosophila* (Burton et al., 1988), *Chironomus* (Carretero et al., 1986), *Lymantria dispar* (Denlinger et al., 1992), the tobacco hornworm, *Manduca sexta* (Fittinghoff and Riddiford, 1990), the desert ant, *Cataglyphis* (Gehring and Wehner, 1995), the flesh fly, *Sarcophaga crassipalpis* (Joplin et al., 1990), *Locusta migratoria* (Whyard et al., 1986) etc. In silkworm, mostly *in vitro* studies were carried out in cells and tissue cultures or organisms from temperate climate. Very few studies have been done *in vivo* in silkworm larvae on continued exposure to higher temperature.

As silkworms are poikilothermic, they thrive best within a temperature range of 23- 28°C. India being a tropical country, temperature shoots up in day time. In summer it goes up to 37 to 40 °C or even more. These fluctuations in temperature have an adverse effect on the survival and pupation of silkworms, especially the bivoltine breeds, incurring heavy loss to the industry. However, the Indian multivoltine breeds of *Bombyx mori (*Pure Mysore, C. Nichi and Nistari for example) are more tolerant to high temperatures. As a means to overcome this loss due to the adverse effect of the high temperature being faced regularly, out Institute has been evolving temperature tolerant bivoltine breeds by exposing them to high temperature (Suresh Kumar et al., 2000). During the process few high yielding bivoltine breeds became tolerant while other failed to become so. Thus, we felt there is a dire necessity for understanding 1) the mechanism of temperature tolerance in silkworm, 2) identification of various families of HSPs synthesized and the threshold temperature which induce their expression and, 3) the differential expression pattern of various HSPs in bivoltine and polyvoltine races. We made an attempt to analyze the varying response of a tolerant and non tolerant breed to high temperature by simple techniques to study the difference if any, in haemolymph protein levels, subjecting them to SDS- PAGE analysis.

MATERIALS AND METHODS

Silkworm breeds selected: A temperature tolerant polyvoltine silkworm breed, Nistari and a non-tolerant bivoltine breed, CSR2 were selected for this study. Ten disease-free laying of each race were obtained from the pure line stocks maintained by the Silkworm Genetics laboratory. The worms were reared on mulberry leaves (V1 variety) up to cocooning by following the standard method with recommended temperature and humidity condition.

Heat shock treatment: Exposure of silkworm to desired high temperature was given in Sericatron, an environment chamber with precise and automatic control facilities for uniform maintenance of temperature and humidity, available at CSRTI, Mysore. A constant relative humidity of 80%±1% was maintained throughout the treatment period. Two days-old third instar larvae were exposed to 36°C and 40°C for a short duration of 1 h, as well as long duration of 6 h and for each treatment about 150 larvae were maintained. Control larvae were maintained in the room temperature. Before exposure to high temperature, the larvae were allowed to feed for a full day after moult in order to recover from any stress induced by starvation during moult. The larvae in both control and treated batches were fed with fresh mulberry leaves as usual. After providing the heat shock for different periods, the larvae of respective batches were returned to the room temperature and reared. Haemolymph was collected immediately after each treatment as well as at specific intervals during recovery periods viz., 1 h, 6 h, 24 h and 48 h.

Collection of haemolymph: Haemolymph was collected from six randomly selected individuals (each serving as a replication) of each treatment and pooled. Samples from treated and control larvae were collected separately prior to heat shock, immediately after heat shock and after allowing recovery period of 1 h, 6h, 24h and 48h. Haemolymph was collected from the cut pro leg of silkworm larvae in a pre-cooled Eppendorf tube containing a pinch of phenylthiourea as an anticoagulant and centrifuged at 5,000 rpm for 5 min at -4°C. The supernatant collected was used for SDS-PAGE analysis.

Sample preparation and analysis: Samples of 2µl in PBS (10 µl) was added to 10 µl of sample buffer(2 x containing 50mM Tris pH 6.8, 10% glycerol, 2% SDS, 5% B-Mercaptoethanol, 0.025% bromophenol blue R250), boiled for 5 min and loaded fully on to the well. Haemolymph samples were run in both 12% and 8% gels to see the differential accumulation of polypeptides of varying molecular weight. Electrophoresis was carried out initially with 20 mA current and once the dye front entered into separating gel, 40mA current was applied till the end of the run. The protein was fixed and stained with 0.025% Coomasie blue in 50% methanol: 10% glacial acetic acid and destained with methanol: acetic acid (15:10) solution. The protein profiles were visualized under visible trans-illuminator and photographed.

RESULTS

The protein profiles of both the races under various treatments when compared with control indicated changes mostly between the 68 and 97 kDa size regions apart from the case of new bands. Therefore, we assumed that heat shock proteins probably Hsp70 family, might have been induced and the variation at this region was considered for comparison of various treatments. The banding pattern was similar in both the breeds, though the intensity of the bands varied with treatments. Also, induction of new protein was clearly discernible in many treatments in both the races but their kinetics varied.

1. Effect of temperature stress on III instar larvae:

The CSR2 larvae when exposed to 36°C for a short duration of 1h, the protein level in 68-97 kDa region was declined (Figure 1a, lane 3) but they were able to recover the normal level within 1h recovery period (Figure 1a, lane 5) in the room temperature and continued even after 6 h (lane 11) and 24 h (lane 15) of recovery period. The induced protein level in larvae after 6 h exposure at 36°C (lane 7) is same as the larvae in 6h recovery period of 1 h exposure (lane 9). Perhaps, the initial one hour exposure would be enough to induce and maintain the heat shock protein level to chaperone the normal protein synthesis. However, following the 6 h exposure period, the protein level started declining after 24 h and 48 h recovery period (lane 16, 24).

In the case of larvae exposed to higher temperature (40°C) irrespective of short (1 h) or long duration (6 h), the induction of protein in 68-97 kDa region is quicker than larvae exposed at 36°C and the protein intensity (lane 4 and 8) is more or on par with them. During the short exposure, the induction of protein persisted after 1 h recovery at room temperature (lane 6) and the level was found increasing slightly higher during 6 h recovery period (lane 10) but it started declining thereafter. However, there was no noticeable increase in protein level of larvae than control after 1h recovery period till 48 h (lane 25) that was exposed for long duration.

The Nistari worms exposed to 36°C for 1 h and 6h exhibited absolutely no change in the protein levels in comparison with control (Figure 1b, lane 3, 7) When the worms were subjected to 40°C, 6 h exposure leads protein level on par with the control at 68-97 kDa region (lane 7) whereas 1 h exposure leads to decrease in protein level (lane 3). Perhaps the normal protein synthesis might have been stopped following 1h exposure at high temperature. The same thing might have happened during first one hour of 6h exposure also, but it had enough time to induce the HSP to restore the normal protein synthesis at the end of long 6 h exposure. Unlike CSR2, the change in protein level was more or less on par with the control during 48 h recovery periods though it was less at 24 h recovery period. The trend remained same whether it is exposed to 36°C or 40°C. On the whole, treatment at both 36 and 40°C, especially 1h, produced only minor effects in Nistari as compared to CSR2. Besides this, new band appeared approximately at 90 kDa region.

2. Effect of temperature stress on IV instar larvae:

When fourth instar CSR2 larvae are exposed to 36°C, irrespective of short or long period the protein level was found to be lower than the control. (Figure 2a, lane 2, 8). But an hour of recovery at the room temperature after 1h (lane 4) and 6h (lane 11) exposure respectively has significantly increased the protein level in 68-97 kDa regions than the control. This increase was progressed on steadily up to 24 h of recovery period (lane 15, 18). The protein profiles of the larvae exposed to 36°C for 6 h (lane 7)and 40°C for 1 h (lane 3) was similar except the decreased protein level that started at 1 h recovery period continued up to 48 h in the later case. In contrast to this, 6 h exposure at 40°C triggered a hike in the protein levels (lane 9) that remained so through the 48 h recovery period. New bands appeared at 35 kDa region in the case of larvae exposed to 36 and 40°C during the recovery periods (24h, 48h).

In Nistari, 1 h recovery period of 1 h exposure at 36°C resulted in increased protein. But later on, the intensity was found on par with control (Figure 2b, lane 15), followed by a decrease during 48 h recovery period (lane 21). However, the protein intensity was less than the control when the larvae were exposed to long duration of 6 h, though, during recovery the protein has increased more than control (lane 11). When the temperature was increased to 40°C, irrespective of short (lane 3) or long (lane 9) duration, the protein level was found less than control immediately after the treatment. During recovery period of 1h, normal level of protein as in control was restored (lane 6, 12). On the whole, the intensity of protein during 24 and 48 h recovery period was found to be same as in control irrespective of exposure period except 48 h recovery of 1h exposure. In contrast with the observations made in the 3rd instar, the 4th instar Nistari worms did not show any additional bands.

3. Effect of temperature stress on V instar larvae:

In fifth instar, male and female larvae were separated and subjected to different temperature treatments. In male CSR2 larvae, exposure at 36°C or 40°C for 1 h did not elicit any response by the way of increasing protein level (Figure 3a, lane 2, 4). However during 1 h recovery period, the protein intensity of larvae exposed to 36 C was slightly less (lane 8) than control while it was on par with control in larvae exposed to 40°C (lane 10). No change in protein levels was observed during 24 h and 48 h recovery period in both the cases. When the exposure period was extended for 6 h at 36°C (lane 5), intensity of protein during the exposure and 1 h recovery period was same as in the control. The induced protein level at 40°C for 1 h was less than control but slightly higher than in larvae treated for 1 h at 36 C. Again no change in protein levels was observed during 24 h (Figure 3b, lane 15) and 48 h recovery period (lane 17) after they were exposed for 6 h in both the cases.

In the case of female, 1 h exposure at only 40°C (Figure 3a, lane 5) decreased the protein level below control but it was restored during 1 h recovery period (lane 11). But the larvae exposed to long duration (6h) at both temperatures showed raised protein level than control during 1 h recovery period (Figure 3b, lane 9, 11) and thereafter it was same as in control.

The male Nistari worms when subjected to 36°C and 40°C for 1 h (Figure 3c, lanes 2, 4) each showed decrease in protein intensity at 68-97 kDa regions. Though 1 h recovery period was sufficient to restore to normal level (lane 8, 10) as in control, it was found to be decreasing after 24 h onwards (lanes 15, 17, 21, 23). During this recovery period, the worms exposed to 36°C showed protein level on par with the control, while 40°C treated batch showed protein level below the control. In contrast, the increased protein level was evidenced in worms subjected to 6 h exposure at 36°C and 40°C which continued to increase in 1 h recovery period too (Figure 3d, lanes 2, 4, 8, 10). However, after 24 h of recovery (lanes 15, 17), the protein intensity was found less than control.

The female Nistari larvae exposed to 36°C for 1 h (Figure 3c, lane 3) did not show much variation from the control whereas the 40°C-1 h (lane 5) treated larvae showed increased protein intensity than control. The protein intensity was increasing in 1 h recover period of both treatments but it was more pronounced in 40°C treated larvae (lane 9) than 36°C treated larvae (lane 11). But after 24 h recovery period, the protein intensity was slightly more in 36°C treated larvae (lane 16) than 40°C treated (lane 18). With 6h exposure at 36°C and 40°C (Figure 3d, lanes 3 and 5), the protein level in 40°C was found to be higher than control and the same result was found after 1 h recovery period also. But after 24 h recovery, the protein intensity was less than control and the effect was more in 40°C treated worms (lane 18) followed by 36°C treated larvae (lane 16).

During fifth instar, both the races showed appearance of new bands between 29 and 43 kDa size region (male Nistari larvae exposed to 1 h at 40°C, CSR2 male and female larvae exposed to 36°C for 1 h) and at 30 kDa size region (male Nistari larvae during 1 h recovery period after exposure to 40°C for 1 h).

DISCUSSION

The response to heat shock is manifested by the appearance of a set of new proteins or an increase in the quantity of certain specific, preexisting proteins in response to exposure of an organism to stress. Inducible HSPs vary in concentration within cells and mainly concern interactions with other proteins. At high temperature, the normal or non-heat shock proteins get unfolded and form aggregates with exposed internal residues which will harm or kill the cells. HSPs can recognize and bind to these unfolded proteins to minimize the aggregation and protect the cell. Generally, the heat shock response and HSP induction depends on the magnitude of temperature elevation and duration of exposure. In the present study we attempted to find out the response of two silkworm breeds to high temperature of various durations in different life stages.

The effect of short and long exposure is different in the two races. In the third instar larvae of CSR2, 1 h exposure at high temperature seems to disrupt or stop the normal protein synthesis and hence the protein level of treated larvae is less than control. During recovery period of 1 h and thereafter when the larvae were brought to room temperature, an increased protein level was observed. Perhaps this much time is needed for the larvae to induce HSP and chaperone the normal protein. Krebs and Feder (1997) made an important contribution by showing that most Hsp70 expression is activated by severe heat shock after a return to physiologically normal temperature as a respond to the heat-induced damage. However, a general decrease in protein content of third instar in all the treatments was observed after 24 h recovery period whereas in control it was after 48 h where the larvae were due to moult. Also, the long exposure to high temperature appears to hasten moulting. The short duration treatment also stimulated early moulting but gradually the pace slowed down, being equal to control. In CSR2, the short exposure induced early moulting around 48 h while long exposure induced after 24 h of recovery period. In Nistari, though the induction of protein is more during long exposure, moulting has taken place more or less at same time in all the treatments. It could be that the third instar larvae of both races were more affected by long duration treatments rather than the temperature levels. That is to say that the larvae were less affected by 1 h exposure at 40°C than the 6h exposure at 36°C. The threshold for damage to third instar may be marked by the duration of temperature.

As far as fourth instar larvae are concerned, the effect of temperature was little more than third instar larvae of both the races. However, Nistari larvae were quick enough to regain their normal protein level at both temperatures than the CSR2. This is possible if the organism regulates HSP expression by producing moderate concentration of Hsp70 immediately after stress, to eliminate the expression in the absence of stress (Solomon et al., 1991) and, to eliminate Hsp70 as soon as recovery is complete (DiDomenico et al., 1982).

The differential susceptibility of fifth instar to high temperature was more pronounced in females, especially for 6 h duration. The initial hike in protein content immediately after the treatments always indicated a sign of response to temperature. Lindquist (1980) reported that the heat shocked *Drosophila* tissues produced more quantity of protein initially and then at a reduced rate, probably due to the shift in the gene transcription mechanism to produce a small number of characteristic heat shock proteins. In the present study, the most visible increase in the haemolymph protein profile as visualized in the gels was as usual in between the 68 and 97 kDa region. It is known that one of the most important families of heat shock protein, HSP70, is found expressed in a wide variety of insects including lepidopterans such as *Calpodes ethilus*, *Manduca sexta* and *Bombyx mori* (Fittinghoff and Riddiford, 1990). The consistent pattern of increase in protein in this particular range subsequent to exposure to high temperature indicates a possibility of certain new proteins that is not found in normal, unstressed individuals. In general, except the third instar, CSR2 appeared to be more sensitive to high temperature rather than the duration of treatment and seems to be very sensitive to rise in temperature even for short duration. Nistari, being less susceptible race the response to rise in temperature as well as to the duration of exposure is immediate and normal level was restored as early as possible.

Available literatures strongly suggest that insects in general and silkworms specifically, are capable of expressing members of Hsp70 under heat shock (Lindquist, 1980; Omana and Gopinathan, 1995). The increase of protein between the 68 and 97 kDa region was not accompanied by visible increase or decrease of other proteins in the gel. This strongly suggests that the increase in this particular region is due to synthesis of fresh protein, could be heat shock proteins. This view gets support from the findings of Lindquist (1980) who pointed out that Hsp70 was produced in much larger amount than any other protein subsequent to heat shock in *Drosophila*. The vigor and the speed of induction of heat shock proteins are greatly enhanced by the fact that synthesis of the normal complement of proteins and mRNAs is sharply and rapidly curtailed. Fittinghoff and Riddiford (1990) established heat induced shut down of normal protein synthesis in *Manduca sexta*, a lepidopteran insect which is phylogenetically very close to silkworm. Though silkworm need not necessarily follow the Hsp70 gene expression pattern, there are reports that the silkworm share similar patterns of Hsp expression with other insects (Landaise et al., 2001).

The appearance of new proteins subsequent to heat shock was observed in third instar Nistari (Figure 4). Nistari, known for its tolerance to high temperature, might have had the capacity to express proteins of 90 kDa size of the 90 kDa Hsp family under high temperature immediately after the treatment. Omana and Gopinathan (1995) have also observed the appearance of 93kDa, 81kDa and 70kDa proteins in three multivoltine breeds of *Bombyx mori* when they were exposed to varying temperatures ranging from 37°C to 40°C. In the gram pest. *Heliothes armigera* Hsp64 was strongly induced after heat shock at 37 °C and 42 °C (Singh and Lakhotia, 2000). The caterpillar *Manduca* *sexta* (Lepidoptera) responds to heat shock by producing at least seven heat shock proteins (Fittinghoff and Riddiford, 1990). It is reported that HSPs are virtually undetectable at normal temperatures (25 °C) and is induced thousand folds upon heat shock (37 °C) (Velazquez *et al*., 1983). As they are not expressed before stress and concentration increase during stress and/ or recovery from stress (Lindquist, 1993), the appeared band at 96kDa and between 97kDa - 205kDa seems to be heat shock induced proteins in Nistari. Besides, *Bombyx mori* is proved to possess the genes encoding Hsp90. Landaise *et al*. (2001) completely sequenced the Hsp90 cDNA from *Bombyx mori* and *Spodoptera frugiperda*. They performed transcription analysis of *hsp90* gene and found that the induction of the gene occurs only at 42°C which is 14°C above physiological growth conditions of *S. frugiperda*.

New bands in the region between 97 and 205 kDa size appeared only in fourth instar CSR2 larvae (Figure 5) during recovery period of the treatment. These high molecular weight HSPs are supposed to have role in protein folding and their consistent expression induced under heat shock indicates these may be specific to CSR2 breed. The Nistari race which is comparatively tolerant might constitutively possess some other HSPs and hence, no expression of new protein. The constitutive expression of HSPs reported in *Drosophila* by Krebs and Feder (1998) would support our results. There was a new protein in the low molecular weight region (between 29 and 43 kDa size) in the fifth instar of both the races in the recovery period induced after exposing to 1 h at 36C (Figure 6). As it is not found in other instars that were exposed to high temperature, this might be a HSP, specific to fifth instar larvae which is more susceptible than the other instars. Similar observation was made by Nagaraja (1991) who has reported a 36 kDa size protein in the haemolymph of CNichi larvae, another temperature tolerant race of silkworm. Besides, the same size protein was observed in a parallel study done on BmNPV inoculated larvae at CSRTI, Mysore (unpublished). This leads us to believe that this protein is induced upon stress whether it is abiotic (temperature) or biotic (virus). When the treated larvae were reared up to cocooning, the larvae treated at 40°C for 6h showed severe mortality than the others that pupated successfully (data not shown). This indicates that the larvae could overcome the stress of high temperature (1h at 40°C and or 6h at 36°C) by induction of new HSPs or increasing the already existing ones.

However, these results has to be confirmed by immunological techniques and sequencing of the proteins under question. The available literature strongly indicates that these new proteins could be HSPs and our preliminary study shows large scope for further studies in this direction.

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REFERENCES

Bijlsma, R., Loeschecka, V., 1997. In: Bijlsma, R., Loeschecka, V.(Eds), Environmental stress, Adaptation and evolution, Birkauser Verlag, Basel. p:193-207

Burton, V., Mitchell, H.K., Young ., P.,Petersen, N.S.,1988. Heat shock protection against cold stress of *Drosophila melanogaster*. *Mol. Cell Biol*., **8**: 3550-3552.

Craig, E.A.,. 1985. The heat shock response. *CRC Crit. Rev. Bioche.,*. **18**:239-280.

Carretero, M.T., Carmona, M.J., Morcillo, G., Barettino, D., Diez, J.L., 1986. Asynchronous expression of heat-shock genes in *Chironomus thummi*. *Biol. Cell.*, **56**: 17-22.

Denlinger, D.L., Lee, R.E., Yocum, G.D., Kukal, O., 1992. Role of chilling in the acquisition of cold tolerance and the capacitation to express stress proteins in diapausing pharate larvae of gypsy moth *Lymantria dispar*. *Arch. Insect Biochem. Physiol*., **21**: 271-80.

DiDomenico, B. J., Bugaisky, G. E., Lindquist, S., 1982. Heat shock and recovery are mediated by different translational mechanisms. *Proc. Natl. Acad. Sci. (USA),* **79**: 6181-6185.

Fittinghoff, C.M., Riddiford, L.M., 1990. Heat sensitivity and protein synthesis during heat-shock in the tobacco horn worm, *Manduca sexta*. *J. Comp. Physiol, B*. ***160,*** 349-356.

Gehring, W.J., Wehner, R., 1995. Heat shock protein synthesis and thermo tolerance in *Cataglyphi*s, an ant from the Sahara desert. *Proc. Natl. Acad. Sci. USA*, **92**: 2994-2998.

Joplin, K.H., Yocum, G.D., Denlinger, D.L., 1990. Cold shock elicits expression of heat shock proteins in the flesh fly *Sarcophaga crassipalpis*. *J. Insect Physiol*., **36**: 825.834.

Krebs, R. A., Feder, M. E.,1998. Hsp70 and larval thermo tolerance in *Drosophila melanogaster*: How much is enough and when is more too much ? *J. Insect Physiol*., **44**: 1091-1101.

Landaise, I., Pommet, J.M., Mita, K., Nohata, J., Gimenez, S., Fournier, P., Devauchelle, G., Cerutti, M.D., Ogliastro, M., 2001. Characterization of the cDNA encoding the 90 kDa heat shock protein in the Lepidoptera *Bombyx mori* and *Spodoptera frugiperda*. *Gene*, **271**: 223-231.

Lindquist, S.,1980. Varying patterns of protein synthesis in Drosophila during heat shock; implications for regulation. *Developmental Biol*., **77**: 463-479.

Lindquist, S., 1986. The heat shock response. *Annu. Rev. Biochem*., **55**:1151-1191.

Lindquist, S.,1993. Auto regulation of the heat-shock response. Translational regulation of gene expression 2 (ed. J. Ilan), Plenum Press, New York. p.279-320.

Nagaraja, G. M., 1991. Heat shock response in Bombyx mori L. Dissertation submitted to CSRTI, Mysore, Central Silk Board, Govt. of India.

Nagata, M., Kobayashi, M., 1990. Quantitative changes in storage proteins during larval development of the silkworm Bombyx mori. *J. Seric. Sci. Jpn*., **59**: 461-468.

Omana, J., Gopinathan, K.P., 1995. Heat shock response in mulberry silkworm races with different thermo tolerances. *J. Biosci*., **20** (4)**:** 499-513.

Singh, A.K., Lakhotia, S.C., 2000. Tissue -specific variation in the induction of HSP 70 and Hsp64 by heat shock in insects. *Cell stress & Chaperons*, **5** (2):90-97.

Solomon, J. M., Rossi, J. M., Golic, K., McGarry, T., Lindquist, S., 1991. Changes in Hsp70 alter thermo tolerance and heat-shock regulation in *Drosophila*. *The New Biologist*, **3**: 1106-1120.

Suresh Kumar, N., Basavaraja, H.K., Mal Reddy, N., Jayaswal, K.P., Datta, R.K., 2000. Heterosis in newly evolved CSR bivoltine hybrids of silkworm, *Bombyx mori* at room and high temperature conditions. *In* :Dandin, S.B., Gupta, V.P.(Eds), Advances in Indian Sericulture Research, Central Silk Board, Bangalore, India, p.117-122.

Whyard, S., Wyatt, G.R., Walker, V.K., 1986. The heat shock response in *Locusta migratoria*. *J. Comp*. *Physiol*., **156** B: 813-817.

Velazquez, J. M., Sonodam S., Bugaisky, G., Lindquist, S., 1983. Is the major *Drosophila* heat shock proteins present in cells that have not been heat shocked? *The J. Cell Biol*., **96**: 286-290.

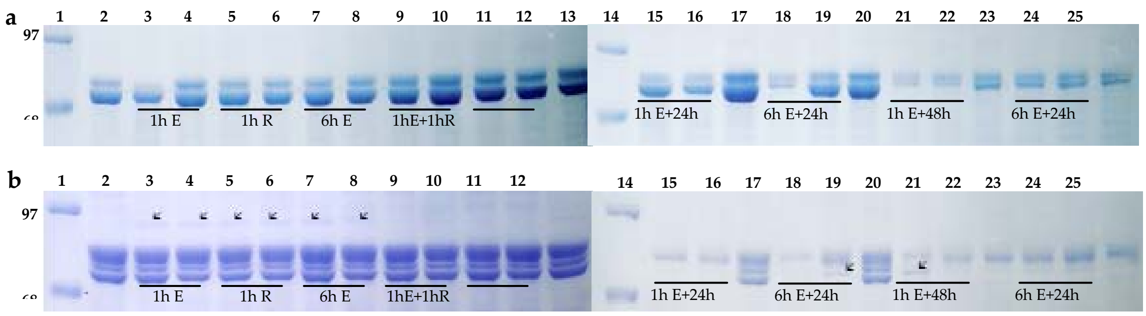

Figure 1: Haemolymph protein profiles of third instar larvae of silkworm. a. CSR2, b. Nistari [lanes 1& 14: marker; lane 2: control at 0 h; lane 13: control after 6h; lanes 17& 20: control after 24 h; lanes 23 & 26: control after 48 h; lanes 3, 5, 7, 9, 11, 15, 18, 21, 24: treatment at 36°C; lanes 4, 6, 8, 10, 12, 16, 19, 25: treatment at 40°C]

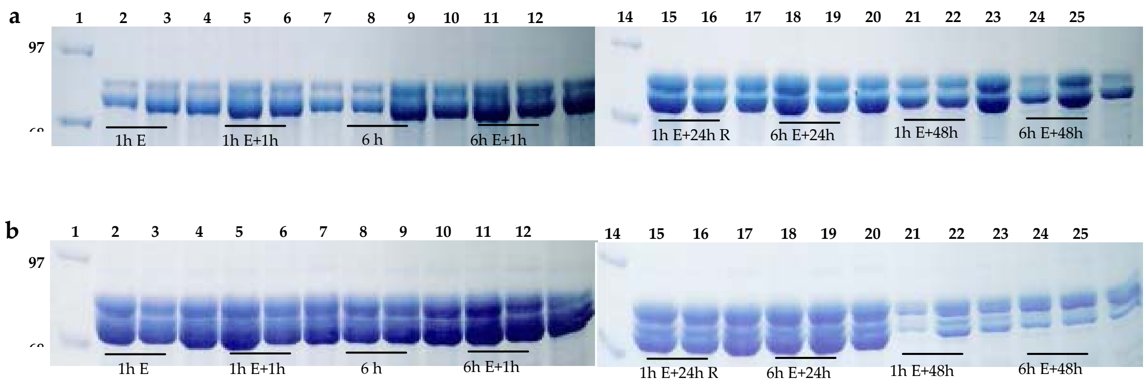

Figure 2: Haemolymph protein profiles of fourth instar larvae of silkworm. a. CSR2; b. Nistari [lanes 1, 14: markers; lanes 4, 7, 10, 13, 17, 20, 23, 26: control at respective treatment period; lanes 2, 5, 8, 11, 15, 18, 21, 24: treatments at 36°C; lanes 3, 6, 9, 12, 16, 19, 25: treatments at 40°C].

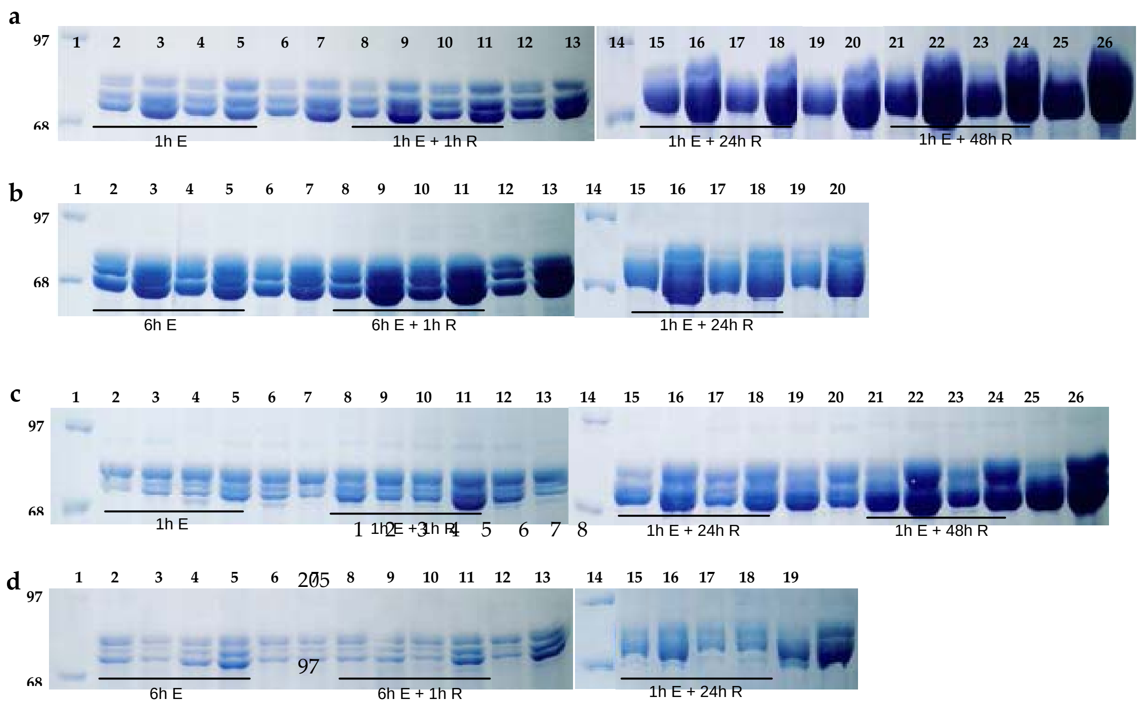

Figure 3: Haemolymph protein profiles of fifth instar larvae of silkworm. a & b:CSR2; c & d: Nistari [lanes 1 & 14: marker; lanes 6 & 7, 12 & 13, 19 & 20, 25, & 26: control male and females respectively; lanes 2 & 3, 8 & 9, 15 &16, 21 & 22: male and female respectively, treated at 36°C; lanes 4 & 5, 10 &11, 17 & 18, 23 & 24: male and female respectively treated at 40°C].

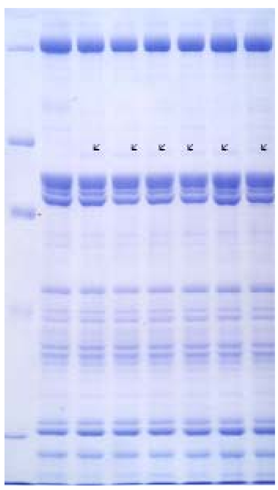

Figure 4: Appearance of new protein in third instar (Nistari) larvae. [Lane 1: marker, 2: control, 3: 1h at 36°C, 4: 1h at 40°C, 5: 1h exposure at 36°C followed by 1h recovery, 6: 1h exposure at 40°C followed by 1h recovery, 7: 6h at 36°C, 8: 6h at 40°C. Arrows indicate appearance of induced protein].

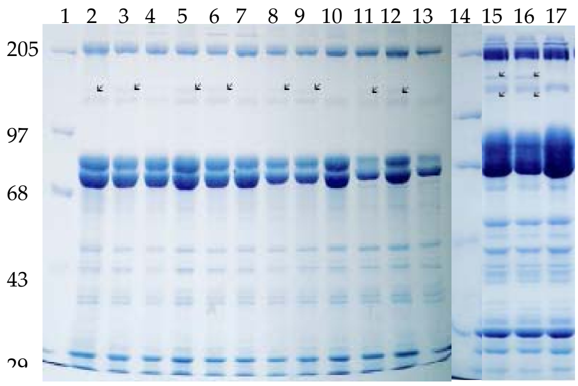

Figure 5: Appearance of new protein in fourth instar (CSR2) larvae. [lane 1, 16: marker, 4, 7, 10, 13, 19: control at respective treatment; 2, 3: 24 h recovery of 1h exposure at 36°C and 40°C respectively; 5, 6: 24 h recovery of 6h exposure at 36°C and 40°C respectively; 8, 9: 48 h recovery of 1h exposure at 36°C and 40°C respectively; 11, 12: 48 h recovery of 6h exposure at 36°C and 40°C respectively; 17, 18: 48 h recovery of 1h exposure at 36°C and 40°C respectively. Arrows indicate appearance of induced protein.]

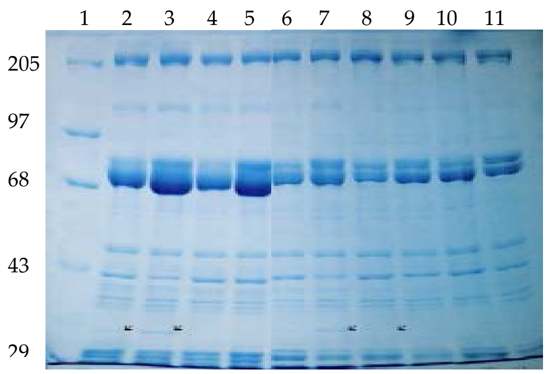

Figure 6: Appearance of new protein in fifth instar larvae. [lanes 2-5: CSR2; lanes 6-11: Nistari; lane 1: marker; 2, 3: male and female at 36°C 1h E + 24h recovery; 4, 5: control male and female larvae; 6, 7: male and female at 36°C 1h E + 24h recovery; 8,9: male and female at 40°C 1h E + 24h recovery; 10, 11: control male and female larvae. Arrows indicate appearance of induced protein.]

Result of using the biostimulator – Bioragi in sericulture in Georgia

By

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ABSTRACT
Last years continued study of influence of Biostimulator-Bioragi on a mulberry seed's energy of sprout and ability for spring up, on healthy and unhealthy plant's biometrical parameters and silkworm's biotechnological parameters -in Georgian Sericulture institute.

With the treatment of mulberry with Bioragi the resistance of the plant towards The micoplasmatic disease-leaf curliness increases. One time treating of diseased mulberry roots with Biorag the immunity of the plants increased and therefore the prevalence of leaf curliness disease is decreases. After the treating of the seeds with Biorag, the stimulation of germinating capacity has been revealed. At the same time the biometric indices of received seedlings increase.

Results of the currently studying were sufficiently successful. The mulberry seed's energy of sprout and ability for spring up, the biotechnological parameters of silkworm and biometrical parameters of mulberry trees significantly improved and develop of illness significantly decreased by using the Biostimulator-Bioragi.

Key words: Biostimulator-Bioragi, seed's energy, spring up

INTRODUCTION

Sericulture is one of the oldest brunches of agriculture, which can give considerable gain in a short period of time. The development of sericulture was stimulated by favorable natural conditions, perfect nutrient medium and great demand on Georgian silk on the world market.

As is known, in the resent years a new disease of the mulberry tree -„leaf rugosity" has made serious negative action on the nutrient base of sericulture.

The disease was first recorded in 1964, on the territory of the experimental sericulture zonal farm in Kutaisi. From the 1990 in has been spread in the east Georgia too. As a result of the above-mentioned disease, more than 80% of nutrient base has been destroyed in the country.

Chemical stimulation of planting materials for increasing crop has a long history, but it deserves particular interest from the viewpoint of getting high yield by means of synthesis of physiologically active substances. One of the effective ways to increase of crop is treatment of seeds before planting. In this direction, before planting, it is especially important to process the seeds with the bioenergoactive-immunizers, which makes the plants more resistant to diseases and unfavorable environmental conditions. They penetrate into the plant sells, play a role of inductors of general unspecific durability, and stimulate plant protection mechanism.

The aim of the present work was to study the stimulate action of biostimulator-bioragi on germination energy and sprouting capacity of the mulberry seed, state the presence of its effect during the processing of mulberry seed after 10, 50, and 100 days from treatment. And also, the effect of bioragi on resistance of the mulberry tree to the leaf rugosity disease.

Biostimulate –biorag is ecologically pure and secure. It is tested on different agricultural crops.
Mulberry seeds were soaked into aqueous solution of Biorag for 24 hour.
Processing before planting of the seed gives quite positive results, which are shown in the table 1.

Table 1

#	Variant	At the moment of treatment		after 10 days from treatment		after 50 days from working		after 100 days from working	
		germination energy, %	sprouting capacity, %	germination energy, %	sprouting capacity, %	germination energy, %	sprouting capacity, %	germination energy, %	sprouting capacity, %
1	control	81,3	89,3	97,0	90,0	75,3	81,3	13,3	15,5
2	Test	96,6	98,0	97,3	97,3	82,6	88,0	28,8	34,4

As is seen germination energy and sprouting capacity of the mulberry seed are quite high in comparison with control variant. experimental variant overcomes control variant by 9,7%; by 0,3% after 10 days from processing; by 6,7 % after 50 days and by18,9 % after 100 days.

The experiments demonstrate that action of Biorag increases germination energy and sprouting capacity of the mulberry seed. Seeds treated with Biorag start germination and sprouting several days earlier and maintain germination energy and sprouting capacity for a long time.

Biorag was also tested on resistance of the mulberry tree to the leaf rugosity disease. The experiments have been carried out on infected plants, in the plantation of mulberry selection yard (aged plants) by the introduction of Biorag into soil. The disease had been monitoring with a method offered by M.Kakulia.

Experiments were carrying out on the territory of Telavi mulberry selection yard. The experimental sort „Gruzia" was put to test. The experimental data are given in table 2.

Table 2

#	Test variant	number of experimental plants	number of infected plants	Percentage of affected plants,%	disease development,%
1	control	20	18	90,0	67,5
2	test	20	4	20,0	7,1

Accordingly, an anatomic investigation was carried out (table 3), as is seen from the Table, Number of diseased plants was decreased by 69%, and progression of the disease decreased by 60, 4%, in comparison with the control data.

Table 3

Test variant	thickness of collenchyma, mk	thickness of the coat, mk	thickness of perimedular zone, mk	number of cells	number of radial rays	Soft coat volume		total number of druses
						in peripetion	in mesopetion	
Control	14,8	5,9	4,1	85,6	17,0,	5,0	2,0	5,8
Test	24,2	10,6	6,3	180,3	33,3	18,0	8,3	212,3

Based on the experiments, it was demonstrated that the processed plant could recover its immune system on account of utilization of reserved substances. Growth and development of the plants is stimulated, active elements of their anatomic structure and data of productivity are improved, and spreading of the mycoplasma disease is decreased. All this can be considered as increasing of general resistance of the plants to the disease, as well as to unfavorable environmental factors.

REFERENCES

1. R. Gakhokidze-Bioenergoaqtivator. Tbilisi.2002
2. M. Kakulia- On the damage Caused by leaf rugosity. Tbilisi.1979

2.2. Silkworm genetics and breeding

THE SILKWORM RACE "J90"

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ABSTRACT

The silkworm race "J90" represents a new biological creation destined to the agriculture – sericulture domain. It is a silkworm race of Japanesse type, created in order to be used as genitor in the creation of silkworm hybrids.

The works of race creation, extended during 12 generations, had as basis a valuable initial material represented by a Japanese commercial hybrid. The utilized amelioration methods were the selection of different types and the crossing, and the selection criteria specific to every stage of the evolutive cycle were chosen both on the basis of their economic importance and some genetic characteristics as the heritability of the characters and the correlation between these.

The race "J90" is characterized by the following parameters: prolificity – 520 eggs/laying; hatching – 93.3%; larval period – 29 days; viability larvae- 93.38%; cocoon yield/10000 larvae – 17.60 kg; raw silk percent – 19.43%; fresh cocoon weight – 1.930 g; shell cocoon weight – 0.460 g; shell cocoon percent – 23.83%; filament length – 1250 m; filament size – 2.70 denyer, raw silk percent – 37.87%; reelability – 81.52%.

Key words: Bombyx mori, race, cocoon weight, shell weight, filament length, reeling silk. .

INTRODUCTION

Obtaining new silkworm breeds and hybrids with the aim of increasing silk production is an activity developed in many sericultural countries (Chatterjje, S.N. et al., 1993; Petkov, N. et al., 1993; Yamamoto, T. et al., 1995, Datta et al., 2000; Chen Keping et al., 2001; Kalpana, G.V. et al., 2004).

In Romania, during the years, different silkworm breeds were obtained (Craiciu, E., 1956; Stroescu, E., 1958; Preadcencu, C., 1956, 1963; Titescu, E., Brasla, A., 1975; Brasla, A., Titescu, E., 1976; Matei, A., Brasla, A., 2006).

There are different factors that cause the need for permanently creating new silkworm breeds: the necessity of getting higher qualitative and quantitative rates of cocoon and natural silk fiber; it is also known that it comes a time when even the best silkworm breeds do not satisfy the economical and technical needs as the genetic variability reserves are reduced.

This context includes the breeding papers which conduct to the creation of a new silkworms breed "J 90".

To create the "J 90" breed, there were considering the following aspects:

- an initial adequate material, with superior quantitative and qualitative parameters;
- a rigorous selection during all the working steps;
- a "perfect pair matching" to consolidate the valuable characters and the possibility to fix and create new characteristics;
- elimination of inadequate descendants;
- optimal food and environment conditions.

In comparison with the replaced breed, during the selection process, we aimed the growing of shell weight instead of fecundity and raw cocoon weight and also, the pupae's weight.

MATERIALS AND METHODS

The "J 90" breed was created by synthesis, having as initial material a commercial hybrid.

The main methods utilized to obtain this breed were selection and crossing.

In some stages mass selection was utilized, constituting eggs units from different layings. The family selection was also practiced, where the families were admitted or rejected from reproduction according with their average performances. In other stages it was used the individual selection, the reproductive individuals being chosen based on the personal performances expressed as deviation from the population average.

Taking in consideration the characters for selection, the individual selection was applied, meaning the selection of one character, despite others.

The specific selection criteria for the four development stages were the following:

- The egg stage: fecundity, the percentage of normal eggs, the hatching percentage, the chorion color, sanitary state;
- The larval stage: body color, larval marks, the duration of larval period, the larval uniformity, illness resistance, the food consumption, the mounting period
- The cocoon stage: the cocoon production/family/unit, cocoon shape, normal cocoons' percentage, double and poor brewed, fresh cocoon weight, shell weight percentage, silk percentage, the cold sputtered fiber length.
- The moth stage: the morphological aspect and moth viability.

The initial material was a Japanese commercial hybrid, from which were obtained 100 layings through reproduction. First, they were selected by their aspect and sanitary state; after that, the final selected layings were grouped in units. As a result, 8 units were made, each with 4-8 layings. 500 larvae were set apart at the beginning of the 4^{th} age from each unit. From the 8 units mentioned above, a part of them were used for reproduction, the ones having the maximum value for the characters that made the selection objective; the others have been eliminated from reproduction.

The breeding by units witch involves the mass selection continued during the next three generations (F3 – F5). Starting with F6, the breeding system switch on family breeding, each generation having 20 families with 300 larvae per family.

The families were admitted for reproduction based on the same selection criteria used for units. Inadequate families were rejected from reproduction.

For four generations (F6 – F9) it was used in the same time intra and inter family crossing and from each family there were selected 50 reproductive individuals (cocoons) both males and females.

Starting from the 10^{th} generation it was used the crossing between consangvinisation families and nonconsangvinisation families. The new breed is represented at the end of selection process by 50 families (layings).

RESULTS AND DISCUSSIONS

The morphological characteristics are the following:

<u>The egg</u>: the shape of the egg is ellipsoidal, the former side is sharp, and the lateral sides are convex. The length is 1,5 mm, its width is 1,2 mm and weights on average 0.5 mg. The egg color is grey and the chorion is white.

<u>The larva</u> has a cylindrical shape; the length of the mature larva is 7,5 cm and the weight is 5,5 g. The tegument which covers larva's body has a dark color at hatching and it is covered with white delicate hair which disappears during the larva growing. After the 3^{rd} sleep the larval marks are visible: the mask over the 2^{nd} thoracic segment and a pair of half-moon on 2^{nd} and one on 5^{th} abdominal segment. The larva's hemolymph is colorless.

<u>The pupa</u> has a fusiform aspect, with the previous body part wider and posterior sharper, it weights on average 1,5 g. The cocoon has a white color with an elongated oval form. The cocoon's longitudinal axis has a length of 3, 74 cm, and the transversal one of 1, 60 cm. The cocoons have a fine granulation.

The moths have medium size, the female has on average 2 cm and the male 1,5 cm. The body is covered with white scalds. The antennas are pectinated at both sexes. The anterior wings are triangular shaped and they have a medium size of 20 cm.

Biological and productive characteristics are presented in table 1.

"J 90" silkworm breed is a bivoltine one. Its evolutive cycle has a complete metamorphose with 4 stages: egg, larva, chrysalis and moth. The larva has 5 ages and 4 moults.

It has a medium fecundity, respective 520 eggs/laying, being smaller than the control breed White Baneasa (606 eggs/laying) and the initial hybrid material (670 eggs/laying). The fecundity diminution and the increase of cocoon technological characteristics were being pursuit during entire selection period.

The hatching percentage is 93,34%.

The larval period is 29 days, same as control breed White Baneasa and one day longer than the initial material.

The larvae is vigorous with high viability (93,38%), high food consumption and disease resistance. Food consumption is 72,22% in I-III stages, 81,56% in I-IV stages and 81,26% on entire period. From this aspect, the control breed, White Baneasa is 4 percentages backward.

The food digestibility, in the case of the new created breed, is 40,63% reported to dry substance. Because of these characteristics, the larvae can develop uniformly and the moulting can take place simultaneously, being a very important aspect in silkworm rearing.

The average cocoon yield/10000 larvae is 17,6 kg (around 3,2 kg/g eggs) higher with 15,78% than the control breed White Baneasa but it's lower with 13,09% than the hybrid that's been used as initial material.

Biological and productive characteristics Table 1

Characteristics	**MU**	**Breed**			**Differences ± to**			
		J 90	**White Baneasa (control 1)**	**Initial material (control 2)**	**Control 1**		**Control 2**	
		X±Sx	**X±Sx**	**X±Sx**	**Absolute values**	**%**	**Absolute values**	**%**
Fecundity	eggs/ laying	520±22	606±35	670±17	-86	-15	-150	-22,39
Hatching	%	93,34±0,51	93,74±0,40	95,65±0,40	-0,4	-0,42	-2,31	-2,41
Larval period	days	29	29	28	0	0	+1	+3,57
Larval viability	%	93,38±0,53	92,40±0,22	98,60±0,18	+0,98	+1,06	-5,22	-5,30
Cocoon yield/10000 larvae	kg	17,60±0,92	15,20±0,66	20,25±0,82	+2,40	+15,78	-2,65	-13,09

The cocoon and natural silk fiber's **technological characteristics** are presented in table 2.

Raw cocoon has an average 1,930 g, lower than the two controls. Cocoon shell weight is 0,460 g, exceeding the White Baneasa with 5,7% and it's lower with 10,50% than the initial material.

The increase of cocoon shell ratio has been the main objective of the selection processes. This materialized with the obtaining of a medium cocoon shell ratio of 23,83% (22,05% females and 25,82% males), exceeding the two controls with 11,04%, respective 2,3%.

The increase of filament length and the improvement of its quality represent another important objective in the new silkworm breed creation.

In this way it's been achieved the performance of 1250 m length, by which the new breed exceeds the White Baneasa breed with 54 m (4,51%).

There are noticeable also other qualities of the fiber: reeling silk percentage 37,87%, metric number of fiber-3330 m/g.

The reelability is 81,52%, higher with 7,46%, respective 9,12% than the two controls and the raw silk ratio is 19,43%.

Table 2

Technological performances of the cocoon and silk fiber

Characteristics	MU	Breed			Differences ± to			
		J 90	White Baneasa (control 1)	Initial material (control 2)	Control 1		Control 2	
		X±Sx	X±Sx	X±Sx	Absolute values	%	Absolute values	%
Raw cocoon weight:								
- Female	g	2,040±0,150	2,103±0,028	2,316±0,021	-0,063	-3,00	-0,276	-11,91
- Male	g	1,820±0,130	1,823±0,036	1,906±0,015	-0,003	-0,17	-0,086	-4,52
- Average	g	1,930±0,140	1,963±0,032	2,111±0,018	-0,033	-1,70	-0,181	-8,57
Shell cocoon weight:								
- Femele	g	0,450±0,040	0,430±0,010	0,545±0,006	+0,020	+4,65	-0,095	-17,44
- Male	g	0,470±0,020	0,440±0,020	0,484±0,004	+0,030	+6,82	-0,014	-2,90
- Average	g	0,460±0,030	0,435±0,045	0,514±0,005	+0,025	+5,75	-0,054	-10,50
Silk content:								
- Female	%	22,05±0,23	20,12±0,61	21,84±0,17	+1,93	+9,59	+0,21	+0,96
- Male	%	25,82±0,30	22,29±0,29	24,74±0,27	+3,53	+15,83	+1,08	+4,36
- Average	%	23,83±0,26	21,46±0,21	23,29±0,22	+2,37	+11,04	+0,54	+2,31
Dry cocoon weight	g	0,990±0,036	0,923±0,024	0,959±0,013	+0,067	+7,25	+0,031	+3,23
Filament length	m	1250±10	1196±32	1300±21	+54	+4,51	-50,00	-3,85
Filament weight	g	0,375±0,032	0,330±0,003	0,384±0,008	+0,045	+13,63	-0,009	-2,35
Filament size	d	2,70±0,04	2,65±0,06	2,65±0,02	+0,05	+1,88	+0,05	+1,88
Reeling silk	%	37,87±0,38	35,75±0,26	40,04±0,18	+2,12	+5,93	-2,17	-5,42
Metric number of fiber	m/g	3330±10	3393±16	3385±12	-63,00	-1,86	-55,00	-1,63
Reelability	%	81,52±0,24	75,86±0,12	74,70±0,22	+5,66	+7,46	+6,82	+9,12
Raw silk	%	19,43±0,62	16,81±0,44	18,19±0,56	+2,62	+15,58	+1,24	+6,81

CONCLUSIONS

The silkworm breed “J 90”, with patent n^{o} 117749/2002, may be considered as a new breed because it shows the following characteristics:

- morphological, biological and technological characteristics different from other breeds;
- certain ecological requirements;
- reproductive isolation during 11 generations.

REFERENCES

CHATTERJJE, S.N. (1993). Silkworm breeding in India. Sericologia, 33 (3), 427-448.

CHEN KEPING, LI MUWANG, YAO QING, LIN SHENYU, HOU CHENGXIANG (2001). Breeding of new germplasm of silkworm (Bombyx mori) resistant to Zhenjiang (China) strain of densonucleosis virus (DNV-Z) – Sericologia, 41 (4), 21-27.

CRAICIU, E. (1956). Rasa de viermi de matase “Alb Nr. 1 Orsova”. Lucrari stiintifice SCCSA, 1, 3-15.

DATTA, R.K., BASAVARAJA, H.K., MAL REDDY N., NIRMAL KUMAR, S., AHSAN M.M., SURESH KUMAR N., RAMESH BABU, M. (2000). Evolution of new productive bivoltine hybrid, CSR 2 x CSR 6. Sericologia, 40 (3), 407-417.

KALPANA G.V., BASAVARAJA H.K., SURESH KUMAR N., PALIT A.K. (2004). Breeding of “a new bivoltine breed” for longer filament length and fine denier by utilizing the strain JPN of Bombyx mory L. – Sericologia, 44 (2), 189-197.

MATEI, A., BRASLA, A. (2006). Sericologia 46 (3) 285-291.

PETKOV, N., SHABALINA, A. (1993). Productivity studies of silkworm (Bombyx mori) inbred line F_{1071}. Genetics and breeding, 26 (5-6), 403-410.

PREADCENCU,C. (1963). Rasa sintetica de viermi de matase “Alb Baneasa”. Lucrari stiintifice SCSA, 4, 5-22.

PREADCENCU, C. (1956). Linia de viermi de matase “Galben Centurat Baneasa”. Lucrari stiintifice SCSA, 1, 54-66.

STROESCU, E. (1958). Rasa de viermi de matase “Alb Cislau”. Lucrari stiintifice SCSA, 2, 31-45.

YAMAMOTO, T., MASE, K., ENOKOJIMA, M. (1995). Breeding of polyphagous silkworm races with a thin cocoon filament. Bull. Natnl. Inst. Seric. Entomol. Sci., 15.

Estimation of the selection material on interrelation of the attributes forming productivity and nutritiousness of the mulberry leaf with activity of enzymes

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ABSTRACT
Now many major problems in the field of plant growing, selections and the industry processing products of plant growing, cannot successfully be solved without chemical researches and corresponding estimations of these products. Biochemical research methods are the important part in an estimation of a chemical compound and biochemical features of new kinds and grades of cultivated plants. Acceleration of rates of scientific and technical progress in sericulture and efficiency increase of selection work in many respects depend on how full and precisely hereditary qualities (genotype) are estimated, the structure of selected lines and forms for the further perfection of selection, and also programming of studied mulberries and a silkworm productivity. With a view of highly effective biochemical methods of research, have been received results at various by origin grades of mulberry by revealing specific activity of peroxidase, ascorbatocsidase and esterase enzymes. Peroxidase (1.11.1.7) plays a great role in breathing process of plants and polyphenoloxidase, or o-diphenolokxidase, or tirosinase (1.10.3.1) as well as peroxidase, plays the major role in respiration of plants, catalysing reaction of polyphenols oxidation. It is revealed, that at grades with high productivity of fodder leaf (Pionerskiy and Uzbekskiy), the maintenance of the general fiber and activity of peroxidase and polyphenoloxidase enzymes surpasses grades with lower leaf productivity (Oktiabrskiy and Selection № A-9-73). Direct highly functional correlation between activity of peroxidase and polyphenoloxidase enzymes and weight of a leaf plate, average shoot length, leaf productivity and functional correlation with cocoon productivity received is established at silkworm feeding of examined mulberry grades.
Keywords: mulberry, selection, hybridization, selection, inflorescence,, vegetation, hetirozis, consolidation, mutation, peroxidase, polyphenoloxidase, fermental activity, testing, metabolism, vegetative duplication.

INTRODUCTION

It is known, that the silkworm is a monophage, its ability to live entirely and completely depends on quality of forage - mulberry leaves, affecting on the maximal realization of its potential opportunities to display economic-valuable parameters-quality of cocoon production.

Mulberry is a long-term wood crop, selection process of new forms and grades deducing of which is quite long, and proceeds 15-20 years on the average. During selection of the numbers are considered all useful morphophysiological attributes, such as size of leafs, grafts, quantity of shoots, leaf-genesis, length and freezyness of shoots, etc. For definition of quality and nutritiousness of leafs experimental silkworm feeding are carried out which as a result give the certain characteristic to a selection number. It is necessary to note, that many parameters are astable enough and cannot give the full an objective complex estimation of studied selection material [1,2].

Now many major problems in the field of plant growing, selections and the industry processing products of plant growing, cannot successfully be solved without chemical researches and corresponding estimations of these products. Biochemical research methods are the important part in an estimation of a chemical compound and biochemical features of new kinds and grades of cultivated plants.

Last decade greater successes are reached in the field of: analytical chemistry, physics and biology that has found reflection in methods of carrying out of biochemical researches by means of modern equipments. Productivity and accuracy of analyses have raised.

Cultivation of plants in various zones of the world and constant selection carried for allocation of plants with useful attributes, promoted formation of the versions possessing various characteristics and biochemical properties. Researches have shown, that the last essentially differ not only at separate grades and forms of cultivated plants within the limits of one kind, but even at plants of the same grades. Fruits and seeds, and also vegetative bodies on the same plant differ on biochemical structure depending on their arrangement and development. Besides among grades of cultivated kinds under influence of hybridization and mutations there are new biotypes with the changed biochemical attributes.

Acceleration of rates of scientific and technical progress in sericulture and efficiency increase of selection work in many respects depend on how full and precisely hereditary qualities (genotype) are estimated, the structure of selected lines and forms for the further perfection of selection, and also programming of studied mulberries and a silkworm productivity.

Fruitful studying of genetics and biochemistry of silkworm has lifted on a new qualitative boundary selection researches in sericulture [3, 4, 5, 6, 7, 8, 9, 10].

For intensification of sericultural manufactures were carried out wide researches on development and introduction into selection practice of the new, fast and reliable methods meeting modern requirements.

A special value got studying polymorphic, protein and fermental systems of organs and tissues of a silkworm as genetically determined attributes for the decision of various questions of theoretical and applied character. Advantage of these biochemical attributes - rather simple character of inheritance by codomination type, stability during ontogenesis to smaller susceptibility to influence of environment factors in comparison with quantitative attributes of efficiency, and also easy detectability by means of electrophoresis methods in various carriers.

Data about protein polymorphism hemoglobin, transferrines, albumines, globulines for specification of animals and plants origin, definition of paternity, genealogic communications of grades and lines and decision of some other questions are widely used. Considering that enzymes are direct products of genes expression, the great interest in this scientific direction in a view of development of new effective biochemical criteria for studying the structural organization of genome, expression of its separate parts during ontogenesis, decisions of taksonony, evolution, philogeny questions and of some problems of practical orientation is clear and understendable.

Extremely perspective direction - studying of separate fermental systems for parental forms estimation, findings-out of biochemical individualities of an organism, drawing up on this basis of optimum programs of crossing and forecasting of heterosis effect in posterity. In opinion of some researchers, biochemical criteria, as genetically determined attributes, should appear most informative, at decoding molecular mechanisms parental forms complementation and decision of heterosis problem [11, 12, 13, 14, 15, 16, 17, 18]. Hence, application of biochemical criteria, their interrelation with each separate attributes peculiar to a concrete selection material and their use in selection process at deducing new grades and forms of mulberry remains opened.

Thus there is a necessity of studying and definition concrete (генотипических) attributes or criteria at various in origin mulberry grades and forms, describing the individual and to pick up biochemical methods economic-useful attributes testing, promoting reduction of selection process.

From the literature it is known, that enzymes of oxidoreductase group are key enzymes in acceleration of metabolic processes at alive organisms, particularly organisms of a phytogenesis, thus enzymes of polyphenoloxidase and peroxidase, concerning to this number, represent specific proteins, catalysting all reactions of metabolism in plants, they are in cytoplasm, parts of cells and in a cell membrane. On enzymes depend speed and direction of biochemical processes. They cause various physiologic and economic attributes of plants, such as drought resistance, early-matureness , productivity, etc.

The results concerning researches of oxidoreductase group fermental systems of mulberry, except for our researches of peroxidase activity level application as biochemical criterion at carrying out selection works on development of cold-resistant forms and grades of mulberry [19], is limited.

MATERIALS AND METHODS

Researches were carried out on the grades differed to some attributes: distance between sheet plates and thickness of the sheet plate, forming mulberry productivity. As model plants were used next grades: Oktiabrskiy with short distance, Pionerskiy with long distance, Uzbekskiy with thick leaf plates and Selection number A-9-73 with thin leaf plates.

During vegetative period of mulberry development, agricultural care of experimental material was carried out. Following parameters have been received: growth and development of shoots; the area of a leaf plate; weight of a leaf and its output.

With a view of highly effective biochemical methods of research, have been received results at various by origin grades of mulberry by revealing specific activity of peroxidase, ascorbatocsidase and esterase enzymes.

Studying of enzymes activity were carried out according to the following technique:

Peroxidase activity definition

It is known, that peroxidase is capable to function and an oxidase, catalysting oxidation of a substratum due to molecular oxygen in absence of hydrogen peroxide. Below are methods of peroxidase and oxidase functions of peroxidase definition.

The method is based on measurement of optical density of the reaction products, formed at oxidation of gvayacole for a definite time interval.

Reactants: 0,15 M the phosphatic buffer with pн 5,4; 0,15 % solution hydrogen peroxide; 3) a solution of gvayacole (183 mg on 25 ml of water), prepare on the day of use.

Course of the analysis. 200-500 mg of leaves pound in a mortar with a small amount of phosphatic buffers and transfer to a measured flask on 25 ml, lead up by buffer to a mark and in 10 minutes of infusing centrifugate an extract at 4000-6000 rev/min for 10 minutes

Into an experimental ditch of spectrophotometer with working length 1 sm bring 0,5 ml of substratum, 1,5 ml of a buffer solution, 0,5 ml enzyme extracts (центрифугата) and 0,5 ml of hydrogen peroxide solution. With adding the first drop of hydrogen peroxide start the timer. The first measurement is carried out in 20 seconds. Measurements should be done every 20 seconds during 1-2 minutes. Preliminary establish in zero position an ammeter arrow of the device on control ditch in which components of a reactionary mix are brought, but instead of hydrogen peroxide –the same quantity of water (0,5 ml). Optical density of solutions measure at 470 nanometers (a maximum of tetragvayacole absorption).

POLYPHENOLOXIDASE ACTIVITY DEFINITION

AT WORK WITH PHENOLASES IT IS NECESSARY TO REMEMBER, THAT FOR CREATING THE CONDITIONS INTERFERING REACTION ENDOGENE PHENOLES WITH FIBERS AND ENZYMES, IT IS IMPORTANT TO ADD POLYAMIDE ON THE FIRST STAGES OF TISSUE HOMOGENIZATION. USUALLY PARITY BETWEEN EXAMPLE OF TISSUE AND POLYAMIDE IS 1:0,5 OR 1:1.

Activity of polyphenoloxidase is defined by a spectrophotometric method, which is based on measurement optical densityof the reaction products which have formed at oxidation of pirocatexine (or other substratum) for the certain time interval.

Reactants: 1/15 m phosphatic buffer with pн 7,4; 0,05 m of pirocatexine solution.

Course of the analysis. Example of a vegetative material weighting 100-200 mg pound in a porcelain mortar at presence of poliamide [16] (50-100 mg) and a buffer solution, transfer to a measured flask of 25 ml and lead up with a buffer solution to a mark. Centrifugate at 4000 rev/min during 10 minutes. At work with protein (acetone) preparations of enzyme prepare solutions with fiber concentration of 20-30 mg/ml.

Into experimental ditch of spectrophotometer bring 0,5 sm3 of fermental extract, 2,0 ml of phosphatic buffer with ph 7,4 and 0,5 ml of pirocatexine solution. With the first drop of pirocatexine start the timer. The first measurement is carried out in 20 seconds. Measurements are carried out every 20 seconds during 2 minutes.

Preliminary establish zero position of an arrow of the ammeter of the device (spectrophotometer) on control ditch in which bring the same components of a reactionary mix, but instead of pirocatexine pirocatexine add 0,5 ml of H_2O. Optical density measure at 420 nanometers.

Activity of peroxidase and polyphenoloxidase enzymes is expressed in relative units on unit of fiber for 1 min, is defined according to formula of Buzun G.L. and others 1975 [20].

$$A = \frac{(D_2 - D_1)60VV_2}{(t_2 - t_1)\ V_1 н},$$

Where D_1-optical density of the solution in the beginning of experiment (the first measurement); D_2-optical density of a solution in the end of experiment; T_1 and T_2-time in the beginning and in the end of experiment, s; *н*-quantities of fiber, mkg; V-total amount fermental extract, ml; v1 -volume taken for carrying out of reaction, ml; V_2-total amount of liquid in a ditch, ml; 60- seconds minutes convertation factor.

$$A = \frac{(D_2 - D_1)\ 60VV_2}{(T_2 - T_1)\ V_1H},$$

RESULTS

Peroxidase activity definition. Peroxidase (1.11.1.7) plays a great role in breathing process of plants.

The most widespread substrata, on which operates peroxidase in fabrics of plants, are polyphenoles in a free condition or in the form of various combinations (glicozides, tannins) and aromatic amines. Those or other connections peroxidase oxidizes by means of peroxide of hydrogen or any organic peroxides, including peroxide of nonsaturated fat acids and carotin.

The received results are presented in table 1.

Table 1. Activity of peroxidase in comparison with economic-valuable parameters of a mulberry and test silkworm feeding results.

Grade name	General maintenance of fiber, mg/g	Activity of peroxidase, mkg/mg/min	Economic-valuable attributes					Cocoon shell weight, mg	Cocoon productivity from 1g of silkworm,
			Leaf plate weight, g	Leaf size, sm		Average shoot length, sm	Leaf crop from one plant, kg		
				Length	Width				
Oktiabrskiy	0,067±0,003	0,0340±0,91	1,61	14,1	11,8	217,1	1,890	347,0	3,37

Pionerskiy	0,082±0,002	0,0369 ± 1,23	2,32	15,2	13,4	215,0	2,096	372,0	3,29
Uzbekskiy	0,087±0,004	0,0398 ± 1,12	3,12	14,9	12,7	220,2	2,212	339,0	3,32
Selection №A-9-73	0,062±0,001	0,0276±1,34	2,10	14,8	12,7	193,3	1,750	329,0	3,25

Apparently from the table data, general maintenance of fiber at mulberry grades varies from 0,062 up to 0,087 mg/g, thus maintenance of peroxidase activity is high at grades with high maintenance of fiber Uzbek and Pionerskiy, at the same grades the best economic-valuable parameters also are established.

In table 2 the correlation interrelation between peroxidase activity and economic-valuable attributes of model grades of mulberry is presented.

Table 2. Correlation factor (r) between activity of peroxidase enzyme with the basic economic-valuable parameters of mulberry and result of test silkworm feeding

Grade name	Economic-valuable attributes					Cocoon shell weight, mg	Cocoon productivity from 1g of silkworm, kg
	Leaf plate weight, g	Leaf size, sm		Average shoot length, sm	Leaf crop from one plant, kg		
		Length	Width				
Oktiabrskiy	0,64	0,42	0,33	0,72	0,87	-0,23	0,52
Pionerskiy	0,62	0,40	0,32	0,70	0,92	-0,22	0,48
Uzbekskiy	0,72	0,38	0,31	0,77	0,91	-0,33	0,50
Selection №A-9-73	0,58	0,33	0,30	0,74	0,72	-0.24	0,53

Direct highly functional correlation between peroxidase activity and weight of a leaf plate, average shoot length, productivity of leaf and functional correlation with productivity of cocoons received is established at silkworm feeding of examined mulberry grades.

Polyphenoloxidase activity definition

Polyphenoloxidase, or o-diphenolokxidase, or tirosinase (1.10.3.1) as well as peroxidase, plays the major role in respiration of plants, catalysing reaction of polyphenols oxidation.

It is established, that depending on from which source polyphenoloxidase was received, its ability to oxidation of o-diphenol, polyphenols and monophenols is various.

The received results on polyphenoloxidase activity in a leaf in comparison with economic-valuable parameters of mulberry grades are presented in table 3.

Table 3. Polyphenoloxidase activity in comparison with economic-valuable parameters of mulberry and result of test silkworm feeding.

Grade name	General maintenance of fiber, mg/g	Activity of polyphenoloxidase mkg/mg/min	Economic-valuable attributes					Cocoon shell weight, mg	Cocoon productivity from 1g of silkworm, kg
			Leaf plate weight, g	Leaf size, sm		Average shoot length, sm	Leaf crop from one plant, kg		
				Length	Width				
Oktiabrskiy	0,067±0,003	0,0350±0,11	1,61	14,1	11,8	217,1	1,890	347,0	3,37
Pionerskiy	0,082±0,002	0,0409 ± 0,83	2,32	15,2	13,4	215,0	2,096	372,0	3,29

Uzbekskiy	0,087±0,004	0,0428 ± 0,92	3,12	14,9	12,7	220,2	2,212	339,0	3,32
Selection №A-9-73	0,062±0,001	0,0346±1,04	2,10	14,8	12,7	193,3	1,750	329,0	3,25

The presented data in the table specify dependence of the maintenance of the general fiber in a leaf and maintenances of polyphenoloxidase enzyme and high parameters of economic-valuable attributes of mulberry grades. At grades with high productivity of a fodder leaf Pionerskiy and Uzbekskiy the maintenance of the general fiber surpasses grades with smaller productivity (Octiabrskiy and Selection № A-9-73) on 23,0-24,4 %, thus at the same grades the maintenance of polyphenoloxidase enzyme activity from the general fiber maintenance, surpasses on 14,43 - 19,6 % accordingly.

Test silkworm feeding with leafs of the same grades specifies reception of high cocoon crop.

Results concerning correlation factor between activity of polyphenoloxidase enzyme with the basic economic-valuable parameters of mulberry are presented in table 4.

Table 4. Correlation factor (r) between activity of polyphenoloxidase enzyme with the basic economic-valuable parameters of mulberry and result of test silkworm feeding

Grade name	Economic-valuable attributes					Cocoon shell weight, mg	Cocoon productivity from 1g of silkworm, kg
	Leaf plate weight, g	Leaf size, sm		Average shoot length, sm	Leaf crop from one plant, kg		
		Length	Width				
Oktiabrskiy	0,74	0,33	0,30	0,77	0,82	-0,33	0,42
Pionerskiy	0,62	0,41	0,29	0,80	0,78	-0,30	0,42
Uzbekskiy	0,92	0,48	0,38	0,81	0,81	-0,23	0,58
Selection №A-9-73	0,57	0,33	0,26	0,72	0,72	-0,20	0,45

The positive high correlation interrelation between of polyphenoloxidase enzyme activity of a leaf and economic valuable attributes of mulberry is observed at leaf plate weight, average shoot length and leaf productivity.

It was possible to establish less functional correlation between activity of investigated enzyme and the general productivity of the cocoons received at test silkworm feeding.

The received results correspond to literary data, asserting that polyphenoloxidase and peroxidase enzymes concerning enzymes of oxidoreductase group, accelerating metabolic processes in an organism, represent specific albumens, catalysing all metabolic reactions in plants. Speed and direction of biochemical processes depend on enzymes activity. The received results testify to a role of studied enzymes as biochemical markers for an intensification of the selection process, causing various physiological and economic-valuable attributes of mulberry.

According to the received results we came to following conclusions:

It is revealed, that at grades with high productivity of fodder leaf (Pionerskiy and Uzbekskiy), the maintenance of the general fiber and activity of peroxidase and polyphenoloxidase enzymes surpasses grades with lower leaf productivity (Oktiabrskiy and Selection № A-9-73).

Direct highly functional correlation between activity of peroxidase and polyphenoloxidase enzymes and weight of a leaf plate, average shoot length, leaf productivity and functional correlation with cocoon productivity received is established at silkworm feeding of examined mulberry grades.

REFERENCES

1. Grebinskaya M.I., Kuchkarov U, Shkalikova K.I. - Fodder advantage of a radiating mulberry grade Tashkent. "Silk" № 3, 1972.
2. Gatin F.G., Ogurtsov K.S., Asamova M - the New selection mulberry grade SANIISH-35. Increase of sericulture efficiency in Uzbekistan,-1989.-pp.132-135.
3. Astaurov E.L. Citogenetics of silkworm development and its experimental control. - M.: Science, 1968. –p.102
4. Beliaev D.K. About genetic principles in selection of animals. Materials and recommendations in conference on improvement of breeding in animal industries. M: 1966.-pp.47-48.
5. Strunnikov V.A. Development of silkworm efficiency increase methods. Tashkent, 1962. –p. 361
6. Philippovich U.B. Egorova T.A., Klunova S.M. Works of Central Asian Institute of Sericulture. Tashkent, 1978. - Vol.12. -p.43-59.
7. Egorova T.A., Vasileva L.E., Nasirillaev U.N. Biochemistry of insects //Scientific works of Pedagogical Institute - 1978, - Vol.103.-p.65-72.
8. Egorov-T.A, Fermental systems of silkworm tissues (in theory and practical aspects).M:-1983. – pp.422.

9. Egorova T.A., Khomidy KH.S. Clearing and properties of membrane-connected forms of tregalase in silkworm eggs. // Biochemistry-1991.-Vol.56.-Issue.8.-p.1374-1384.

10. Egorova T.A., Khomidy KH.S.Tregalaza of silkworm *Bombyx mori* L. //J General biology.-1992.-Vol.53.-№ 4.-p.615-632.

11. Tikhonov V.K. Problems of theoretical and applied genetics. - Novosibirsk: Institute of cytology and genetics AS of the USSR, 1973,-p.328-350.
12. Bekmuratova, Aleksandrov M.V. // Silk. - 1970. - № 3.-C.16-17.
13. Kirpichnikov V.S. Genetic bases of fishes selection. - L.: Science, 1979. -p. 391.
14. Kushner K.F., Zubareva L.A., etc. Polymorphism of proteins and its value in genetics and selection of animals. - M.: - 1968.-p.128.
15. Kushner KH.F. Success of modern biology. - 1973. - Vol.75.-
Issue.2.-p.236-247.
16. Smirnov O.K. Early definition of animals efficiency -M.: -1974. – pp.111.
17. Smirnov O.K. Activity of blood enzymes and their role in a problem of early efficiency diagnostics of agricultural animals: Dr. dissertation, - Dubrovitsi, 1970. –p. 421
18. Mashurov A.M. Genetic markers in animals selection: Dr. dissertation -M.-1981. – p.53
19. Khomidi Kh.S., Ogurtsov K., Khalmatov D. Frost resistance of mulberry and its definition. // Scientific bases of Sericulture development in Uzbekistan. "Science", Tashkent, 2001.-p.12-15.
20. Buzin G.L., Jtmukhagze K.M., Mileshko L.F., Gelashvily N.N. Methods of modern biochemistry. M: -1975.-p.19-20.

Genetic resources of the silkworm in Ukraine. A level of scrutiny and prospects of use

By

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Creation of a modern Ukrainian collection of breeds of a silkworm has a 75-years history. According to contemporary records of 383 breeds was in collection fund of laboratory of selection since 1932 and only 122 breeds are totaled for today.

Foreign breeds make the most part of a collection (63 %). It mainly white cocoon monovoltine breeds not having characteristic phenotypic markers. Exception the breeds having color cocoons (Din-Guan, Si-Chuan, Bonde, Green) make only, distinctive painting of caterpillars (Bukhara, Magellan, French), sexual differentiation on color грены (№21, №22, C-13, Soviet 5, Soviet 5 NGL, C-8 NGL, C-14 NGL).

Work on gathering and the analysis of the information on an origin of collection breeds, their genealogical and morphological communications till now was not carried out. The basic efforts of employees of laboratory have been directed to last 20-30 years on creation of domestic breeds for industrial hybridization. 45 breeds of the Ukrainian selection are present in collection fund and among them 12 breeds-components of modern hybrids.

Taking into account an insufficient level of scrutiny of genetic resources of a silkworm of Ukraine, the following problems have been put:

1. To investigate genealogic structure of collection breeds (2007-2008).
2. To lead ordering collection breeds to morphological attributes at various stages of development of a silkworm (2008).
3. To analyse scientific development on genetic identification agricultural breeds of animals and grades of plants (2007).
4. To make selection of markers of molecular diagnostics and to develop techniques of their carrying out on a silkworm (2008).
5. To define breeds-specific genetic markers of a silkworm (2009).
6. To develop structure of preservation and the organization of the information on a genofund of a silkworm in computer databases by means of the program "Access" (2007).
7. To create databases of genetic resources of a silkworm of Ukraine (2008-2009).
8. To make a complex estimation of a level of ecological adaptability of breeds of a silkworm on parameters of viability of caterpillars and weight of a cocoon. To develop the qualitative forecast of viability of a silkworm for various groups of breeds for 2008-2010 years.

Theoretical and practical bases of adaptive selection of the silkworm in Azerbaijan

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ABSTRACT
As a result of long-term experimental and analytical researches are developed theoretical bases and practical methods of creation of new breeds of a silkworm, tolerant to adverse rearing conditions. Following theoretical preconditions of adaptive selection are established: a) There is high enough variability of adaptive ability between families, breeds and hybrids of a silkworm on productivity; b) Adaptive ability is inherited is intermediate, that testifies to its polygenic character; c) Correlation between adaptive ability and productivity of a silkworm very weak. Two new parameters are developed for conducting adaptive selection: coefficient of ecological stability (CES) and an index of selection value of a genotype (ISVG) families of a silkworm. On the basis of theoretical and practical preconditions the method of adaptive selection of a silkworm for the first time is developed. By this method creates 4 new breeds of a silkworm which are very steady against adverse conditions of an environment and at the same time, possess high productivity.
Keywords: silkworm, adaptive selection, , tolerant, adverse rearing conditions

INTRODUCTION

In conditions of development of market economy in Azerbaijan, private subsidiary and farms became a basis for the organization of manufacture of cocoons - the important raw material for to the silk-reeling industry, and used breeds and hybrids of a silkworm - the most important elements of a technological complex of an intensification of sericulture in the country. Therefore, for maintenance of steady development sericulture, creation and use of new highly productive breeds and hybrids of a silkworm with the raised adaptability and combining high genetic potential to the basic economic characters with stability of its realization in various conditions of environment is required.

Creation of breeds and hybrids with high adaptive potential was braked by a weak level of scrutiny on a silkworm of genetic laws of reaction and stability of genotypes of a silkworm on various changes of an environment, methods of an estimation of stability (plasticity, stability, the general and specific adaptive ability), and also absence of theoretically proved methods of selection for optimization of these important properties of a silkworm. Separate researches were however, carried out in Uzbekistan - on studying interaction of a genotype with environment /5,6,7/in Ukraine - on studying parameters of ecological stability and plasticity of breeds of a silkworm/12,13/, in Bulgaria - on studying tolerance of hybrids of a silkworm to provocative conditions of environment/10/. However, it is not enough of it for a theoretical substantiation and development of methods of adaptive selection of a silkworm.

Proceeding from importance of a problem, we, since 1991, carried out experimental and analytical researches on studying parameters of the general and specific adaptive ability and ecological stability of the Azerbaijan breeds and hybrids of a silkworm on productivity of fresh cocoons and raw silks. Ecological tests were spent on six breeds and thirteen hybrids of a silkworm in four various conditions of environment. Materials, methods and results of these experiences are in detail described by us earlier/1,2/. On the basis of results of these experiences we formulate and establish necessary theoretical and methodical preconditions of adaptive selection of a silkworm, methods of creation of steady breeds of a silkworm which are presentation below are developed and experimentally tested.

1. Theoretical and methodical preconditions of adaptive selection of a silkworm

Realization of adaptive selection of a silkworm probably only at presence of the certain theoretical and methodical preconditions. Most important of them, in our opinion, are the following:

1.1. Existence of sufficient variability between genotypes (families, breeds, hybrids, etc.) a silkworm on ecological stability. At absence of variability it is impossible to improve by selection any characters of alive objects, including ecological stability;

1.2. Absence of strong negative correlation between efficiency and ecological stability at genotypes (families, breeds, hybrids) a silkworm. At presence of strong negative correlation between productivity and its stability simultaneous improvement of both properties by selection is impossible;

1.3. Presence of special parameter for an estimation of ecological stability of genotypes (families, breeds and hybrids) a silkworm by results of their test in two conditions of environment ;

1.4. Presence of the complex selection index including productivity and stability of the estimated genotype, by means of which it would be possible to select simultaneously more productive and stable genotypes (families, breeds or hybrids) a silkworm .

Before to pass to the analysis and discussion of the formulated preconditions of adaptive selection of a silkworm, we shall specify, that the parameters presented in tables 1 and 2, mean the following: $\overline{X}_i$ - average productivity of alive cocoons and raw silks by 1 gram of caterpillars from four conditions of environment; S_{gi}- a parameter of relative stability of the genotype, calculated on method Kilchevsky and Khotyleva/8,9/; ES_i- coefficient of ecological stability of the genotype, calculated on our method; SVG_i- an index of selection value of the genotype, calculated on method Kilchevsky and Khotyleva /8,9/; SI_i - an index of selection value of the genotype, calculated on our method.

Now there are some methods for definition of parameters of ecological stability of genotypes of plants/3,4,8,9,14 / among which the highest accuracy and scientific validity parameter S_{gi} by Kilchevsky and Khotyleva /8,9/differs. Therefore, we shall take advantage of this parameter for finding-out of the first precondition of adaptive selection of a silkworm, i.e. for finding-out of a degree of variability (variety) of ecological stability between breeds and hybrids of a silkworm. The comparative analysis of ecological stability on fresh cocoon yield of breeds and hybrids (table 1) shows, that numerical values S_{gi} at breeds within the limits of 4.76 - 8.50, and at hybrids within the limits of 4.32 - 9.51. At breeds difference Sgi makes 1.8 times, and at hybrids 2.2 times that specifies presence enough to high variability between breeds and hybrids on a degree of ecological stability of fresh cocoon yield. Variability of ecological stability between breeds and hybrids raw silk yield (table 2) still above. Numerical values S_{gi} on raw silk yield is at breeds within the limits of 3.77 - 8.40 (a difference in 2.2 times), and at hybrids within the limits of 2.42 - 11.45 (a difference in 4.7 times). It shows all, that the first precondition of adaptive selection is satisfied.

The second precondition of adaptive selection consists that there should not be a strong negative correlation between efficiency and its stability, otherwise at improvement of one of them another will be will worsen. We have applied the correlation analysis to finding-out of this question. Coefficient of correlation (r) and determination ($d=r^2$) between parameters of average productivity ($\overline{X}_i$) and ecological stability (S_{gi}) with use of the given 19 genotypes (six breeds and thirteen hybrids) a silkworm (table 3) have been calculated. It was found out, that coefficient of correlation (r =-0.068) and determination (d=0.005) between average productivity of fresh cocoon and their ecological stability are close to zero. Between average productivity of raw silk and parameter of ecological stability (S_{gi}) the coefficient of correlation is equal r =-0.412. If to consider, that the below numerical value S_{gi}, the above ecological stability of a genotype it is possible to approve, that between productivity of raw silk and its ecological stability there is a positive correlation. However, the coefficient of determination (d=0.170) shows, that interference of these characters makes no more than 17.0 % that is practically insignificant. Thus, the received results show, that productive characters and them ecological stability are independent from each other. Hence, the second precondition of adaptive selection of a silkworm is carried out also.

Now, we shall consider the third precondition of adaptive selection of a silkworm. We already specified, that there are some methods for definition of parameters of ecological stability of genotypes at plants/3,4,8,9,14/. These methods can be used in ecological researches of a silkworm. However, their use in adaptive selection of a silkworm is unsuitable for the several reasons. First, for definition of parameters of ecological stability on these methods, performance of great volume of complex calculations that demands the certain mathematical preparation from breeders is necessary. Secondly, by means of these methods not probably to define parameters of

Table 1. Parameters of productivity, ecological stability and selection value of breeds and hybrids of a silkworm on fresh cocoon yield by 1 gram of caterpillars

Breeds and hybrids	$\bar{X}_{и}$	$С_{эи}$	$EC_{и}$ т м	$СВЭ_{и}$	$SI_{и}$
Mayak 1	4.89	6.54	0.851 ± 0,004	4.25	4.16
Mayak 2	5.24	5.46	0.883 ± 0.006	4.67	4.63
Mayak 3	5.12	6.52	0.855 ± 0.002	4.45	4.38
Mayak 6	5.02	8.50	0.811 ± 0.008	4.17	4.06
Sheki 1	4.87	4.76	0.890 ± 0.024	4.41	4.33
Sheki 2	4.79	7.95	0.823 ± 0.016	4.03	3.94
Average on breeds	4.99	6.62	0.852 ± 0.015	4.33	4.25
Mayak 2 x Sheki 1	5.41	4.32	0.914 ± 0.016	4.94	4.94
Sheki 1 x Mayak 2	5.12	4.92	0.893 ± 0.008	4.62	4.57
Mayak 2 x Mayak 3	5.24	5.50	0.874± 0.009	4.66	4.58
Mayak 3 x Mayak 2	5.16	5.16	0.882 ± 0.007	4.63	4.55
Mayak 2 x Sheki 2	5.23	8.09	0.818 ± 0.008	4.38	4.28
Sheki 2 x Mayak 2	5,00	7,42	0.835 ± 0.008	4.26	4.18
Mayak 1 x Mayak 3	5.10	6.59	0.852 ± 0.013	4.43	4.34
Mayak 3 x Mayak 1	5.10	7.35	0.836 ± 0.006	4.35	4.26
Mayak 1 x Sheki 2	5.35	9.01	0.800 ± 0.014	4.39	4.28
Sheki 2 x Mayak 1	4.99	9.18	0.797 ± 0.002	4.07	3.98
Mayak 6 x Sheki 2	5.44	8.80	0.804 ± 0.006	4.48	4.37
Sheki 2 x Mayak 6	5.12	9.51	0.790 ± 0.012	4.15	4.04
Sheki 1 x Sheki 2	4.93	7.95	0.825 ± 0.006	4.15	4.07
Average on hybrids	5.17	7.22	0.840 ± 0.010	4.42	4.34

ecological stability of separately taken genotype, i.e. it is necessary to include some genotypes in the analysis. At last, the third and main reason consists that all these methods demand carrying

out of ecological tests of studied genotypes at least in three conditions of environment. It is unacceptable for adaptive selection of a silkworm, especially at application family breeding. However, basically it is possible to divide each family of a selection population into 3-4 parts and to bring up each of them in various conditions of environment. However, it not really also

will create greater difficulties for normal performance of selection works.Therefore, we have offered a simple method for definition of ecological stability of genotypes (families, breeds and hybrids) on the basis of test only in two conditions of environment. According to this method, the coefficient of ecological stability of each genotype (family, breed and a hybrid) to any selection character and its mistake by below-mentioned formulas all over again is calculated:

$$ES_i = \overline{X}_i^{unf} : \overline{X}_i^{fav} \quad (1) \qquad m_{ES_i} = ES_i\sqrt{\left(m_{\overline{X}_i}^{unf} : \overline{X}_i^{unf}\right)^2 + \left(m_{\overline{X}_i}^{fav} : \overline{X}_i^{fav}\right)^2} \quad (2)$$

Where ES_i- coefficient of ecological stability of i genotype to an analyzed character;

$\overline{X}_i^{unf}$ - an average estimation of an analyzed character of a i genotype in adverse (unfavorable) condition of environment ;

$\overline{X}_i^{fav}$ - an average estimation of an analyzed character of a i genotype in favorable conditions of environment;

m_{ES_i} - a mistake of coefficient of ecological stability of a genotype;

$m_{\overline{X}_i}^{unf}$ - a mistake of average of an analyzed character in the adverse environment;

$m_{\overline{X}_i}^{fav}$ - a mistake of average of an analyzed character in the favorable environment.

Mistakes of an average estimation in adverse and favorable environments it is calculated by a usual biometric method/11/.

The average coefficient of ecological stability and its mistake are calculated by following formulas

$$ES_{average} = \sum_{i=1}^{n} ES_i : n \quad (3); \qquad m_{ES_{av}} = \sqrt{\sum_{i=1}^{n} m_{ES_i}^2 : n} \quad (4)$$

Where n - quantity of genotypes (families, breeds or hybrids).

For check accuracy of the coefficient of ecological stability offered by us calculated coefficient of correlation and determination between our parameter *ECi* and parameter S_{gi} by Kilchevsky and Khotyleva according to table 1 and 2. Apparently from data of table 3, correlation between both in parameters of ecological stability is available very strong correlation (-0.996 and-0.985), significant at p > 0.999. Coefficient of determination (0.992 and 0.970) show, that accuracy both parameters coincide on 97.0-99.2 %. Thus, the method of definition of ecological stability offered by us on the accuracy does not concede to method Kilchevsky-Khotyleva, to the most exact among existing methods and satisfies the requirement of the third precondition of adaptive selection of a silkworm.

The fourth precondition of adaptive selection of a silkworm demands presence of a complex index for selection of the genotypes combining high productivity and stability. Such index is developed by Kilchevsky and Khotyleva /8.9/. However, this index of selection value it is possible to apply only under condition of test of genotypes not less, than in three various environments. Therefore, we offer an index (*SI*) for definition of selection value of genotypes of a silkworm by results of test in two various environments. This index is calculated under the following simple formula:

$$SI_u = EC_u\,(\overline{X}_i^{unf} + \overline{X}_i^{fav}) : 2 \quad (5)$$

Apparently, for definition of an index of selection value of genotypes under the formula (5), the nobility average estimations of an analyzed attribute of genotypes in the adverse and favorable environment as coefficient of ecological stability of a genotype (ES) too is defined on the basis of these average estimations under the formula (1) suffices.

The offered selection index is used as follows. First the index of selection value of each genotype (SI_i) is calculated. Then, average selection value of all genotypes ($SI_{aver.}$) is calculated :

$$SI_{aver} = \sum_{i=1}^{n} SI_i : \text{n} \quad (6)$$

After that selection value of each genotype (SI_i) is compared to average selection value of all genotypes (SI_{aver}) and the necessary quantity of the best genotypes is selected.

For check of suitability and accuracy, the index offered by us (SI) compared to a similar index (SVG) Kilchevsky-Khotyleva by calculation of coefficient of correlation and determination

Table 2. Parameters of productivity, ecological stability and selection value of breeds and hybrids of a silkworm on raw silk yield by 1 gram of caterpillars

Breeds and hybrids	$\bar{X}_и$	$C_{эи}$	$EC_и$ т м	$СВЭ_и$	$SI_и$
Mayak 1	886	5.50	0.873 ± 0,026	789	773
Mayak 2	978	3.77	0.910 ± 0.010	904	890
Mayak 3	947	4.96	0.883 ± 0.013	853	836
Mayak 6	896	8.40	0.813 ± 0.012	745	728
Sheki 1	862	4.41	0.903 ± 0.022	786	778
Sheki 2	833	8.40	0.822 ± 0.010	693	685
Average on breeds	900	5.91	0.867 ± 0.017	795	782
Mayak 2 x Sheki 1	982	2.42	0.949 ± 0.018	934	932
Sheki 1 x Mayak 2	938	4.21	0.919 ± 0.028	859	862
Mayak 2 x Mayak 3	979	3.74	0.906 ± 0.015	906	887
Mayak 3 x Mayak 2	970	4.33	0.896± 0.022	886	869
Mayak 2 x Sheki 2	938	6.71	0.844 ± 0.010	803	783
Sheki 2 x Mayak 2	908	6.42	0.856 ± 0.015	791	777
Mayak 1 x Mayak 3	920	5.40	0.893 ± 0.017	821	822
Mayak 3 x Mayak 1	916	6.15	0.886 ± 0.026	803	812
Mayak 1 x Sheki 2	945	9.52	0.809 ± 0.022	765	764
Sheki 2 x Mayak 1	882	8.91	0.801 ± 0.023	725	706
Mayak 6 x Sheki 2	946	11.45	0.755 ± 0.010	729	714
Sheki 2 x Mayak 6	910	9.77	0.795 ± 0.034	732	723
Sheki 1 x Sheki 2	878	7.22	0.836 ± 0.022	751	734
Average on hybrids	931	6.63	0.857 ± 0.021	808	799

Table 3. Coefficients of correlation (r) and determination ($d= r^2$) between parameters of productivity, ecological stability and selection value at breeds and hybrids of a silkworm.

Parameters	Fresh cocoon yield		Raw silk yield	
	р	д	р	д
$X_и$ - $C_{эи}$	-0.068	0.005	-0.412	0.170
$X_и$ – $СВЭ_и$	+0.696	0.484	+0.788	0.621
$C_{эи}$ - $СВЭ_и$	- 0.764***	0.584	-0.877***	0.769
$EC_и$ - $C_{эи}$	-0.996***	0.992	-0.985***	0.970
$EC_и$ - $X_и$	+0.102	0.010	+0.402	0.162
$SI_и$ - $СВЭ_и$	+0.997***	0.994	+0.993***	0.986

$SI_и - X_и$	+ 0.665**	0.442	+0.781***	0.610
$SI_и - EC_и$	+0.810***	0.656	+0.885***	0.783

Foot-note: ** - p > 0.99; *** - p > 0.999

between them on the basis of data of table 1 and 2. It is established, that between both selection indexes is available strong correlation (+0.997 and +0.993) and determination (0.994 and 0.986) dependence (table 3). It means, that offered by us the index (*SI*) to be flush with an index (*SVG*) Kilchevsky-Khotyleva on the accuracy and satisfies the fourth precondition of adaptive selection of a silkworm.

2.Experimental test of methods of adaptive selection of a silkworm

Presence of the necessary theoretical and methodical preconditions have opened an opportunity for experimental check of efficiency of adaptive selection of a silkworm.

Selection experiments were spent during 2001 - 2006. As a selection material for experiments line KN allocated from the Chinese hybrid. Then, since 2002 in the beginning has been taken, three more lines have been included in experiment: line KM-2 (the Chinese hybrid x the Mayak- 2), line MU - 51 (the Mayak- 5 x Ukraine - 1) and line MR - 52 (the Mayak- 5 x Rahimli- 2).

Selection work with line KN carried out as follows: Applied family breeding of a selection material. The quantity of families in a line changed on generations within the limits of 20 -32. Each family of a selection line during 1^{st}-3^{rd} instars contained in optimum (favorable) rearing conditions, accepted for breeds and hybrids in Azerbaijan. At the third instar each family divided into two half on 100 - 150 caterpillars in everyone. Then, during the fourth and fifth instar one half of all families contained in optimum (standard) conditions bring up, and other half of all families contained in adverse(unfavorable) conditions of rearing (temperature 26 - 27 ^{0} C, relative humidity 55 - 60 %, feeding amount and rearing spase- reduced by 30 - 35 %). As the basic characters of adaptive selection used fresh cocoon weight and cocoon shell weight. In the end rearing defined (the standard methods) all biological and technological characters of a line, including average weight of an fresh cocoon and an shell of families in favorable and adverse conditions of environment, and also coefficients of ecological stability and indexes of selection value of families on weight of an fresh cocoon and shell.Applied three-stage selection. At the first step from among all families selected 10 - 12 best families possessing with the highest indexes of selection value on weight of an fresh cocoon. At the second step selected 5 - 6 families with the highest indexes of selection value on weight shell. At the third step in these families spent individual selection of cocoons. From each family selected on 10 - 12 cocoons – female and as much cocoons – male with the highest shell ratio(at this step breeders can spend selection to any quantitative characters of a cocoon, depending on the purposes and problems).

First we shall consider results of adaptive selection of a silkworm on the basis of test of families in two conditions of environment on an example of line KN. For this purpose we shall track changes of the basic selected characters, of average weight of an fresh cocoon and shell of a line in adverse ($\overline{X}_i^{unf}$)and optimum ($\overline{X}_i^{fav}$) conditions of rearing, and also coefficients of ecological stability of these characters in consecutive generations lines KN (table 4). For objectivity of comparison, in this table data of those generations who are brought up on spring seasons are presented. Comparison of these data shows, that from the second generation to the tenth generation there is a gradual improvement of average weight of an fresh cocoon of a line both in adverse ($\overline{X}_i^{unf}$) environment and in optimum ($\overline{X}_i^{fav}$) environment. However, in adverse ($\overline{X}_i^{unf}$) environment improvement of this character is more, than in optimum ($\overline{X}_i^{fav}$) environment that speaks improvement of ecological stability of this character. Noticeably, that in 2003 and 2005 average weight of a fresh cocoon a little below, than the last years. The reason of it consists that agriclimatic conditions these years were very adverse for mulberry silkworm. As a whole, efficiency of adaptive selection to the given attribute it is obvious. In the tenth generation, the average weight of a fresh cocoon has improved in the adverse environment on 25.9 %, and in the Table 4. Change of weight of a fresh cocoon and cocoon shell and coefficients their ecological stability under action of adaptive selection in consecutive generations at line KN

Generation, rearing season and year	Fresh cocoon weight			Shell weight		
	$X_{ПР}$	$X_{ОР}$	EC	$X_{ПР}$	$X_{ОР}$	EC
$Ф_2$ – spring, 2001	1.66	1.89	0.878	369	424	0.870
$Ф_4$ – spring, 2002	1.80	1.96	0.918	428	469	0.912
$Ф_5$ - spring, 2003	1.77	1.94	0.912	438	477	0.918
$Ф_7$ - spring, 2004	1.92	2.10	0.914	472	512	0.922
$Ф_8$ – spring, 2005	1.91	2.04	0.936	462	492	0.939
$Ф_{10}$ – spring, 2006	2.09	2.16	0.968	483	488	0.990
Effect of selection, in % to F_2	125.9	114.3	110.2	130.9	115.1	113.8

optimum environment on 14.3 %. Ecological stability of this character has improved on 10.2 %. The similar situation is observed and on average weight of a shell. Improvement of this character in the tenth generation has made in adverse environment of 30.9 %, and in optimum environment of 15.1 %. Ecological stability of shell weight has improved on 13.8 %. Thus, results of the lead experiment testify to the big efficiency of adaptive selection on the basis of test of families in two conditions of environment.

During selection experiments, in 2002, we had been revealed existence at all four lines (KN, KM-2, MU-51 and MR-52) very strong positive correlation between average weight of a fresh cocoon of family in adverse ($\overline{X}_i^{unf}$) environment and an index of selection value of family (SVG) to this character (within the limits of from + 0.935 up to + 0.970), and also between average weight of shell of family in the adverse environment and an index of selection value of family to this character (within the limits of from + 0.946 up to + 0.974). Such strong correlation specified an opportunity of conducting adaptive selection of a silkworm only in one, adverse environment. For research of this question selection work with lines KM-2, MU-51 and MR-52 spent as follows. During the fourth and fifth instar selection families of all lines contained in adverse conditions of rearing, specified above. For monitoring changes of genetic potential and definition of ecological stability of the basic selected characters of lines, at the third instar formed representative control populations from each line are counted 4 replicates,consisting of 200 caterpillars in everyone for what in each frequency included till 8-10 caterpillars from each family of a corresponding line. Control populations of lines during the fourth and fifth instar contained in optimum (standard) conditions of rearing. Upon termination of rearing spent three-stage selection. First selected 10-12 families with the highest average weight of a fresh cocoon. Then, selected 5-6 families with the highest average weight of shell. Inside of these families spent individual selection of cocoons on shell ratio. Other conditions of selection experiment corresponded to the conditions described above for line KN.

Now, we shall consider results of the adaptive selection, lead in adverse conditions of environment (table 5). Apparently from the data presented in table 5, all lines have an increase in average weight of a fresh cocoon and shell from the second generation to the eighth generation both in the adverse environment, and in the optimum environment. The relative increase in weight of an fresh cocoon and shell in the adverse environment is more, than in the optimum environment, as a result of increase of ecological stability of these characters at all lines. The average weight of a fresh cocoon in the eighth generation, in comparison with the second generation, has increased in the adverse environment on 7.5-16.0 %, in the optimum environment on 1.3-8.4 %. The average weight of a shell has increased in the adverse environment on 14.3-16.2 %, in the optimum environment on 8.5-8.8 %. Rather the greater

Table 5. Change of weight of a fresh cocoon and shell and coefficients of their ecological stability under action of adaptive selection in consecutive generations at lines KM-2, MU-51 and MR-52

Generation, rearing season and year	Fresh cocoon weight			Shell weight		
	$X_{\Pi P}$	X_{OP}	EC	$X_{\Pi P}$	X_{OP}	EC
Line КМ-2						
$Ф_2$ – spring , 2002	1.90	2.09	0.912	427	474	0.901
$Ф_3$ – spring, 2003	1.99	2.25	0.884	466	520	0.896
$Ф_5$ – spring, 2004	2.05	2.25	0.911	488	528	0.924
$Ф_6$ – spring, 2005	2.02	2.16	0.935	470	500	0.940
$Ф_8$ – spring, 2006	2.16	2.19	0.986	488	498	0.980
Effect of selection, in % to F_2	113.7	104.8	108.1	114.3	105.1	108.8
Line МУ - 51						
$Ф_2$ – spring , 2002	2.12	2.32.	0.916	444	492	0.903
$Ф_3$ – spring, 2003	2.02	2.24	0.902	448	497	0.901
$Ф_5$ – spring, 2004	2.17	2.38	0.912	496	528	0.939
$Ф_6$ – spring, 2005	2.03	2.13	0.953	470	488	0.963
$Ф_8$ – spring, 2006	2.28	2.35	0.970	516	526	0.981
Effect of selection, in % to F_2	107.5	101.3	105.9	116.2	106.2	108.6
Line МР – 52						
$Ф_2$ – spring , 2002	2.06	2.27	0.910	453	498	0.913
$Ф_3$ – spring, 2003	2.09	2.36	0.886	466	515	0.905
$Ф_5$ – spring, 2004	2.34	2.54	0.921	524	560	0.936
$Ф_6$ – spring, 2005	2.12	2.25	0.942	480	510	0.941
$Ф_8$ – spring, 2006	2.39	2.46	0.972	524	529	0.991
Effect of selection, in % to F_2	116.0	108.4	106.8	115.7	106.2	108.5

increase in average weight of a shell in comparison with weight of a fresh cocoon, in our opinion, speaks higher heritability of weight of a shell, that well known to breeders. Results of the second experiment testify to efficiency of carrying out of adaptive selection of a silkworm in adverse conditions of environment.

Comparison of results of two methods of the adaptive selection lead in two (optimum and adverse) conditions of environment and only in the adverse environment shows, that efficiency of the second method is a little bit less, than the first method. However, it is necessary to consider the following two facts. In the first, adaptive selection was spent on the first method up to the tenth generation, and on the second method up to the eighth generation. In the second, at carrying out of adaptive selection on the second method, only in the adverse environment, it is possible to increase volume of a selected material, and consequently also intensity of selection in 2 times that will lead to increase in efficiency of this method.

As a whole, experiments have passed successfully and have come to the end with creation of four new lines of the silkworm possessing in the raised adaptive potential and high tolerance to adverse conditions of environment. The comparative analysis of the basic biological and technological characters of these lines in - the second and last generation, received in unfavorable and the favorable environment have shown, that there was not only significant improvement of the basic selected characters, i.e. weights of a fresh cocoon and a shell, but also some improvement of other biological and technological characters, that else time confirms efficiency of the methods of adaptive selection applied by us.

CONCLUSIONS

1.Results of long-term experiments have confirmed the validity and legitimacy of theoretical and methodical preconditions of adaptive selection of the silkworm, put forward by us;

2 Two new parameters (coefficient of ecological stability and an index of selection value of genotypes) are developed for adaptive selection of a silkworm which efficiency it is confirmed experimentally;

3.Two methods of adaptive selection of a silkworm are developed:a) a method of selection on the basis of test of genotypes in two (optimum and adverse) environments; b)a method of selection on the basis of test of genotypes in one, adverse environment.

4. Efficiency of both methods of adaptive selection it is confirmed by creation of four new lines of the silkworm possessing in the raised adaptive potential and high tolerance to adverse conditions of environment.

REFERENCES

1. Abbasov B.H. Studying of ecological stability of breeds and hybrids of a silkworm on productivity of cocoons. Proceedings AZNIISh, 2000, v. XV, p.49 – 55 (In Azerbaijanian)
2.Abbasov B.H. Studying of ecological stability of breeds and hybrids of a silkworm on productivity of raw silk. J.Agrarian science of Azerbaijan, 2001, No 3-4, p.60-63 (In Azerbaijanian
3. Еберщарт С.А., Русsел W.A. Stability параметрс фор сомпаринэ вариетес. Ъроп. Съи., 1966, в. 6, № 1, п. 36-40
4. Финлай K.W., Wилкинсон Э.Н. Тще аналйсис оф адаптатион ин плант бреединэ проэрамме. Аустрал. Ж. Аэриъ. Рес., 1963, в. 14, № 6, п. 742-754
5. Кенжайев Б., Насириллайев У. Абоут щеритабилитй оф wеиэщт оф а ъоъоон анд силк сщелл оф расе САНИИSh 17 ундер дифферент сондитионс оф феединг. Ж. Сщелк, 1974, №4, п.12 (In Russian)
6. Kenjayev B., Nasirillayev U. Interaction of a genotype with environment at a silkworm.1.Heritability of productivity characters of a silkworm in various natural- climatic zones. Proceedings SANIISh, 1976, v. 10, p. 83-87 (In Russian)
7. Kenjayev B., Nasirillayev U. Interaction of a genotype with environment at a silkworm. 2. Heritability of productivity characters of a silkworm in various seasons of rearing. Collection " Scientific bases of development of sericulture", Tashkent, 1977, v. 11, p. 146-151(In Russian)
8. Килсщевску А.В., Кщотйлева Л.В. А метщод фор естиматион оф эенотйпес´ адаптиве абилитй анд стабилитй, оф енвиронмент´с диферентиативе абилитй. Ы . Эроундс оф тще метщод. – Эенетиъс, 1985, №9, п. 1481-1490 (In Russian)
9. Килсщевску А.В., Кщотйлева Л.В. А метщод фор естиматион оф эенотйпес´ адаптиве абилитй анд стабилитй, оф енвиронмент´с диферентиативе абилитй. ЫЫ. Нумерисал модел анд диссуссион. Эенетиъс, 1985, № 9, п. 1491-1498 (In Russian)
10. Лазаров Й., Тзенов П., Студй он тще толеранъе оф силкwорм (Бомбйх мори Л.) щйбридс то унфаворабле ъондитионс оф реаринэ. – Булэ. Ж. Аэриъ. Съи., 2000, в. :, №5, п. 589-592
11. Plokhinsky N.A. Biometrics. M.:University of Moscow, 1970, p.367 (In Russian)
12. Shukin A.R. Change of genetic structure population of a silkworm at creation of breeds and hybrids in conditions repeated rearing. PhD thesis, Leningrad-Pushkin 1988,19 p. (In Russian)

13. Shukin A.R., Akimenko L.M. An estimation of plasticity of breeds of a silkworm Shelk, 1988, No 2, p.12-13 (In Russian)
14.Tai G.C.C. Genotypik stability analysis and its application to potato regional trials.Crop.Sci.,1971,v. 11, № 2, p. 184 - 190.

Results of Mulberry Silkworm Clone Selection

By

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ABSTRACT

Scientific Research Institute of Sericulture of Georgia has been leading the studies in the field of mulberry silkworm clone selection. These studies pursue obtaining of parthenoclones of high viability, creation of clone-breed hybrids and their inculcation in industry.

Mulberry silkworm parthenoclones: PK-31, PK-33, PK-43 and clone-breed hybrids: PK-31 x Asga, PK-33 x Asga, PK-43 x Digomi-6, PK-43 x Digomi-7 were obtained by the method of moth partheno-stimulation. The obtained parthenoclones and hybrids are characterized by high biotechnological indices. They are better than the standard and fully meet the modern normative demands fixed for hybrids. Cocoon output per gram worm equals to 5.3-5.8 kg.

F_1 generation is characterized by homogeneous cocoon form, high silk capacity and high silk thread reeling (88%-90%).

Application of parthenoclones in industrial hybrids of mulberry silkworm as one of the components of female sex results in 2.5-fold increase of grain, which provides high profitableness of grain factory activity.

Key words: mulberry silkworm, parthenoclone, hybrid, silkworm cocoon, grain

INTRODUCTION

As it is known the industrial sericulture is based on the use of mulberry silkworm, hybrids, as they are characterized by more productivity and vitality compared with the pure species. To produce industrial hybrid silkworm eggs (grains) it is necessary to separate cocoons according to sexes, which is realized by special devices (OPC and others) which often make errors while determining the sex.

The problem of separating cocoons according to sexes and producing 100% pure hybrid grains can be solved by using ameiosic parthenogenesis developed by acad. B. Astaurov (1,2,3).

The researches of acad. B.Astaurov were continued and further developed by acad. V.Strunikov to perfect the method of high temperature ameniosic parthenogenetic development of grains either extracted from the abdomen of moths or laid and unimpregnated grains in the moth abdomens influenced by low and combined (low+high) temperatures have been worked out under V.Strunikov's supervision and his directs participation (4).

The experimental researches carried out for the creation of industrial parthenoclones, clone – species hybrids and for the development of biotechnology of parthenogrenage are combined at the Training-Research Institute of Sericulture (Georgia State Agrarian University).

As a result of the above activity highly vital and productive three parthenoclones, three ordinary sexual species (to use as a male component) and 4 clone-species hybrids have been bred. The State Commission for Species Testing has zoned them in Georgia and they are to appear in industry soon.

This fact is essential for the relation and further development of sericulture in Georgia – the country with the best natural and climatic conditions for silkworm breeding and ancient traditions in this branch.

Some indexes of new clones and pure species

Table 1.

No	Clones and Breeds	ПК-31	ПК-33	ASGA	Ukr-14

	Indexes				(standard)
1	Number of grains per gram	1760	1780	1740	1576
2	Grain vivification, %	91,5	92,3	94,3	93,3
3	Number of silkworms per grain	2428	2500	2406	2350
4	Length of worm feeding (days)	30	30	30	30
5	Worm vitality, %	98,3	96,6	97,3	92,5
6	Cocoon harvest per gram worm, (kg)	4,67	4,61	4,72	3,96
7	Average mass of cocoon (g)	1,96	1,91	2,02	1,92
8	Mass of cover (mlg)	430	435	482	384
9	Silk capacity of the live cocoon, %	21,9	22,7	23,9	20,0
10	Length of cocoon filament (m)	1112	1091	1239	1230

Table 2.
Biotechnological indices of clone-species hybrids according to the stationary experiments of three years.

No	Hybrid / Indices	ПК-31 X ASGA	ПК-33 x ASGA	Ukr- 14x15 (standard)
1	Number of grain per gram, pc	1836	1843	1760
2	Grain reanimation, %	97,9	97,6	94,6
3	Number of worm per gram, p	2506	2490	2330
4	Duration of worm feeding, da	30	30	30
5	Worm vital capacity, %	98,6	98,0	95,0
6	Cocoon outcome per gram wo	4,74	4,88	4,42
7	Average mass of live cocoon,	2,03	2,0	2,0
8	Silk capacity of live cocoon,	24,5	24,8	20,9
9	Cocoon outcome from live cocoon, %	42,7	42,9	40,5
10	Silk capacity of air-dry cocoo	49,5	50,0	46,2
11	Yield of raw silk, %	43,7	44,8	40,3
12	Silk thread unwinding capacit	89,1	89,2	88,2
13	Length of cocoon thread, m	1307	1266	1160
14	Thread metric number	3308	3208	3550
15	Approximate output of raw s 1 g worm, gram	780	804	625

Comparatively low silk capacity of clones is quite natural as they contain only female silkworms. As for the dominance over the standard is obvious and they meet normative demands.

In the industrial hybridization the use of parthenoclones is more advantageous compared with ordinary bisexual species. No costly species – selective work is needed in parthenoclone generation and no industrial sorting of cocoons is required for division into sexes.

Besides it provides 100% pure industrial hybrid grains (instead of 30-40% purity). Productivity of industrial grains increases 2,5 times and even more. All the above state results in the high profitability of the grenage industry.

The most important fact is that parthenoclones tend to be highly combinative. Clone-species hybrids are used in industrial feeding which increases cocoons harvest and quality by 15-20%. Primary filament harvest per box of worms (19 g) increases to 3-4 kg compared with the standard.

Nowadays the activities are still in progress to receive highest productive parthenoclones, species marked in grain and worm forms and bilethal lines (to use as a male component in clone-species hybrids) and to perfect biotechnology of parthenoclones.

Breeding of the labeled breeds at the stage of grain and worm and their application in the clone-species hybrids as the male component is very important, since in such a case division of cocoon into sexes at the grenage factory completely excludes the labor consuming jobs, which is needed for separation of ordinary breeds into sexes.

More important is breeding of new genetic bilethal lines and their application in industrial clone-species hybrids as the male component, since spematozoids of new genetic line contain lethal genes, which while impregnating kill zygotes generating female sex, and leave safe zygotes generating male sex, as a result of which the hybrid is obtained only from male sex individuals. It has great significance for industrial sericulture, since the male hybrid compared with the ordinary bisexual hybrid contains 20-25% more silk, and compensating female individuals lost in the grain stage, finally gives high economic effect.

REFERENCES

1. Astaurov B.L. – Artificial parthenogenesis in mulberry silkworm. M.-L., Ed. AS USSR, 1940, p.25
2. Astaurov B.L. – Heredity and development. M., Ed. "Nauka" , 1974, p.116.
3. Astaurov B.L. – Parthenogenesis, androgenesis and polyploidia. M., Ed. "Nauka" , 1977, p.7
4. Strunikov V.A. – Genetic methods of selection and sex regulation in mulberry silkworm. M., Ed. "Agropromizdat", 1987, p.12

Evaluation of new-created sex-limited silkworm *Bombyx mori L.* lines

By

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ABSTRACT

15 new-created sex-limited silkworm races, incl. four sex-marked at eggs stage and 11 sex-marked at larva stage were tested at Regional Centre for Scientific Applied Service, Vratza, Bulgaria during the period of 2001-2003. The evaluation was done by subordinate function, evaluation and total cumulative index methods at phenotype parameters of tenth of most important quantitative selection characters. It was determined that XT215/38 and Vratza2001, sex-limited at eggs stage and Vratza2002, Vratza2003, TBV2/24 and TV3/2, sex-limited at larva stage lines are especially perspective for creation of F_1 industrial hybrids.

Key words: silkworm, *Bombyx mori L.*, sex-limited lines, complex evaluation methods.

INTRODUCTION

One of most essential element of technological complex for intensification of silkworm cocoon production is using of F_1 hybrids with high productive and adaptive potential.

In this aspect during the last 15 years in Bulgaria particularly attention was given on selection of high productive genetically sex-marked at eggs and larva stage lines and their using as initial forms for creation of industrial silkworm hybrids (Petkov, 1993, 1995; Petkov and Natcheva, 1996, 1997; Petkov *et al.*, 2000).

The priorities of hybrids, selected with participation of sex-limited lines are consist not only of full realization the adventitious of hybridization but of simplification and improving of technology for production of absolute free from contamination with initial form industrial (F_1) silkworm eggs.

The aim of the present study was to examine some methods and testing of new-created sex-limited lines in connection to further using the best ones for industrial hybridization.

MATERIALS AND METHODS

The experimental and theoretical work was done at RCSAS- Vratza, Bulgaria during the period of 2001-2003. Object of our investigation was 15 new-created genetically sex-limited silkworm lines, incl. 4 (T15/4, XT215/38, Vratza2001 and Vratza2001b) sex-marked at eggs stage and 11 (B2/6, BTV-2/64, TBV2/24, XB2/21, TV3/2, Vratza2002, Vratza2003, Vratza2005, Vratza2007, Vratza2009 and Vratza2012) sex-marked at larva stage. All lines were reared in 4 repetitions with 200 individuals each.

The testing was done by methods of subordinate function (Fi), evaluation (Ei) and total cumulative (TCi) index at phenotype parameters of tenth of most important quantitative selection characters. The lines were ranked (R) on the basis of total cumulative index, determined as summing of valuation of two index methods.

Testing of lines by subordinate function index was performed using the formula of Gower (1971):

$$Fi = \frac{\overline{X}i - \overline{X}\min}{\overline{X}\max - \overline{X}\min}$$

Where: Fi - subordinate function index;

$\overline{X}i$ - Measurement of character of tested races;

$\overline{X}\,\mathrm{min}$ - The minimum value of the character from all tested races;

$\overline{X}\,\mathrm{max}$ - The maximum value of the character from all tested races.

The evaluation index values character wise were calculated by using the formula of Mano *et al*. (1993):

$$Ei = \frac{10(A-B)}{SD} + 50$$

Where: Ei - evaluation index;

A – Value obtained for a character for a race;

B – Mean of character of all races for the character;

SD – Standard deviation of all races for the character;

10 – Standard unit;

50 – Fixed value.

The races were ranked through the values of total cumulative indices, calculated by the formula:

$$TCi = TFi + TEi$$

Where: TCi – total cumulative index;

TFi – total subordinate function index;

TEi – total evaluation index.

RESULTS AND DISCUSSION

It is well established that silk yield in silkworm is contributed by more 21 characters (Thiagarajan *et al*., 1993) It is therefore obvious that the superiority of silkworm genotype is to be assessed by a number of quantitative characters. In the present study 10 important primary economical quantitative characters are considered and analyze so as to find out the superiority and relative merits of the 15 new created sex-marked silkworm lines.

The mean performance of these races is presented in table 1.

It is evident that BTV2/64, TV3/2 and Vratza2002 lines, which were characterized with relatively high eggs hatchability (96,00%) were arranged at third, sixth and fifth place, respectively on cocoon weight character (2215 mg, 2139 mg and 2157 mg), at third, ninth and second place on shell weight, at fifth, forth and third place on filament length character and at second, fifth and forth place on complex cocoon yield per one box of silkworms character (42.130 kg, 40.461 kg and 40.802 kg).

At this instant Vratza2003 lines, which was found out at first place on cocoon yield per one box (20000±200 viable eggs) (42.272 kg) was just at sixth-seventh place on survival ratio, at forth place on shell ratio (22.90%) and at forth place on eggs hatchability character (98.47%). In this aspect the results obtained are in agreement with other authors, worked with not sex-limited silkworm races (Ramech Babu *et al.,* 2002).

Data for calculated subordinate function indices for each character and total for tested lines are presented in table 2. It is evident that total subordinate function index (TFi), which unites all individual indices (Fi) for all quantitative characters was varied in wide limits, from 2.147 for Vratza2001b to 8.846 for Vratza2003.

On the base of information from total subordinate function indices it is evident that Vratza2003, Vratza2002, Vratza2005 and TBV2/24 lines, with TFi 8.846, 8.080, 7.263 and 6.810, respectively have the highest merits for using in selection programs.

By analogy with values of total subordinate function indices (TFi), the total evaluation indices (TEi) were varied in wide limits, from 42.967 for Vratza2001b line to 59.303 for Vratza2003 line.

It is obvious that tested lines were found at the same position and have the same merit irrespective of methods and formulae for evaluation, which means that they possess the same virtue. This fact gives us good reason to accept used statistical parameters and methods for evaluation of silkworm races and lines as well determined and that the results obtained were real. This coincides to a great extent with established by Ramech Babu et al. (2002) at silkworm hybrids F_1 hybrids.

Data for total cumulative indices, calculated by summing up the values of total subordinate function and total evaluation indices and comparative ranking of tested races are presented in table 4.

The results obtained gives us a reason to recommend Vratza2003, Vratza2002, TB2/24 and TV3/2 sex-marked at larva stage lines with TCi 68.149, 65.839, 60.748 and 59.839, respective and XT215/38 and Vratza2001, sex-marked at eggs stage with TCI 47.482 and 46.175 for creation of new high-productive lines in selection programs and for industrial hybridization,

CONCLUSION

Used by us statistical methods for complex evaluation of new-created sex-marked silkworm lines and their superiority and relative merit find out allow selecting the best ones for selection purposes.

XT215/38 and V2001, sex-marked at eggs stage and Vratza2002, Vratza2003, TBV2/24 and TV3/2, sex-marked at larva stage were identified as the most promising lines, perspective for using in selection programs and for creation of new F_1 industrial hybrids.

REFERENCES

Grower, J. (1971) A general coefficient of similarity and some of its proprieties. Biometrics, 27, p. 857-871.

Mano, Y., Kumar, S., Basavaraja, H., Reddy, N. and Datta, R. (1993) A new method to select promising silkworm breeds combinations, Indian silk, 31, p. 53-54.

Petkov, N. (1993) Possibilities for selection sex-limited silkworm breeds in egg and larva stages, Introduced novelties, 1, p. 10-11.

Petkov, N. (1995) Selection-genetic investigations and results from the silkworm *(Bombyx mori L.)* races, lines and hybrids breeding, Sofia, Thesis for obtaining of the scientific degree Doctor of the Agricultural Science: 305 p.

Petkov, N. and Natcheva, Y. (1997) Possibilities for creation of genetically sex-limited silkworm *(Bombyx mori L.)* races, Journal of Animal Science, 4, p. 23-24.

Petkov, N., and Natcheva, Y. (1996) Sex limited silkworm (Bombyx mori L.) breeds selection, Journal of Animal Science, 3, p. 64-69.

Petkov, N., Natcheva, Y. and Tzenov, P. (2000) The problem of selecting breeds genetically labeled by sex in the egg and larva stages of the silkworm (Bombyx mori L.), Agricultural Science, 4, p. 43-45.

Thiagarajan, V., Bhargava, K., Babu, M., and Nagaraju, B. (1993) Differences in seasonal performance of 26 strains of silkworm, B. mori L., J. Lapiopter. Soc. America, 47, p. 331-337

Table 1. Mean value of some quantitative selection characters

Lines	Eggs hatchability %	Pupation ratio %	Fresh cocoon weight mg	Shell weight mg	Shell ratio %	Cocoon yield per 1 box kg	Filament length m	Filament weight mg	Filament thickness denier	Raw silk ratio %
T15/4	98.23	93.33	1819	384	21.36	33.401	1263.3	402.2	2.86	43.58
XT215/38	98.16	94.00	1840	396	21.88	33.803	1286.2	404.1	2.81	43.65
Vratza2001	98.13	93.33	1906	389	20.25	34.552	1236.3	405.1	2.95	43.77
Vratza2001b	98.07	94.00	1880	383	20.45	34.871	1203.8	403.2	3.01	42.19
B2/6	97.97	94.67	2072	457	22.19	38.672	1240.0	382.3	2.77	42.38
BTV2/64	98.07	96.00	2215	491	22.38	42.130	1284.3	402.3	2.82	43.64
TBV2/24	98.27	95.67	2014	471	23.10	37.933	1297.4	437.1	3.03	44.08
XБ2/22	98.01	94.00	2057	454	22.58	38.331	1237.5	381.4	2.77	41.76
TV3/2	98.17	96.00	2139	457	21.65	40.461	1304.1	427.4	2.95	44.51
Vratza2002	98.13	96.00	2157	498	23.31	40.802	1320.5	445.1	3.03	44.93
Vratza2003	98.47	95.00	2290	519	22.90	42.272	1323.5	451.8	3.07	45.02
Vratza2005	98.77	94.33	2219	480	21.82	35.203	1332.2	448.8	3.03	44.95
Vratza2007	98.23	94.16	2090	489	23.59	38.472	1154.7	399.1	3.11	43.11
Vratza2009	98.81	95.33	2205	473	22.14	40.803	1238.0	401.5	2.92	43.69
Vratza2012	98.65	95.00	2044	423	20.83	38.532	1226.7	400.9	2.94	43.23
Average	98.276	94.72	2063	451	22.03	38.016	1263.2	412.8	2.94	43.63
SD	2.68	2.77	0.161	0.033	1.19	1.847	128	0.022	0.183	1.48

Table 2. Subordinated functional indices

Lines	Eggs hatchability %	Pupation ratio %	Fresh cocoon weight mg	Shell weight mg	Shell ratio %	Cocoon yield per 1 box kg	Filament length m	Filament weight mg	Filament thickness denier	Raw silk ratio %	SFi
T15/4	0.309	0.000	0.000	0.007	0.332	0.000	0.612	0.295	0.265	0.558	2.378
XT215/38	0.226	0.251	0.045	0.096	0.488	0.045	0.741	0.322	0.118	0.579	2.911
Vratza2001	0.190	0.000	0.185	0.044	0.000	0.129	0.459	0.337	0.529	0.617	2.490
Vratza2001b	0.119	0.251	0.129	0.000	0.059	0.165	0.277	0.309	0.706	0.132	2.147
B2/6	0.000	0.502	0.537	0.544	0.581	0.594	0.481	0.013	0.000	0.190	3.442
BTV2/64	0.119	1.000	0.841	0.794	0.638	0.984	0.730	0.297	0.147	0.577	6.127
TBV2/24	0.357	0.876	0.414	0.647	0.853	0.511	0.884	0.791	0.765	0.712	6.810
ХБ2/22	0.048	0.251	0.505	0.522	0.698	0.556	0.466	0.000	0.000	0.000	3.046
TV3/2	0.238	1.000	0.679	0.544	0.419	0.796	0.842	0.653	0.529	0.844	6.544
Vratza2002	0.190	1.000	0.718	0.846	0.916	0.834	0.934	0.905	0.765	0.972	8.080
Vratza2003	0.595	0.625	1.000	1.000	0.793	1.000	0.951	1.000	0.882	1.000	8.846
Vratza2005	0.952	0.375	0.849	0.713	0.470	0.203	1.000	0.957	0.765	0.979	7.263
Vratza2007	0.309	0.311	0.575	0.779	1.000	0.572	0.000	0.251	1.000	0.414	5.211
Vratza2009	1.000	0.749	0.819	0.662	0.566	0.834	0.469	0.286	0.441	0.592	6.418
Vratza2012	0.809	0.625	0.469	0.294	0.174	0.578	0.406	0.277	0.500	0.451	4.583

Table 3. Evaluation indices

Lines	Eggs hatchability %	Pupation ratio %	Fresh cocoon weight mg	Shell weight mg	Shell ratio %	Cocoon yield per 1 box kg	Filament length m	Filament weight mg	Filament thickness denier	Raw silk ratio %	SEi-
T15/4	49.83	44.98	48.48	29.69	44.37	25.01	50.00	45.18	45.63	49.66	43.283
XT215/38	49.57	47.40	48.61	33.33	48.74	27.19	51.79	46.05	42.89	50.14	44.571
Vratza2001	49.46	44.98	49.02	31.21	35.04	31.25	47.89	46.50	50.55	50.95	43.685
Vratza2001b	49.23	47.40	48.86	29.39	36.72	32.97	45.36	45.64	53.83	40.27	42.967
B2/6	48.86	49.82	50.06	51.82	51.34	53.55	48.19	36.14	40.71	41.55	47.204
BTV2/64	49.23	54.62	50.94	62.12	52.94	72.27	51.65	45.23	43.44	50.07	53.251
TBV2/24	49.98	53.43	49.69	56.06	58.99	49.55	52.67	61.05	54.92	53.04	53.938
XБ2/22	49.01	47.40	49.96	50.91	54.62	51.71	47.99	35.73	40.71	37.36	46.540
TV3/2	49.60	54.62	50.47	51.82	46.81	63.24	53.19	56.64	50.55	55.95	53.289
Vratza2002	49.46	54.62	50.58	64.24	60.75	65.08	54.48	64.68	54.92	58.78	57.759
Vratza2003	50.72	51.01	51.41	70.61	57.31	73.04	54.71	67.73	57.10	59.39	59.303
Vratza2005	51.84	44.98	50.97	58.79	48.24	34.77	55.39	66.00	54.92	58.92	52.482
Vratza2007	49.83	47.98	50.17	61.52	63.11	52.47	41.52	43.77	59.29	46.49	51.615
Vratza2009	51.99	52.20	50.88	56.67	50.92	65.09	48.03	44.86	48.91	50.14	51.996
Vratza2012	51.39	51.01	49.88	41.52	39.92	52.79	47.15	44.59	50.00	47.29	47.554

Table 4. Comparative ranking of tested lines

Lines	TSi	TEi	TCi	Rank of the line
T15/4	2.378	43.283	45.661	14
XT215/38	2.911	44.571	47.482	12
Vratza2001	2.490	43.685	46.175	13
Vratza2001b	2.147	42.967	45.114	15
B2/6	3.442	47.204	50.646	10
BTV2/64	6.127	53.251	59.378	6
TBV2/24	6.810	53.938	60.748	3
ХБ2/22	3.046	46.540	49.586	11
TV3/2	6.544	53.289	59.833	4
Vratza2002	8.080	57.759	65.839	2
Vratza2003	8.846	59.303	68.149	1
Vratza2005	7.263	52.482	59.745	5
Vratza2007	5.211	51.615	56.826	8
Vratza2009	6.418	51.996	58.414	7
Vratza2012	4.583	47.554	52.137	9

Mathematical forecasting of selection effect in silkworm Bombyx mori L. on the basis of shell ratio character

By

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ABSTRACT

Individual selection on the basis of shell ratio character in four sex-marked silkworm races was carried out and the generations of chosen parents with highest values along with initial populations were reared. Selection effect was determined as difference between phenotypic value of character at chosen parents and average value of previous population on the basis of realized heritability coefficient and selection differential. It was obtained approximately equal actual and prognostic for chosen parent's generation values. Genetic-selection parameters allow us to develop a program for initial choice on the basis of shell ratio character and will increase the effectiveness of silkworm selection.

Key words: silkworm, selection effect, mathematical forecasting, shell ratio

INTRODUCTION

Using of different mathematical and statistical methods has been uncovered great possibilities for new approaches in silkworm selection (Rokitskii, 1969).

Numerous attempts for forecasting of selection effect in silkworm *Bombyx mori* L. at shell ratio character (Abbasov, Nasirillaev, 1976; Nasirillaev, 1977; Petkov, 1981), cocoon weight (Petkov, 1981), inter-cocoon co-ordination of filament (Natcheva, 1980), shell weight (Natcheva, 1990; Natcheva *et al*., 1997, 2001) have been done.

Selection effect forecasting attains more and more great importance in planning of different schemes and methods for silkworm selection (Natcheva, 1990; Petkov, 1995).

The aim of the present study was to forecast of selection effect at shell ratio character in new-created sex-marked silkworm *Bombyx mori L.* races.

MATERIALS AND METHODS

The study was carried out with four new-created sex-marked silkworm races, T15/4 (at eggs stage) and XT215/38, TBV2/24 и TV3/2 (at larva stage). The races were reared in amount of 4 families with 200 larvae each, counted in the beginning of third larval instar. The generations of chosen parents along with initial populations with zero intensity of selection were reared under the equal conditions.

Mathematical forecasting of selection effect at shell weight character was done with followed formulas:

1. $$R = h_r^2 . S$$
2. $$h_r^2 = \frac{\bar{x}_{gen} - \bar{x}_{pop}}{\bar{x}_{par} - \bar{x}_{pop}}$$
3. $$S = \bar{x}_{par} - \bar{x}_{pop}$$
4. $$\bar{x}_{m.par} = \bar{x}_{par} \pm d$$
5. $$d = \sigma_p . u$$
6. $$i = \frac{R}{\sigma_p . h_r^2}$$

7. $\bar{x}_{prog.} = \bar{x}_{pop} + R$

Where: h_r^2 - Realized heritability coefficient;

S - Selection differential;

R - Selection effect;

$\bar{x}_{gen} - \bar{x}_{pop}$ - Excellence of generation over population;

$\bar{x}_{par} - \bar{x}_{pop}$ - Excellence of parents over population;

$\bar{x}_{t.par}$ - Theoretical value of character for parents for obtaining of generation with planned character value;

$\bar{x}_{pop}$ - Mean population's value;

d – Difference between mean population's value and parent's character value for obtaining of generation with planned character value;

σ_p - Mean square deviation of initial population;

u - Distance which cut Y-axis from average in part of σ, which value is obtained from selection intensity value (i) from table of Nikoro et al. (1968);

i - Intensity of selection;

$\bar{x}_{prog.}$ - Prognostic value of character in generation.

The formulas 1, 2, 3 and 7 were applied by Abbasov, Nasirillaev (1976), Nasirillaev (1977), Petkov (1979)and formulas 4, 5 and 6 were used by Nikoro et al. (1968), Reshetnikova, Kiseleva (1969) and adapted by Natcheva (1980) for inter-cocoon co-ordination character.

RESULTS AND DISCUSSION

Parameters, used for selection effect at shell ratio character forecasting are presented in table 1. Selection effect (R) was determined from heritability coefficient and selection differential. Selection effect in average for two sexes was varied between 0.311% for TV3/2 race and 0.418% for T15/4 race. For both two races selection effect was varied from 0.248% to 0.548% for female individuals and from 0.219% to 0.577% for male ones.

High heritability coefficients, (♀ h_r^2 = 0.590 - 0.637 and ♂ h_r^2 = 0.559-0.595) were determined. Realized coefficient of heritability at female individuals was insignificantly higher in comparison to male individuals, which confirms the established by Petkov (1981; 1995). Analogical tendency was determined for inter-cocoon co-ordination of filament (Natcheva, 1980). High heredity coefficients obtained testify for possibility of high effectiveness of mass choice by families at this character.

Selection differential is other important parameter of selection, which is directly interrelated with intensity of selection (part of selected individuals toward parents) and changeability of population.

The minimal theoretical value for parent's shell ratio character, necessary for obtaining of prognostic selection effect in T15/4 race was 21.065% for female individuals and 25.752% for male individuals and for other three races, XT215/38, TBV2/24 and TV3/2 21.497%, 21.846% and 20.741%, respectively for female individuals and 25.009%, 26.217% and 26.206% for male ones, respectively.

Planned parameters for mathematical forecasting of selection effect in all races manifest equal actual and prognostic values of shell weight characters. The approximate error of prognosis was varied between 0,246 and 0,377 and coincidence of actual and prognostic values of character is proved.

CONCLUSIONS

Applied genetic-selection forecasting method affords an opportunity for determination of selection effect at initial choice for shell ratio character. The approximate error of prognosis was varied between 0,246 and 0,377 and coincidence of actual and prognostic values of character was proved.

Theoretical value of character for parents, necessary for obtaining of planned value of prognostic selection effect was calculated on the basis of genetic-selection parameters.

Genetic-selection parameters, viz. realized coefficient of heritability' selection differential, mean square deviation and intensity of selection obtained allow to develop a substantiated scientific program for initial choice on shell ratio character and to forecast the selection effect.

REFERENCES

Abbasov, B. and Nasirillaev, U. (1976) Prognostication of selection effect on shell ratio character, Shelk, 2, p. 10-11.

Nasirillaev, U. (1977) Heritability of silkworm economical characters, in Genetic basis of medicine and selection, Ac. Sci. Uz.SSR, p. 143-151.

Natcheva, I. (1980) Possibilities for prognostication of selection effectiveness on inter-cocoon co-ordination of filament in *Bombyx mori L.*, Genetics and selection, 3, p. 206-211.

Natcheva, I. (1986) Some parameters of main silkworm *Bombyx mori L.* selection characters. II. Correlations between main selection characters, Genetics and selection, 2, p. 144-150.

Natcheva, I. (1990) Some question at silkworm *Bombyx mori L.* races, lines and hybrids selection, Habilitation work, Sofia.

Natcheva, I., Petkov, N., Tzenov, P., Ignatova, L., Braslavskii, M. and Golovko, V. (1997) Possibilities for mathematical forecasting of silkworm *Bombyx mori L.* selection effect on shell weight character, Animal breeding, 5-6, p. 126-129.

Natcheva, Y., Petkov, N. and Tzenov, P. (2001) Mathematical forecast of breeding effect based on cocoon shell weight index of silkworm *(Bombyx mori L.),* BJAS, 7, p. 345-347.

Nikoro, Z., Stakan, G., Haritonova, Z., Vasileva, L., Ginzburg, E. and Reshetnikova, A. (1968) Theoretical base of animal selection, Kolos, Moscow.

Petkov, N. (1976) Selection of silkworm *Bombyx mori L.* lines and possibilities for creation of hybrids for summer-autumn rearing, PhD dissertation, Sofia.

Petkov, N. (1981) Possibilities for prognostications of silkworm selection effectiveness on shell weight and shell ratio characters, Agricultural science, 2, p. 92-96.

Petkov, N. (1995) Selection-genetic investigations and results from silkworm *Bombyx mori L.* races, lines and hybrids, DS dissertation, Sofia, 305 pp.

Reshetnikova, N. and Kiseleva, Z. (1969) Use of heritability coefficient for prognostication of milk productivity, Questions of mathematical genetics, Minsk, p. 105-112.

Table 1. Genetic-selection parameters at shell weight characters

Lines	Sex	Shell ratio %		h_r^2	σ	R	Shell ratio in generation, %		Relative error	$\bar{x}t.par$
		Initial population	Elite parents				Factual	Prognostic		
T15/4	♀	21.213	21.632	0.618	0.932	0.259	21.472	21.472	0.241	21.065-22.199
	♂	25.164	26.143	0.589	0.889	0.577	25.741	25.741	0.513	25.752-26.534
	♀ + ♂	23.189	23.888	0.604	0.911	0.418	23.607	23.607	0.377	23.409-24.367
XT215/38	♀	20.943	21.593	0.600	0.735	0.390	21.333	21.333	0.287	21.497-21.689
	♂	24.584	25.161	0.567	0.845	0.327	24.911	24.911	0.276	25.009-25.313
	♀ + ♂	22.764	23.377	0.584	0.790	0.359	23.022	23.022	0.281	23.253-23.501
TBV2/24	♀	21.213	22.073	0.637	0.895	0.548	21.761	21.761	0.490	21.849-22.297
	♂	26.423	26.791	0.595	0.857	0.219	26.642	26.642	0.188	26.217-27.365
	♀ + ♂	23.813	24.432	0.616	0.876	0.384	24.202	24.202	0.339	24.033-24.831
TV3/2	♀	20.613	21.033	0.590	0.748	0.248	20.861	20.861	0.186	20.741-21.325
	♂	25.654	26.231	0.559	0.818	0.373	25.937	25.937	0.305	26.206-26.256
	♀ + ♂	23.089	23.632	0.575	0.783	0.311	23.399	23.399	0.246	23.474-23.791

The performances of the hybrids resulted from dialele crossings between the lines selected on the basis of general combinative ability

By

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ABSTRACT
The inbred lines are formed with the aim of being used in crossings to obtain F1 hybrids. It is necessary yet to establish which lines are more suitable for crossing, knowing that the phenotypic effect of the crossings is different and the performance of F1 hybrids depends on the adequate choice of the parents and also on the genetic divergence between them. The analysis of the performances obtained by 30 hybrid combinations realized between the inbred lines and the Tester race allowed the selection of 4 inbred lines, constituting a superior biologic material in the obtaining of commercial hybrids.
Keywords: inbreeding, heterosis, silkworm hybrids, combinative ability

INTRODUCTION

The silk cocoon productions obtained in all the sericultural countries are based on the commercial hybrids exploitation, their superiority to the pure races being demonstrated by many researchers (PETKOV N. and coll., 1979; DAS S.K. and coll. (1994); CRAICIU M. (1965); ANA BRASLĂ and coll. (1992); ALEXANDRA MATEI and coll. (2002)). As in the case of the other animal species, the extention into production of the silkworm hybrids is based on the heterosis. A series of characters specific to the different stages of silkworm development influence the silk quantity obtained. However, the characters presenting a stronger heterosis are: the duration of the larval period, the viability of larvae, cocoon weight, shell cocoon weight, filament length, filament weight.

MATERIALS AND METHODS

The first selection of the inbred lines extracted from White Baneasa was made in C_4 on the basis of the results obtained following their crossing with the Tester race (general combinative ability), resulting a total number of 30 hybrid combinations. The selection was based on the performances obtained by the resulted hybrids, fact concretized by the selection of 4 inbred lines. In C_6 the dialele crossing of the inbred lines selected in the previous stage and the study of their specific combinative ability took place. The observations were extended on a total number of 12 hybrids. The volume of the samples for each hybrid used in determinations was: in the egg stage - 3 repetitions x 500 eggs/experimental variant; in the larva stage, for each hybrid, at the beginning of the 3^{rd} stage 3 lots x 300 larvae/lot were made; in the fresh cocoon stage, the measurements were made on 100 cocoons representing both sexes; and in the dried cocoon and filament stage on 50 cocoons/hybrid.

RESULTS AND DISCUSSIONS

Biological and productive characters (table 1)

Larvae hatching recorded values within the limits 90.93 – 98.47 %. Through their values the hybrids are superior to the genitors, the positive differences being distinctly and high statistically significant, in the most of the cases. The following hybrids are remarked through their high values of the hatching percentage: 22/14 x 14/10 (98.47 %), 10/8 x 14/10 (98.27 %), 22/14 x 10/8 (98.13 %), 10/8 x 22/14 (98.07 %). The data obtained are similar with those presented by other authors. DAS S.K. and coll. (1994) specify for trihybrids, in accordance with the rearing season, a hatching percentage within 87.20 – 99.09 %, and SING R. and coll. (1990) presents a set of hybrids whose hatching percentage ranges within the limits 91.6 – 97.9 %. For the same character ROY G.C. and coll. (1997) present values within 83.07 – 96.57 %.

The pupation percentage of hybrids presented, like the previous character, values superior to the genitors, the positive differences being statistically significative. Noticeable pupation percentage was obtained for the following hybrids: 22/14 x 4/3 (93.22 %), 22/14 x 10/8 (91.77 %), 10/8 x 14/10 (91.22 %). For the analysed character different authors obtained the following values: 42.78 – 94.44 % (RAJANNA K.L. and coll. 1998), 91.50 – 96.93 % (ROY, G.C. and coll., 1997), 75.00 – 88.40 % for simple hybrids, 78.20 – 89.20 % for trihybrids and 78.9 – 84.0 % for double hybrids (SOHN, K.W. and coll., 1999), 83.30 – 90.30% (DATTA, R.K. and coll., 2000), 95.91 – 96.88 % (LI MUWANG and coll., 2001), 77.00 – 98.00 % (HO ZOO LEA, 1998).

The cocoon production/10000 larvae recorded in hybrids exceeded with distinct and high significant values the production of the genitors, ranging within the limits 18.10 – 20.14 kg. The following hybrids were remarked by their productions: 22/14 x 4/3 (20.14 kg), 4/3 x 14/10 (19.44 kg), 22/14 x 10/8 (19.40 kg). The obtained data range within the values' limits which characterize the silkworm cocoons production worldwide. So, SURESH KUMAR N. (1999) created hybrids with a silk cocoon production /10000 larvae of 15.54 – 20.46 kg, and RAZDAN J.L. and coll. (1994) specify a production within 12.86 – 16.82 kg. The cocoon production / box (1 box = 20000 larvae) obtained by SOHN K.W. and coll. (1999) oscillated, in accordance with the practiced type of crossing, within 21.4 – 27.5 kg for simple hybrids, 25.4 – 31.0 for trihybrids and 29.6 – 31.1 kg for double hybrids. For a hybrid recently obtained in India the cocoon production was 19.37 kg / 10000 larvae (DATTA, R.K. and coll. 2000). A new series of hybrids created in China present a cocoon production ranging, in accordance with the season, within 16.83 – 18.45 kg / 10000 larvae (LI MUWANG and coll., 2001), 16.6 – 23.3 kg / 10000 larvae (HO ZOO LEA, 1998).

The technological characters of the fresh cocoon (table 2)

The fresh cocoon weight records the maximum value of 2.666 g for the hybrid 10/8 x 14/10 and the minimum value of 2.123 g for the hybrid 22/14 x 4/3. Eight hybrids are superior to the maternal genitor and the same number of hybrids exceed the paternal genitor as well as the genitors mean. For comparison, several values of the fresh cocoon weight selected from references are presented: 1.718 – 2.134 g (SURESH KUMAR N., 1999), 1.40 – 1.95 g (RAZDAN J.L. and coll., 1994), 2.40 – 2.55 g (SOHN K.W. and coll., 1999), 2.05 g (DATTA R.K. and coll., 2000), 1.70 – 1.90 g (LI MUWANG and coll., 2001).

Table 1

Comparative performance of parental lines and interninear hybrids – White Băneasa - Biological and production characters

Line/ hybrid	Hatching (%)				Pupation (%)				Cocoon yield (kg/10000 larve)			
	$\overline{X} \pm s_{\overline{x}}$	Differences significative in comparison with:			$\overline{X} \pm s_{\overline{x}}$	Differences significative in comparison with:			$\overline{X} \pm s_{\overline{x}}$	Differences significative in comparison with:		
		Genitor ♀	Genitor ♂	MP		Genitor ♀	Genitor ♂	MP		Genitor ♀	Genitor ♂	MP
4/3	84,87 ± 0,82				77,00 ± 2,90				16,63 ± 0,28			
10/8	84,93 ± 0,77				77,22 ± 1,17				17,21 ± 0,18			
14/10	86,27 ± 0,94				76,55 ± 3,13				16,46 ± 0,36			
22/14	84,33 ± 0,46				78,22 ± 1,90				15,80 ± 0,12			
4/3 x 10/8	90,93 ± 1,41	*	*	*	81,33 ± 1,76	*	*	*	18,54 ± 0,80	**	*	**
10/8 x 4/3	95,60 ± 0,61	***	***	***	83,11 ± 0,30	**	*	***	18,88 ± 0,42	**	*	**
MP	84,90 ± 0,16				73,36 ± 0,27				16,96 ± 0,20			
4/3 x 14/10	96,60 ± 0,53	**	*	**	87,11 ± 0,80	**	NS	**	19,44 ± 0,56	***	***	***
14/10 x 4/3	96,93 ± 0,46	**	**	**	90,22 ± 2,43	*	*	*	19,06 ± 0,30	***	***	***
MP	85,57 ± 0,81				75,52 ± 1,21				16,55 ± 0,16			
4/3 x 22/14	97,53 ± 0,35	***	***	***	91,11 ± 1,68	**	**	**	18,76 ± 0,28	**	***	**
22/14 x 4/3	97,80 ± 0,30	***	***	***	93,22 ± 0,80	**	**	**	20,14 ± 0,16	***	***	***
MP	84,60 ± 0,60				76,36 ± 1,19				16,22 ± 0,12			
10/8 x 14/10	98,27 ± 0,24	**	**	**	91,22 ± 1,50	***	*	**	19,32 ± 0,22	**	***	***
14/10 x 10/8	97,40 ± 0,11	**	**	**	90,22 ± 0,40	*	**	*	18,10 ± 0,44	**	*	**
MP	85,60 ± 0,85				74,39 ± 2,06				16,84 ± 0,14			
10/8 x 22/14	98,07 ± 0,43	***	***	***	91,20 ± 2,53	**	*	*	18,86 ± 0,38	**	***	**
22/14 x 10/8	98,13 ± 0,35	***	***	***	91,77 ± 1,78	**	**	**	19,40 ± 0,18	***	**	**
MP	84,63 ± 0,49				75,22 ± 1,25				16,51 ± 0,28			

14/10 x 22/14	97,73 ± 0,30	**	***	***	90,11 ± 2,21	*	*	*	19,06 ± 0,32	***	***	***
22/14 x 14/10	98,47 ± 0,35	***	**	***	90,55 ± 2,51	*	*	*	18,32 ± 0,19	**	**	**
MP	85,30 ± 0,53				77,39 ± 2,41				16,33 ± 0,24			

* P < 0,05; ** P < 0,01; *** P < 0,001; NS - Unsignificant

Table 2

Comparative performance of parental lines and interninear hybrids – White Băneasa 75 - Technological characters of fresh cocoon

Line/ hybrid	Fresh cocoon weight (g)				Shell cocoon weight (g)				Shell ratio (%)			
	$\overline{X} \pm s_{\overline{x}}$	Differences significative in comparison with:			$\overline{X} \pm s_{\overline{x}}$	Differences significative in comparison with:			$\overline{X} \pm s_{\overline{x}}$	Differences significative in comparison with:		
		Genitor ♀	Genitor ♂	PM		Genitor ♀	Genitor ♂	PM		Genitor ♀	Genitor ♂	PM
4/3	2,192 ± 0,053				0,450 ± 0,006				20,71 ± 0,38			
10/8	2,120 ± 0,031				0,433 ± 0,003				20,51 ± 0,27			
14/10	2,260 ± 0,027				0,443 ± 0,004				19,66 ± 0,22			
22/14	2,300 ± 0,027				0,450 ± 0,004				19,59 ± 0,30			
4/3 x 10/8	2,456 ± 0,056	**	***	***	0,497 ± 0,007	***	***	***	20,42 ± 0,36	NS	NS	NS
10/8 x 4/3	2,621 ± 0,064	***	***	***	0,555 ± 0,007	***	***	***	21,35 ± 0,34	NS	NS	NS
PM	2,156 ± 0,027				0,442 ± 0,004				20,61 ± 0,18			
4/3 x 14/10	2,468 ± 0,070	**	**	**	0,533 ± 0,008	***	***	***	21,83 ± 0,42	NS	000	**
14/10 x 4/3	2,423 ± 0,052	***	**	**	0,511 ± 0,006	***	***	***	21,28 ± 0,40	**	NS	*
MP	2,225 ± 0,033				0,447 ± 0,004				20,19 ± 0,20			
4/3 x 22/14	2,140 ± 0,028	NS	000	0	0,431 ± 0,006	0	0	0	20,66 ± 0,42	NS	NS	NS
22/14 x 4/3	2,123 ± 0,030	000	NS	00	0,430 ± 0,005	0	0	0	20,35 ± 0,18	NS	NS	NS
PM	2,245 ± 0,030				0,450 ± 0,004				20,15 ± 0,25			
10/8 x 14/10	2,666 ± 0,065	***	***	***	0,531 ± 0,007	***	***	***	20,12 ± 0,41	NS	NS	NS

14/10 x 10/8	2,493 ± 0,050	***	***	***	0,535 ± 0,007	***	***	***	21,41 ± 0,30	NS	NS	NS
PM	2,189 ± 0,021				0,438 ± 0,003				20,08 ± 0,16			
10/8 x 22/14	2,136 ± 0,063	NS	NS	NS	0,467 ± 0,006	***	*	*	21,12 ± 0,44	*	***	***
22/14 x 10/8	2,267 ± 0,057	NS	NS	NS	0,483 ± 0,007	***	***	***	21,50 ± 0,37	***	*	***
PM	2,209 ± 0,019				0,441 ± 0,030				20,05 ± 0,20			
14/10 x 22/14	2,589 ± 0,067	***	***	***	0,536 ± 0,008	***	***	***	20,99 ± 0,53	*	*	*
22/14 x 14/10	2,384 ± 0,030	*	**	**	0,499 ± 0,004	***	***	***	20,87 ± 0,20	***	***	***
PM	2,279 ± 0,022				0,446 ± 0,004				19,62 ± 0,18			

* P < 0,05; ** P < 0,01; *** P < 0,001; NS - Unsignificant

The shell cocoon weight ranged within 0.430 – 0.555 g and the following hybrids were remarked: 10/8 x 4/3 (0.555 g), 14/10 x 22/14 (0.536 g), 14/10 x 10/8 (0.535 g), 4/3 x 14/10 (0.533 g), 10/8 x 14/10 (0.531g). From the number of homologated hybrids, only 10 hybrids (83.33 %) are superior to the both genitors. The values of this character worldwide are as follows: 0.266 – 0.303 g (SING R., 1990), 0.310 – 0.380 g (CHATTERJJE S.N., 1993), 0.198 – 0.346 g (DAS S.K., 1994), 0.263 – 0.319 g (ROY G.C., 1997), 0.374 – 0.510 g (SURESH KUMAR N., 1999), 0.502 g (DATTA R. K., 2000), 0.404 – 0.457 g (LI MUWANG, 2001), 0.340 – 0.530 g (HO ZOO LEA, 1998).

The silk ratio ranged within 20.12 – 21.83 %, five hybrids being superior to the maternal genitor with statistically significative values (41.66 %), and only four hybrids being superior to the paternal genitor (33.33 %). The parents mean was exceeded only by 50% of the hybrids. The data obtained for this character are situated within the limits presented by other researchers. The values recorded by different authors for the silk ratio are the following: 18.1 – 19.0 % (SINGH R. and coll., 1990), 18.8 – 20.7 % (CHATTERJJE S.N., 1993), 15.50 – 20.66 % (DAS S.K. and coll., 1994), 21.7 – 24.2% (SURESH KUMAR N., 1999), 22.8 – 23.9 % (SOHN, K. W. and coll.,1994), 24.5 % (DATTA R.K., 2000), 23.0 – 24.5 % (LI MUWANG and coll., 2001), 19.6 – 29.9 % (HO ZOO LEA, 1998).

The characters of the silk filament (table 3)

Table 3

Comparative performances of parental lines and interlinear hybrids – White Băneasa 75 –
Silk fiber characters

Line/ hybrid	Filament length (m)				Filament size (d)			
	$\overline{X} \pm s_{\overline{x}}$	Differences significance in comparison with:			$\overline{X} \pm s_{\overline{x}}$	Differences significance in comparison with:		
		Genitor ♀	Genitor ♂	*PM*		Genitor ♀	Genitor ♂	*PM*
4/3	1210 ± 10				2,74 ± 0,05			
10/8	1200 ± 8				2,87 ± 0,05			
14/10	1202 ± 6				2,95 ± 0,03			
22/14	1206 ± 5				2,87 ± 0,04			
4/3 x 10/8	1305 ± 6	***	***	***	2,71 ± 0,05	NS	00	NS
10/8 x 4/3	1336 ± 11	***	***	***	2,80 ± 0,04	NS	NS	NS
PM	1204 ± 6				2,80 ± 0,03			
4/3 x 14/10	1387 ± 11	***	***	***	2,91 ± 0,04	**	NS	NS
14/10 x 4/3	1344 ± 14	***	***	***	2,87 ± 0,04	NS	*	NS
PM	1205 ± 6				2,84 ± 0,02			
4/3 x 22/14	1209 ± 10	NS	NS	NS	2,86 ± 0,04	*	NS	NS
22/14 x 4/3	1174 ± 13	0	0	0	2,70 ± 0,04	000	NS	0

PM	1207 ± 5				2,80 ± 0,03			
10/8 x 14/10	1348 ± 11	***	***	***	2,77 ± 0,03	NS	000	000
14/10 x 10/8	1410 ± 8	***	***	***	2,82 ± 0,02	00	NS	0
PM	1201 ± 5				2,91 ± 0,02			
10/8 x 22/14	1267 ± 11	***	***	***	2,80 ± 0,02	NS	NS	NS
22/14 x 10/8	1206 ± 8	-	NS	NS	2,88 ± 0,04	NS	NS	NS
PM	1203 ± 5				2,87 ± 0,03			
14/10 x 22/14	1349 ± 11	***	***	***	2,87 ± 0,03	NS	NS	NS
22/14 x 14/10	1328 ± 12	***	***	***	2,79 ± 0,04	NS	00	0
PM	1204 ± 4				2,91 ± 0,02			

* P < 0,05; ** P < 0,01; *** P < 0,001; NS – Unsignificant

The filament length recorded values within 1174 - 1410 m. The genitors were exceeded with statistically significant values in 75% of the cases. By a high filament length the following hybrids were remarked: 14/10 x 10/8 (1410 m), 4/3 x 14/10 (1387 m), 14/10 x 22/14 (1349 m), 10/8 x 14/10 (1348 m). Worldwide the following performances of the filament length were ontained for hybrids: 732 - 1161 m (RAZDAN J.L. and coll., 1994), 750 - 969 m (SINGH R. and coll., 1990), 600 - 1040 m (DAS S.K. and coll., 1994), 837 - 978 m (ROY G.C., 1997), 569 - 827 m (RAJANNA K.L. and coll., 1998), 1295m (DATTA R.K., 2000), 1374 - 1350 m (GENOVA, E., 1994), 1163 - 1233 m (LI MUWANG and coll., 2001).

The filament fineness did not record significative changes following hybridization, ranging within 2.70 – 2.91 d. The obtained values are higher than those recorded worldwide, indicating a silk filament with a higher size. For comparison some data selected from different sources are presented: 2.1 – 2.6 d (SINGH R. and coll., 1990), 2.35 – 2.66 d (LI MUWANG and coll., 2001), 1.87 – 2.39 d (RAJANNA K.L. and coll., 1998).

CONCLUSIONS

The experimental works which had the aim of studying the inbreeding and hybridization effect allowed the selection of 3 inbred lines (4/3; 10/8; 14/10) and 4 hybrids characterized by superior biological and technological parameters, recommended in sericultural production (4/3 x 14/10; 14/10 x 4/3; 10/8 x 14/10; 14/10 x 10/8).

REFERENCES

BRASLĂ ANA, MATEI ALEXANDRA **-** Noi hibrizi de viermi de mătase destinați creşterilor de primăvară - *Revista de Medicină Veterinară şi Creşterea Animalelor, 11-12, 12-14, 1992.*

CHATTERJE S.N. - Silkworm breeding in India - *Sericologia, Vol. 33(3), 427-448,* 1993

CRAICIU M. **-** Hibrizi de viermi de mătase în F_1, valoroşi pentru sporirea producției sericicole - *Lucrări științifice, S.C.A.S., 6, 117-161,1965.*

DAS S.K., PATTNAIK S., GHOSH B., SINGH T., NAIR B.P., SEN S.K., SUBBA RAO G. - Heterosis analysis in some three-way crosses of *Bombyx mori L.* - *Sericologia, Vol. 34(1), 51-61,1994.*

DATTA R.K., BASAVARAJA H.K., MAL REDDY N., NIRMAL KUMAR S., AHSAN M.M., SURESH KUMAR N., RAMESH BABU M. - Evolution of new productive bivoltine hybrid, CSR3 x CSR6 - *Sericologia, Vol. 40(3), 407-416, 2000.*

HO ZOO LEA - Combining ability and heritability estimation for sri lankan stocks of mulberry silkworm, *Bombyx mori* - *Sericologia, Vol. 38(3), 425-431,* 1998

LI MUWANG, HOU CHENGXIANG, YAO QIN, CHEN KEPING - Breeding commercial bivoltine silkworm hybrid resistant to Zhenjiang (China) strain of densonucleosis virus (DNZ-Z) - *Sericologia, Vol. 41(4), 581-588, 2001.*

MATEI ALEXANDRA, MĂRGHITAŞ L.A., CIULU MARIETA, DINIȚĂ GEORGETA, PASCA I. - Hibrizi de viermi de mătase de perspectivă pentru exploatațiile agricole mixte - *A 31-a Sesiune anuală de comunicări ştiințifice a Facultății de Zootehnie, Bucureşti, 2002.*

PETKOV N., YOLOV A. - Influence of cocoon size and weight on heterosis effect in silkworm *Bombyx mori L. - Genet. Sel., 12, 286-291,1979.*

RAJANNA K.L., PUTTARAJU H.P. - Heterosis among lines selected for pupal weight in the interline hybrids of the silkworm *Bombyx mori L. - Sericologia, Vol. 38(4), 587-595,* 1998

RAZDAN J.L., SIDDIQUI A.A., BALI R.K., MUKHERJEE P. - Study on the identification of region-specific heterotic crosses in *Bombyx mori L. - Sericologia, Vol. 34(2), 249-260,* 1994

ROY G.C., GHOSH B., DAS S.K., NAIR B.P., RAO P.R.T., SEN S.K., SENGUPTA K., SINHA S.S. - Comparative performance of multivoltine x bivoltine and bivoltine x multivoltine hybrids of *Bombyx mori L.* for commercial use in eastern India - *Sericologia, Vol. 37(1), 113-121,1997*

SINGH R, NAGARAJU J., RAMAMOHANA RAO P., PREMALATHA V., VIJAYARAGHAVAN K., GUPTA S.K. - Heterosis analysis in the silkworm, *Bombyx mori L.* - *Sericologia, Vol. 30(3), 293-300,* 1990

SOHN K.W., RAMIREZ L - Comparison of the variation in cocoon quality among the single, three-way and double cross hybrids in the silkworm, *Bombyx mori* - *Sericologia, Vol. 39(1), 15-26,* 1999

SURESH KUMAR N., KISHOR KUMAR C.M., BASAVARAJA H.K., MAL REDDY N., RAMESH BABU M., DATTA R.K. - Comparative performance of robust and productive bivoltine hybrids of *Bombyx mori L.* under high temperature conditions - *Sericologia, Vol. 39(4), 567-571,* 1999

Highly Productive Mulberry Silkworm Breeds and Hybrids for Industrial Feeding

By

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Selection work has been carried out for the creation of high productive mulberry silkworm breeds and hybrids by the use of analytical and synthetic methods of selection. The main attention had been paid to the increase the viability, at all stages of both embryo and post-embryo development. All available methods were used for preliminary prognostics of silkworm viability. These are incubation of grain at the provocative background, worm feeding at the provocative background and others. Selection of cocoon coiling has been introduced which provides isolation of cocoon coiled on the first day and the moths leaving those cocoon on the first day and only grain laid by them on the first day were left for obtaining in generations. Likewise, worms hatched from grain on the first day were left for feeding. In the process of papillonage, after cocoon membrane mass is defined, pupa is placed back in the same cocoon with its head to the non-cut end and the membrane is tightly closed. In such a condition moths of low viability can not manage to leave the cocoon membrane and are mechanically excluded from the selection process. Crossing of individuals selected for breeding is performed by the principle of heterogeneous selection.

The above stated method was used for breeding of mulberry silkworm breeds such as: Digomi-1 and Digomi-3, and the hybrids made from those breeds have been zoned by the Ministry of Agriculture of Georgia and are ready for their inculcation and distribution in industry. As a result of purposeful work the mulberry silkworm viability of the above referred breeds and hybrids was increased up to 96-97%, silk capacity – up to 25-26%, cocoon filament length – up to 1400-1500 m. By other biotechnological indices they conform to the fixed normative demands.

Key words: mulberry silkworm, cocoon, pupa, viability

Perspective Breeds of Mulberry Silkworm with the View of Cocoon Filament Length and Thinness

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Lately, while breeding new breeds and hybrids of mulberry silkworm at the Scientific Research Institute of Sericulture of Georgia the great attention has been paid to the problem of increase of cocoon filament/thread length, thinness and homogeneity, alongside with improvement of other technological indices. The breeds of the zoned breeds, such as Mziuri-I and Mziuri-2 are mostly distinguished by these indices. Cocoon of these breeds gave 1.56 tex linear density raw silk thread. By the length and thinness of cocoon filament they had no analogue in the former Soviet Union and the All Union Ministry of Textile Industry demanded increase of the volume of cocoon of Mziuri breeds at solid extra-price. Therefore it was planned to obtain breeds possessing better properties at the expense of improvement of these breeds and on the base of analogous selection. This works in this direction are continued till now and annually the pursued results are obtained. In recent years thread length of the breeds reached 2000-2500 m, while in current year cocoon thread length of certain individuals reached 3400 m. The only low index of these breeds was that of viability, which in recent years was increased significantly by the use of modern selection methods. It equals to 96-97.5 % permanently. Selection works are still continued to obtain more stable indices by preservation of continuous thread length, in order to use these breeds further as starting material for obtaining of new unique breeds.

Key words: mulberry silkworm, cocoon thread length, thread thinness.

Mulberry Silkworm Perspective Breeds with Very Long and Fine Cocoon Thread

By

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ABSTRACT

The paper considers the results of activity carried out in mulberry silkworm selection in Georgia. It deals with the selection of Mziuri group breeds two of which, Mziuri–1 and Mziuri-2 are zoned in East Georgia characterized with the relatively dry climate, while two other breeds Mziuri-4 and Mziuri-5 are considered perspective and their zoning is planned in the regions of West Georgia, characterized with excess humidity.

Cocoon of the above stated breeds is fit for machine uncoiling, is characterized with long and fine thread. Cocoon thread length exceeds 2500 m, while its thinness - exceeds 4500 metric number. These breeds give raw silk thread of minimal linear density (1,56 tex), which is used in manufacturing of the airy and most costly silk fabrics.

This cocoon thread thanks to its length and fineness is used for making surgical threads of 4/0, 5/0, 6/0 and 7/0 conditional number which are used as wound sewing material in cardiovascular and eye surgery.

Key words: mulberry silkworm, cocoon, pupa, viability

INTRODUCTION

From the very beginning of selection activity (1930s) 5 breed-substitution was carried out in Georgia at the expense of local selection breeds. Selection breeds obtained in the first period were characterized by short length and not very fine thread (800-900 m, metric number 2000-2200), as a result of which for obtaining complex raw thread (No 429) only 6-7 cocoon were to be uncoiled jointly, while in China and Japan the complex raw thread of the same number was obtained as a result of uncoiling of 10-12 cocoon, jointly, and correspondingly cocoon thread length, fineness, strength and other indices were relatively high, which in its turn, conditioned high quality of the manufactured fabrics.

In the same period automated cocoon uncoiling machines were introduced in textile industry, which were designed for uncoiling of average caliber cocoon (16-19 mm) and the researchers dealing with selection were faced with a task to continue selection of new breeds. Such works, alongside with satisfaction of other demands would take into consideration the cocoon dimensions, caliber.

And from that time on, selection activity for breeding of new mulberry silkworm breeds and hybrids was carried out and is still carried out by the observance of the above referred demands. From the very beginning great attention was paid to correct choosing of starting material and its thorough study. Mulberry silkworm breeds of local geographical origin that were characterized with high viability were taken as starting material.

The researchers of the S/R Institute of Sericulture were the first who used the method of preliminary prognostics – by defining form elements in hemolymph in the study and evaluation of starting breeds and starting populations obtained from them. In some cases we used the method of blood injection too.

The principal signs for the selection were the length of cocoon thread minimum 1500 m, fineness – minimum 4000 metric number, non-homogeneity maximum: inside a cocoon – 30, among cocoons – 17 and general - 35, cocoon caliber: 16-19 mm.

A group of researchers (N.Sanadze, A.Giorgadze, A.Khatelishvili, A.Dzneladze, B.Gadakhabadze, M.Iobashvili), as a result of fruitful work selected two new breeds: Mziuri-1 and Mziuri-2. The new breeds, for the moment of their zoning were characterized by the following main biotechnological indices: live cocoon silk capacity 22.4-22.9 %; air-dry cocoon silk capacity 49.5-50.0 %; raw thread yield 43.0-43.6 %, cocoon thread length –1550-1600 m., calculated yield of raw thread per gram warm – 680 gr., coefficient of air-dry cocoon from live cocoon 2.21.

After the zoning of the new breeds, the selection works for preservation and improvement of new breeds (Mziuri-1 and Mziuri-2) were continued. This work was performed by means of selection of families and individuals characterized by high indices, by strict rejection as defective of cocoon not falling in the fixed norms and by their population in generations on the base of non-relationship crossing. The results carried out in this direction in 90s are offered in Table 1.

Table 1, Some biotechnological indices of zoned mulberry silkworm families selected for annual reproduction

	Characteristics	Breeds	Major statistical parameters		
			$\widetilde{X} \pm m_{\widetilde{X}}$	σ	C %
1	Silkworm viability, %	Mziuri-1	95.4 ± 0.09	0.41	0.01
		Mziuri-2	95.8 ± 1.47	5.87	6.11
2	Live cocoon average mass, g.	Mziuri-1	2.48 ± 0.07	0.03	1.21
		Mziuri-2	2.48 ± 0.06	0.62	1.10
3	Cocoon membrane mass, mg.	Mziuri-1	559 ± 2.20	0.57	1.71
		Mziuri-2	573 ± 1.75	7.08	1.23
4	Live cocoon silk capacity, %	Mziuri-1	23.06 ± 0.05	0.20	0.88
		Mziuri-2	23.09 ± 0.06	0.24	0.26
5	Raw silk thread yield, %	Mziuri-1	19.5 ± 0.38	0.98	4.59
		Mziuri-2	20.4 ± 0.24	0.69	1.17
6	Thread uncoiling capacity, %	Mziuri-1	87.8 ± 6.55	1.36	1.54
		Mziuri-2	90.0 ± 0.26	0.68	0.75
7	Total length of cocoon thread, m	Mziuri-1	2023 ± 15.5	47.8	2.76
		Mziuri-2	2007 ± 5.9	15.4	0.78
8	Cocoon thread metric number	Mziuri-1	4187 ± 49.5	121.4	2.90
		Mziuri-2	3998 ± 42.8	113.4	2.84

As is seen from the Table 1, selection work enabled us not only to preserve the main indices (length of cocoon thread and fineness) of selection in the zoned breeds (Mziuri-1 and Mziuri-2), but also their significant improvement. Simultaneously with the increase of cocoon thread length and perfection of thread fineness the non-homogeneity index was improved too, which formed: inside a cocoon 17-19; among cocoons 11-12, general 21-22, which, is far better compared with the standard. Content of average size cocoon was preserved within 92-95%, which fully conforms the demands of automated uncoiling.

At the next stage the work was conducted by the method of analytical selection and the breeds Mziuri 4 (from Mziuri-1) and Mziuri 5 (from Mziuri –2) were obtained. Their zoning is planned in West Georgia, the regions known for excess humidity. The works for preservation and improvement of indices of Mziuri-1 and Mziuri-2 were continued. Mean biotechnological indices of all four breeds of Mziuri group in 2001 and 2007 years are given in Table 2.

Table 2. Some biotechnological indices of zoned and perspective breeds of mulberry silkworm Mzuiri group according to spring feeding.

# #	Indices	Years and Breeds									
		2001 y.					2007 y.				
		Mzuiri-1 zined	Mzuiri-2 zoned	Mzuiri-4 perspective	Mzuiri-5 perspective	Ukr-14 improv-ed. (stand.)	Mzuiri-1 zoned	Mzuiri-2 zoned	4 perspective	5 perspective	Ukr.-14 nprov=ed. (stand.)
1	Vivification of grain, %	94.7	95.0	95.5	94.7	95.0	96.5	96.7	97.1	96.6	94.0
2	Quantity of worm, per gr. pcs	2220	2231	2037	2230	22.45	2280	2270	2260	2270	2225
3	Length of feeding, days	30	30	30	30	30	28.2	28.9	28.4	28.2	29.2
4	Silkworm viability, %	92.5	90.0	92.8	93.4	91.7	97.0	94.8	95.5	95.7	93.1
5	Cocoon yield per gr worm, kg.	4.82	5.02	5.08	4.94	4.29	4.9	4.9	5.2	5.0	4.5
6	Average mass of live cocoon, g.	2.35	2.50	2.45	2.40	2.1	2.2	2.3	2.4	2.3	2.17
7	Silk capacity of live cocoon, %	22.6	23.1	24.0	23.4	21.4	23.5	23.2	24.3	23.5	21.8
8	Air-dry cocoon yield from live cocoon,%	44.5	46.5	47.0	45.6	43.3	46.2	467	47.6	45.8	43.3
9	Silk capacity of air-dry cocoon,%	49.5	50.0	50.1	49.3	47.0	51.1	50.2	50.7	49.5	48.0
10	Yield of raw thread, %	20.0	19.8	21.0	20.3	19.5	20.9	20.4	22.1	21.5	19.7
11	Cocoon uncoiling capacity, %	89.6	90.0	91.5	90.1	86.7	91.9	91.5	91.6	93.1	87.2
12	Cocoon thread length, m.	1981	2015	2200	2167	1280	2269	2245	2290	2273	1370
13	Metric number of cocoon thread	4085	4105	4150	4230	2245	4793	4673	4300	4481	3200

According to the data of Table 2 the zoned and perspective experimental breeds, by their biotechnological indices of 2001 are far better than the standard breed and in the principle they respond to the normative demands fixed for breed selection. The indices, which are given below, are considered the best:

- Live cocoon yield from gram warm, that forms 4.82-5.08 kg and that exceeds the standard by 0.53-0.79 kg;
- Yield of air-dry cocoon from the live one, which according to breeds varies within 44.5-47.0% and exceeds the standard by 1.20-3.7%;
- Silk capacity of air-dry cocoon, in experimental breeds varies within 49.3-50.1%, while in standard it doesn't exceed 46.2%;
- Cocoon uncoiling capacity in experimental breeds equals to 49.6-50.1% and exceeds the correspondent index of standard by 2.36-4.8%;
- Cocoon thread length in experimental breeds equals to 2200 m in 1961, while thread fineness to - 4100-4280 metric number. In standard this index doesn't exceed 1280 m and 3438 metric number, correspondingly;

Irrespective of the fact that other biotechnological indices (grain vivification capacity, warm viability, live cocoon silk capacity and raw thread yield) in experimental breeds according to the results of 2001 don't leg behind those of standard and in some cases even are better, these breeds still need perfection to a certain extent.

As to biotechnological indices of 2007, in experimental breeds they are significantly improved and they fully conform to normative demands. They, by their indices which are considered leading for selection (such as cocoon thread length and fineness) fully justify our preliminarily pursued objective and we can state that our goal has been achieved. Cocoon thread length in experimental breeds varies from 2269 to 2290 m., thread fineness from 4300 to 4793 metric number while the corresponding indices of the standard don't exceed the 1700 m and 2300 metric number. Irrespective of it the work in this direction is still in progress pursuing improvement and stabilization of these indices, which is clearly observed from Table 3. Table 3 offers statistical indices of individuals to be reproduced in generations.

Table 3. Statistical characterization of cocoon thread length and fineness of individuals selected for reproduction from the zoned and perspective breeds of Mziuri group mulberry silkworm, according to the spring feeding of 2007.

	Characteristics	Breeds	Main statistical parameters		
			$\widetilde{X} \pm m_{\widetilde{X}}$	σ	C %
1	Length of cocoon thread, m.	Mziuri-1	2667 ± 130	285	10.7
		Mziuri-2	2469 ± 140	308	5.7
		Mziuri-4	2319 ± 73	160	3.1
		Mziuri-5	2414 ± 41	90	3.7
2	Metric number of cocoon thread	Mziuri-1	5855 ± 338	743.3	12.7
		Mziuri-2	5359 ± 378	831.7	15.5
		Mziuri-4	4419 ± 134	295.5	6.7
		Mziuri-5	4938 ± 333	731.8	14.8

Table 3 shows that average cocoon thread length of individuals selected for reproduction in generations from the experimental breeds varies within 2319 to 2667 m. Its mean quadratic deflection (σ) equals to 90.3-308, while variation coefficient (c) equals to 3.1-10.7 %. This refers to the fact that there is still the possibility to increase the above stated indices. Similar should be said about cocoon thread fineness. Its mean value varies within 4419-5855, mean quadratic deflection (σ) is 295.5-831.7, while the variation coefficient (c)- is 6.7-15.5 %.

In 2007, in the breeds of Mziuri group the families were revealed the cocoon thread length of which exceeded 3000 m and in some individuals this index reached 3400 m, but unfortunately we couldn't preserve normal viability of such larvae.

Thanks to the length and fineness of thread, cocoon of Mziuri breeds gives raw silk thread of the most minimal linear density (1.56 tex), which is fit for manufacturing of airy and costly silk fabric. Therefore, before disintegration of Soviet Union, Ministry of Light Industry of Georgia demanded on making of Mziuri breed cocoon at the guaranty of 50% extra charge.

Experimental breeds of Mziuri group, alongside with their direct designation, possess other useful properties. Namely their cocoon give 4/0, 5/0, 6/0 and 7/0 conditional number threads, which are used in cardiovascular and eye surgery as wound sewing means. Thread obtained from silk gland of the V age warm – "Fibroseam" (with conditional number 0 and 2/0) was used in maxilla-facial surgery for wound sewing and it provides high functional and cosmetic effect. The corresponding authorities permitted its serial production.

The only drawback of the breeds of Mziuri group is that in experimental conditions they are characterized by relatively low viability and they can't expose fully their potential possibilities. The work for elimination of this drawback is still in progress.

CONCLUSION

1. As a result of long and fruitful work mulberry silkworm breeds Mziuri-1 and Mziuri-2 possessing high technological characteristics were obtained at the S/R Institute of Sericulture of the Georgian Agrarian University, which were zoned in the regions of West Georgia where dry climate prevails.
2. By the use of analytical method of selection two new breeds Mziuri-4 and Mziuri-5 were obtained, which are characterized by high technological indices. These breeds are considered the perspective breeds and their zoning is planned in West Georgia where excessive humid climate prevails.
3. Zoned and perspective breeds of Mziuri group mainly comprise average caliber cocoon and are designed for automated uncoiling. They are characterized by high biotechnological properties. Especially high is the length of cocoon thread, which exceeds 3000 m and the fineness of cocoon thread which reaches 5000-6000 metric number. Raw silk thread of minimal linear density (1,56 tex) is obtained from this cocoon, which is used in making airy and costly silk fabrics.
4. Thread (conditional number 4/0. 5/0, 6/0 and 7/0) obtained from cocoon of the above described breeds thanks to its length, fineness and homogeneity are used in cardiovascular and eye microsurgery as the material for wound sewing, while thread obtained from silk gland of V age warm organism – "Fibroseam" (conditional number 0 and 2/0) is used in maxilla-facial surgery as sewing material. The above stated threads are recommended for serial production and application.
5. Breeds of Mziuri group: Mziuri-1, Mziuri-2, Mziuri-4 and Mziuri-5 are the perfect starting material for selection of more unique breeds.

REFERENCES

1. N. Goderdzishvili. Preparation of surgical threads. J. "Sholk", No 2, Tashkent, 1978.
2. N.Rustamov et al. Application of special silk threads in eye microsurgery as sewing material. J. "Sholk" No 2, Tashkent, 1982.
3. N. Stepanishvili, A. Giorgadze, L.Kobakhidze, E.Tsotskolauri. Estimation of selection efficiency according to warm viability along the one generation period, Collection of Scientific Works of Georgian Agrarian University "Problems of Agrarian Sciences", v. 33, Tbilisi, 2005, p. 92-94.
4. N.Stepanishvili, A. Giorgadze, L. Kobakhidze, Z. Tskaruashvili. Main biotechnological indices of improved mulberry silkworm breeds of Mziuri-1 and Mziuri-2 for obtaining special designation silk thread. Collection of Scientific Works of Georgian Agrarian University "Problems of Agrarian Sciences", v. 33, Tbilisi, 2005, p. 98-100.

2.3. Silkworm egg production

Effect of short-term preservation of multivoltine eggs (Nistari strain) at low temperatures on hatching

By

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ABSTRACT
Long-term (more than one year) preservation of silkworm eggs is a very ambitious objective, which has been pursued for long time, but has never been practically achieved. The implications of this preservation method are obvious, especially if they are applied to silkworm germplasm bank system whose maintenance is expensive in terms of money and at risk for unexpected occurrences. A new research branch focused on silkworm egg cryopreservation has been recently undertaken by the staff of the Sericultural Specialised Section of Padua. In order to assess egg resistance to low temperatures some experiments were performed in order to evaluate hatching response after three-hour exposure to 5°C, 0°C, -18°C and -30°C, at different stages of embryo development, shifting eggs from 25°C to the above-mentioned temperatures directly. Experimental results show that multivoltine eggs have a very strong resistance to short-term chilling in the range of 5/-18°C, while -30°C are a non-tolerable limit for the embryos. This findings encourage toward cryopreservation, as even silkworm multivoltine eggs seem to be endowed with adaptation mechanisms which can make them survive during the different steps of their preparation to long-term storage under ultra-low temperatures.
Keywords: cryopreservation, exposure to 0°C, 5°C, 18°C, 30°C, embryo stage

INTRODUCTION
Currently, around 3000 genotypes, having their origin in temperate and tropical countries, constitute the world silkworm germplasm (Nagaraju *et al.,* 2000). Among them, strains adapted to tropical conditions are non-diapausing, while strains adapted to temperate climate undergo embryonic diapause.
Cold hardiness of monovoltine eggs during their wintering has been investigated since the 19th century, in order to obtain good larval hatching in the subsequent springtime. On the other hand, investigation on cold hardiness of polyvoltine strains is quite recent. In fact, cold endurance is not required by tropical polyvoltine embryos, which do not have to face temperatures below 0°C in their own environment. However, several attempts at interrupting their continuous life cycle have been carried out in order to obtain a better management of rearing and a more rational organization of egg production. Scientific literature on short-term (1-3 months) preservation of polyvoltine silkworm eggs at 4-5°C is available (Tzenov *et al*., 2001; Chuprayoon *et al*., 2002). Furthermore, new perspectives in insect germplasm preservation on the medium and long-term induce to study more attentively egg cold hardiness of the polyvoltine silkworm; in fact, cryopreservation of silkworm eggs may represent an interesting target to achieve for the future development of silkworm germplasm banks. As cryopreservation can be obtained through two major techniques, slow freezing or vitrification, whose both require performing some procedural steps at low

temperatures, an in-depth knowledge of silkworm egg behaviour at temperatures around and below 0°C appear to be fundamental in order to develop appropriate methodologies which are already available for other insect eggs (Wang *et al*., 2000; Luo *et al*., 2006).

MATERIALS AND METHODS

Polyvoltine larvae, hatched from one-month chilled layings of the Nistari strain, fed on an artificial diet (ISZA's patent) (Cappellozza *et al*., 2005) containing 40% mulberry leaf on a dry weight basis. Larvae were reared as per ISZA's standard method (*ibidem*) until spinning, under 8L:16D hour photoperiod, with the beginning of the subjunctive day at 8.00 a.m. At moth emergence, which started about ten days after spinning, at lightening, male and female adults were mated for two hours; then, the moths were separated and females were put on a paper sheet into a wooden box with a metallic lid, endowed with several holes, where moths were allowed to separately lay their eggs. Every two hours moths were gently transferred on a new paper sheet, in another box, in order to obtain fractionate layings. With the purpose of not disturbing moths laying, a red light lamp was used by the operator in order to transfer the females during darkness.

As the moths began to lay their eggs from 4 p.m. in the evening, four subsequent fractionated layings were collected for the experimental aims: from 4 to 6, from 6 to 8, from 8 to10 and from10 to12 p.m.. The number of eggs collected per each interval of time largely varied; however, a minimum number of 20 eggs per repetition was tested. The time counting began with laying, so that the egg started to be put into the refrigerator immediately after the completion of the second hours of embryonic development. In fact, in the silkworm, fertilization occurs at egg laying.

Fractionate egg layings, individually cut and still adherent to their paper sheet, were exposed for three hours at low temperatures in different period of their embryonic development. Experimental temperatures were 5, 0, -18, -30° $\pm$ 1°C. Thirteen subsequent embryonic stages of development were tested, corresponding to the most part of critical points in embryo development described by Sagakuchi (1978). Embryo dissection had been performed in previous experiments carried out under the same environmental conditions and with the same strain in order to check the conformity of the progression of embryo development with the stages reported by Sagakuchi (*ibidem*) for the various hours/days of incubation at 25°C.

Three different egg layings represented three replications for each thesis (temperature x embryonic stage). Egg layings were put into the refrigerator/freezer apparatus inside a plastic petri dish. After three hours, the three petri dishes belonging to each thesis were directly transferred from the low temperature to the incubation room (25°C) and put into an airtight container. Saturation humidity was obtained by putting a small piece of moist adsorbent paper in the same container. Control eggs were not subjected to any change in the temperature during all the period of incubation.

Egg hatching started on day 9th after laying, at light switch on. On day 11th , larvae were gently brushed away from the eggs shells and paper, and all the petri dishes were stored into the refrigerator, at 5°C, in order to be counted at convenience. White shells of eggs, from which larvae had hatched, were easily distinguishable both from yellow, desiccated sterile eggs and also from pigmented eggs with dead embryos still inside.

Percentages of hatched/survived larvae were calculated for treated and control repetitions. Schneider- Orelli's corrected mortality was calculated according with the following formula

$$\text{Corrected mortality \%} = \left(\frac{\text{\% treated mortality - \% control mortality}}{\text{100 - \% control mortality}} \right) \text{x } 100$$

Angular transformation on data collected as percentages was performed before carrying out two-way ANOVA at the tested temperatures. Tukey's post-hoc test was employed in order to calculate the significance of differences among means. The computer software Statistica 7.0 was used.

RESULTS

The first finding of the study regarded moth laying behaviour. It was observed that females started laying eggs just at light switch off and the maximum amount of eggs was collected within four

hours from the beginning of darkness. Moths completely stopped laying at subsequent lightening, and started again when darkness came back.
With regard to the egg mortality at the different temperatures, the first set of experimental data showed, apart for the temperature of – 30°C, which resulted in no embryo survival, a general good ability at facing a sudden decrease of the incubation temperature for the tested 3-hour exposure. The two-way ANOVA showed that there was a significant effect of different temperatures ($F_{2,78}$ = 779.42 p=0.05), of different developmental stages ($F_{12,78}$ = 152,29 p=0.05) and the interaction temperature-developmental stage was also significant ($F_{24,78}$ = 116.52; p= 0.005).
Under our experimental conditions the average percentage of the control mortality at egg hatching was 5.14 with a standard deviation of 1.95.
With regard to the 5°C exposed group, if we do not consider the mortality at the 2nd hours from laying, the average percentage of the mortality of all the experimental groups treated at different stages of embryo development was 3.86 with a standard deviation of 2.57. Thus, a three-hour exposure to the temperature of 5°C did not affect embryo viability at all in comparison to the control. The Tukey’s test did not outline any significant difference among the means of corrected mortality at different hours, a part for the above-mentioned 2nd hour from laying.
The same behaviour was noticed in the 0°C exposed eggs; in fact, a significant difference among means was also recorded in the case of the 2nd hour from laying (Tukey’s test); the average percentage of the mortality of all the experimental groups at different stages of embryo development (a part for the 2nd hour) was 6.76 with a standard deviation of 5.77, with a slight increase in comparison to the control and 5°C exposed eggs.
Coming to the -18°C exposed eggs, results are completely different. Not only did this temperature cause an hatching near to 0% at 2nd hour exposure but even when eggs were exposed at the end of their embryo development, i.e. at the 144th, 168th, and 192nd hours. Furthermore, a mortality rate around 46% was also observed for the eggs which underwent -18°C at the12th hour from laying. Nevertheless, if we calculate the average percentage of the mortality of all the experimental groups from the 24th to the 120th hour, i.e. a part for the above-mentioned treated groups, it was 6.89 with a standard deviation of 6.99, and this value is only slightly higher than in the control group. This set of observations gives us a clear indication about the fact that silkworm eggs are very sensitive to low temperature exposition at the beginning of their development, as well at the end of the same. The Tukey’s test confirmed the significance of the differences among means recorded for groups which were treated, on one hand, at the beginning and at the end of the development, on the other hand, in the middle. Furthermore, the mechanism of egg death was different, in case it occurred at the begin or at the end of the development; eggs dead at the 2nd hour of development did not show pigmentation and desiccated with the incubation progression; while, when eggs experimented a late exposure to -18°C, they continued their development until the “blue egg” stage (just before hatching, when embryos can be seen through the shells of the polyvoltine eggs, where serosa membrane is not pigmented), but were unable at hatching.
No useful information was obtained from the -30°C exposed eggs, because, as mentioned before, no hatching was observed from this experimental set.
Another very important observation regards the standard deviation of the means, whose value showed an increasing trend with the decrease of the treatment temperatures and particularly for those developmental hours when high, even if not complete, mortality was recorded. This result could be dependent on differences among the genetic background of each laying (as the three repetitions per thesis came from different mother moths), but also from slightly differences in the steps of embryo development reached by the different eggs at the moment when they were exposed to low temperatures.

DISCUSSION

Silkworm diapausing eggs are endowed with many strategies which permit them to resist to very cold winters.
In the silkworm, embryo development is identical both in diapausing and non diapausing eggs until the first 24-30 hours of growth, when head and tail differentiate in the embryo; then, around the 30-

40 hr, diapausing eggs enter pre-diapause and then cease further development on the third day after laying, while the true diapause period starts about two weeks after egg laying. From the pre-diapause period metabolic pathways begin to diverge in polyvoltine and monovoltine eggs. Nevertheless, our experiment demonstrated that polyvoltine eggs are also able to cope with low temperatures to a certain extent. Resistance showed by the Nistari eggs exposed to 5°C temperature was not surprising; in fact, in the sericultural practice, when the expected date of hatching must be postponed after the beginning of incubation, experienced silkworm rearers suggest to cold-store the eggs at 5°C for a maximum period of a week. The best period is generally considered to be after 2-3 days of the incubation and before the reversal stage. After blastokinesis, the cold preservation is not recommended until the "blue egg" stage (just before hatching) that is indicated as another stage resistant to cold. Chaturvedi and Upadhyay (1990) found that the hatchability of eggs gradually decreased when they cold stored eggs beyond five days at various embryonic stages from 48 hours after oviposition. According to them, the earlier the embryonic development stage, the more resistant. Nevertheless, our findings demonstrate that the 2nd hour from laying is a critical point with regard to cold hardiness. In fact, sperm enters the egg through the micropyle just before laying, but the fertilization (i.e. fusion of female and male pronuclei) takes place about two hours after laying. This process is probably disturbed by a sudden variation of the environmental temperature. On the other hand, on the basis of our experimental data, the 40th and 96th hours from oviposition seem to be the best points in time to preserve eggs at all the tested temperatures, as demonstrated, not only by the low mortality for these hours, but also by the low standard deviations of the means, testifying that individual variability at these stages are less relevant than in later stages. According to Sakaguchi (1978) the 40th hour is the period when appendages at head and thoracic region develop. At this stage monovoltine eggs enters diapause; while the 96th hour should be the beginning of the blastokinesis, i.e. of a very critical stage in the embryo development, so that a high mortality ratio should have been expected for eggs exposed to low temperatures at this point of the development.
Whichever the mechanism is, resistance to 0°C and -18°C of polyvoltine eggs, recorded in our experiments, was remarkable. In fact, at certain hours from oviposition, egg mortality was quite comparable to that of control. Rapid cold hardening has also been studied in other insects (in particular Dipterans), but the physiological and biochemical mechanisms which are involved in it are yet unknown (Bale, 2002). Also interesting is the fact that the most part of eggs treated at late stages of development were able at continuing their growth and attaining head or body pigmentation stage; their death occurred only after the completion of these embryonic steps. This lead us to think that cold and freezing damages at the tested temperatures consist in a global weakening of the embryos more than in a concrete damage to their tissues and organs; therefore, data on cold resistance achieved through mortality recording at egg hatching might be not sufficient to describe the entire phenomenon and further observations on post-embryonic development should be established.

REFERENCES

Bale, J.S. (2002) Insects and low temperatures: from molecular biology to distributions and abundance. *Phylosophical Transactions of the Royal Society of London*, **B**, 357, 849-862.

Cappellozza L., Cappellozza S., Saviane A., Sbrenna G. (2005) Artificial diet rearing system for the silkworm *Bombyx mori* (Lepidoptera: Bombycidae): effect of vitamin C deprivation on larval growth and cocoon production. *Applied Entomology and Zoology*, 40, 405-412.

Chaturvedi, M.L. and Upahyay, V.B. (1990) Effect of cold storage on the hatchability of silkworm (*Bombyx mori*) eggs. *Journal of Advanced Zoology*, **11 (1),** 63-65.

Chuprayoon, S., Sopha, S., & Kongpun, N. (2002) Influence of low temperature egg preservation at early development stages on hatching ability of multivoltine silkworm, *Bombyx mori* L. *Proceedings XIXth International Congress of the International Sericultural Commission, Bangkok, Thailand*, 143-147.

Luo, L., Pang, Y., Chen, Q., & Li, G. (2006) Cryopreservation of the late stage embryos of *Spodoptera exigua* (Lepidoptera: Noctuidae). *CryoLetters*, **27 (6)**, 341-352.

Nagaraju, J., Klimenko, V. and Couble, P. (2000) The silkworm, *Bombyx mori*: a model genetic system. *Encyclopedia of Genetics* (ed. by E. Reeves), pp.219-239 London, Fitzroy Dearborn.

Sagakuchi, B. (1978) Gametogenesis, fertilization and embryogenesis of the silkworm. *The silkworm: an important laboratory tool* (ed. by G.A. Kerkut and L.I. Gilbert), p. 16, Kodansha ltd., Tokyo.

Schneider-Orelli, O. (1947) *Entomologisches Praktikum – Einführung in die land – und forstwirtschaftliche Insektenkunde*. Sauerlander and Co., Aaran, 237 pp.

Tzenov, P., Nacheva, Y., & Lazarov, Y. (2001) Study on preservation terms of nondiapausing silkworm (*Bombyx mori* L.) eggs at low temperature. *Bulgarian Journal of Agricultural Science*, **7,** 467-470.

Wang, W.B., Leopold, R.A., Nelson, D. R., & Freeman, T.P. (2000) Cryopreservation of *Musca domestica* (Diptera: Muscidae) embryos. *Cryobiology*, 41 (2): 153-166.

Occurrence of Unfertilized Eggs in the Mulberry Silkworm, *Bombyx mori* (L.) (Lepidoptera: Bombycidae)

By

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Quality of seed in the mulberry silkworm, *Bombyx mori* (L.) is determined by many factors of significant importance, wherein unfertilized eggs, arise of abnormality in the sexual organs of the male and female or abnormal development of the micropylar end of the egg besides due to unfavorable environmental conditions during spinning, cocoon preservation, imperfect handling of moths, mating, ovipostion, cold storing of pupae / moths and indiscriminate use of male moths etc. plays an important role

Though the presence of unfertilized eggs would in no way affect the fertilized ones and quality directly, yet the frequency of their occurrence underrates the quality and brings down the hatching percentage. Lower the occurrence of unfertilized eggs, higher is the rating of seed quality.

Of the various intrinsic and extrinsic factors and events of significant importance involved in egg deposition by an adult silk moth, mating an instinct and a biological obligation for the ultimate perpetuation of the species is a must to provide stimulus for oogenesis and brings about biochemical changes in the spermatophore of the silkworm to ensure presence of sufficient number of normal sperms and or testicular fluid in the female reproductive organ to activate ovulation, accelerate oviposition behavior and egg deposition.

An attempt has been made in this study to elucidate the characteristics of unfertilized eggs, causes of their occurrence and its impact on seed quality and to suggest future avenues of investigations to overcome their reoccurrence for the quality seed management in the mulberry silkworm, *Bombyx mori* (L.)

Key words: Unfertilized eggs, *Bombyx mori,* Mating

Effect of varied low temperature preservation of male moths on reproductive parameters in the silkworm *Bombyx mori* L.

By

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ABSTRACT

Silk produced by silkworm Bombyx mori L. a lepidopteran insect that has attained a reputation of luxury and beauty unparalled by other fibres. Concerted efforts made by the breeders in the evolution of highly productive bivoltine silkworm breeds have ushered in a new era of increasing not only the productivity of silk but also its quality. Among a host of factors that are responsible for the success of silkworm crop and stabilization of sericulture industry, quality of silkworm seed is the foremost. The handling techniques adopted during the process of egg production also influences the quality of seed produced. Proper preservation and processing of seed cocoons under ideal conditions play a key role in the production of quality silkworm seed. In practice, the commercial grainages resort to refrigeration of male moths at 5°C before and after mating for synchronization of batches and economical utilization of male moths. The potency of male moths to effectively pair with female moths and contribute to the production of viable eggs depends on its genetic consortium and the energy budget. In the present study some newly evolved promising bivoltine breeds viz., CSR2, CSR3, CSR4, CSR6, CSR16, CSR17, CSR18, CSR19, KA and NB4D2 were utilized. When male moths were preserved at low temperatures of 5, 7.5 and 10° C for a duration of 1, 3, 5 and 7 days and later mated with virgin female moths, results revealed highly significant (P<0.001) variations between treatments. The fresh male moths mated with virgin female moths (control) gave the best results with regard to reproductive parameters. A decreasing trend was observed in all the parameters when the male moths were refrigerated at 10, 7.5 and 5°C with an increased duration of preservation, respectively. Male moths preserved for more than 3 days in all the treatment temperatures gave poor results. In order to synchronize mating of appropriate components, male moths can be preferably consigned at 10°C for not more than 3 days followed by 7.5°C up to 3 days, but not at 5°C as moths consigned at 5°C fail to pair properly and lay more number of unfertilized eggs. Male moths can be safely consigned at 10 and 7.5°C for 1 day without any adverse effect on the reproductive parameters. The performance of male moths refrigerated in all the treatment temperatures for a longer duration of 5 to 7 days was found to be significantly lower with regard to their pairing efficiency and occurrence of unfertilized eggs.

Keywords: Reproductive efficiency, male moth preservation, low temperature preservation

INTRODUCTION

Among a host of factors responsible for the success of silkworm crop and stabilization of sericulture industry, quality of silkworm seed is of paramount importance. Quality silkworm seed means disease free, rich and fertile eggs. Handling techniques adopted during the process of egg production also influences the quality of seed produced. Many of the new silkworm breeds evolved in India are let off into the commercial stream without properly studying the seed production aspects and reproductive potential (Veeraiah, 2001). Such problems can be reduced, if the breeds are subjected to detailed studies with regard to seed technological aspects and reproductive efficiency in order to ensure sustainable performance in the field.

One important factor affecting the quality of silkworm seed is the low temperature preservation of male moth for synchronization of emergence. Proper preservation and processing of seed cocoons under ideal conditions play a key role in the production of quality silkworm seed. However, during exigencies, adoption of low temperature preservation technique for cocoons and moths is resorted to by the seed producers by subjecting seed cocoons / pupae or moths of early emerging breeds to cold storage in order to synchronize mating with the late emerging breeds for egg production. Though this practice is in vogue, there is lack of detailed information about the effect of low temperature on egg recovery, hatchability and crop performance. Female moths of *Bombyx mori* L. refrigerated before mating, laid more sterile eggs and the number increased with the increase in refrigeration period (Roychoudhury *et al*., 1992). Though most of the workers who studied the age related mating in female moths of *B. mori*, opined that there exists a negative correlation between the age of the female moths and fertility level not much work has been carried out by refrigerating male moths. Male sterility is more deleterious and affects the reproductive efficiency of the female moths. Therefore, a study has been conducted to assess the range of temperature and duration at which the male moths can be preserved before mating without causing deleterious effects on egg production efficiency or quality of eggs produced.

MATERIALS AND METHODS

Four elite bivoltine breeds viz., CSR2, CSR4, CSR18, CSR19 and 2 traditional bivoltine breeds viz., KA and NB4D2 were drawn from the germplasm bank of CSR&TI, Mysore, Karnataka, India for the present study.

Silkworm rearing was conducted in 2 staggered batches. Standard rearing techniques as advocated by Kawakami (2001), was followed for generating the parent seed cocoons. The cocoons thus harvested were sorted and assessed for pupation rate, sex separated and preserved separately on corrugated sheets placed in wooden trays and provided optimum essential conditions. The emerged male and female moths were collected separately. Fifty male moths in three replications were preserved at 5, 7.5 and 10°C for a duration of 1, 3, 5 and 7 days. After the prescribed preservation duration the male moths were released and allowed to mate with an equal number of virgin female moths under each treatment for a duration of 3 h. One batch of male moths preserved under optimum conditions served as control.

Later the moths were de-paired manually and allowed for oviposition on egg cards under optimum conditions. Layings were collected after 20h of oviposition, subjected to surface sterilization, treated in Hydrochloric acid and incubated under ideal condition. Data with regard to grainage parameters like pairing, unlaid moths, unfertilized layings, poor layings, good layings, fecundity, unfertilized eggs, un-hatched / Dead eggs and hatched eggs were recorded.

RESULTS

When the male moths were preserved at low temperatures of 5, 7.5 and 10° C for a duration of 1, 3, 5 and 7 days and later mated with virgin female moths, results revealed highly significant ($P<0.001$) variations between treatments with regard to all the parameters studied in all the breeds considered for the study. The fresh male moths mated with virgin female moths (control) gave the best results with regard to reproductive parameters in all the breeds, which was followed by preservation at 10°C for one day and 7.5°C for one day. In KA preservation of male moths even for 3 days at 10°C gave good performance. In general, male moths preserved for more than 3 days in all the treatment temperatures gave poor results. It can be inferred form the study that, in order to synchronize mating of appropriate components of CSR breeds, male moths can be preferably consigned at 10°C and 7.5°C for not more than 3 days, but not at 5°C as moths consigned at 5°C failed to pair properly and laid more number of unfertilized eggs. Male moths can be safely consigned at 10 and 7.5°C for 1 day without any adverse effect on the reproductive parameters in all the breeds, as the results were found to be on par with control, but in case of exigencies can be extended up to 3 days with a loss of about 5% which is negligible. While in case of KA and NB4D2, the male moths can be safely preserved even at 5°C for 1 day without any adverse effect and can be extended up to 3 days in case of exigencies.

DISCUSSION

In order to synchronize eclosion during grainage operations, either proper scheduling of the brushing and rearing of parent seeds or refrigerating pupae or moths is resorted to. In practice, the commercial grainages resort to refrigeration of male moths at 5°C before and after mating for synchronization of batches and economical utilization of male moths. The potency of male moths to effectively pair with female moths and contribute to the production of viable eggs depends on its genetic consortium and the energy budget. Longer the duration of refrigeration between the matings, lower will be the performance of the male moths in terms of pairing ability and egg yield. To avoid deleterious effects on egg production, refrigeration has to be resorted to only once during any one of the developmental stages (Jolly, 1983).

Results of the present study showed highly significant variations between the treatments. A decreasing trend was observed in all the reproductive parameters studied, when the male moths were refrigerated at 10, 7.5 and 5°C with an increased duration of preservation, respectively. Mating of virgin female moths with fresh male moths revealed significantly higher values for all the parameters studied indicating increased vigour and vitality of the fresh male moths resulting in effective pairing, higher egg yield and improved fertility.

However, the male moths of traditional breeds like KA and NB4D2 have shown significantly higher tolerance for 5°C followed by CSR4, CSR2, CSR18, and CSR19. Similar findings have been reported by Vemananda Reddy (2001), when the male moths were refrigerated for lesser duration and used for mating. As the duration of refrigeration increased, the performance of moths decreased significantly. Also, when the male moths were refrigerated at 5°C, the reproductive performance was found to be significantly lower compared to the male moths refrigerated at 7.5 and 10°C for a similar duration. Vemananda Reddy (1999) reported that even when the seed cocoons / pupae were preserved at low temperatures for longer duration, egg parameters like fecundity, unfertilized eggs and hatchability were adversely affected irrespective of age of pupae and temperature of preservation. Further increase in the duration of preservation leads to aging of male moths which can also attribute to less pairing efficiency and less productivity which is in conformity with the studies made by Haniffa and Thatheyus (1992).

Autogenous insects like *Bombyx mori,* which do not feed in imaginal stage, utilize the reserve food energy. Since the adult is a non feeding stage, it hardly finds any energy for reproductive purpose with an increase in age. Moreover, the reproductive potential is also affected by the endocrine mechanism which is under the control of nutritional factors. Takemura *et al.* (1999), demonstrated that even in artificial insemination, the male moths cold stored for longer duration lost their mating ability thus failing to have a positive impact on the reproductive efficiency, which supports the observations made in the present study.

Though many workers (Kovalev, 1970; Ayuzawa *et al.,* 1972; Krishnaswami *et al*., 1973; Ullal and Narasimhanna 1978 and Jolly, 1983) who studied the effect of male moth preservation at low temperatures for different durations, arrived at different conclusions, it could be inferred from the above findings, that the performance of male moths refrigerated in all the treatment temperatures for a longer duration of 5 to 7 days was found to be significantly lower with regard to their pairing efficiency and occurrence of unfertilized eggs. It is therefore suggested that, in order to get the desired positive results, mating virgin female moths with fresh male moths should be adopted. However, in case of exigencies, male moths can be refrigerated at 10°C and 7.5°C for one to three days before mating and can be effectively utilized, without having deleterious effect on the reproductive parameters. However, preservation of male moths beyond three days will not only affect the fertility but also the productivity.

REFERENCES

Ayuzawa, C., I. Sekido, K. Yamakawa, U. Sakurai, W. Kurata, Y. Yaginuma and Y. Tokoro (1972) *Hand Book of Silkworm Rearing*. Fuji Publishing Company, Tokyo, Japan.

Haniffa, M.A., A.J. Thatheyus (1992) Effect of age related mating schedule on reproduction in the silkworm, *Bombyx mori* L., *Sericologia*, **32(2):** 217-225.

Jolly, M.S. (1983) Organisation of industrial bivoltine grainage for tropics. Sericulture project 3, Central Sericultural Research and Training Institute, Mysore, India.

Kawakami, K. (2001) Illustrated working process of new bivoltine silkworm rearing technology, JICA, PPPBST Project, CSR&TI, Mysore, India.

Kovalev, P.A. (1970) Silkworm breeding stocks. Published by Central Silk Board, Meghdoot, 95-B Marine drive, Bombay, India.

Krishnaswamy, S., M. N. Narasimhanna, S.K. Suryanarayan, S. Kumararaj (1973) Manual on sericulture: *Silkworm rearing* **Vol II**, Food and Agriculture Organisation of the United Nations, Rome.

Roychoudhury, N., R. Basu., M. Shamsuddin and S.C. Goel (1992) Effect of refrigeration on fecundity and hatching potentiality of silkworm *Bombyx mori* L. (race nistari), *Bioecology and control of insect pests*.

Takemura, Y., T. Kanda, Y. Horie (1999) Effect of long term cold storage of male pupae and moth on reproductive ability of sperm in the silkworm *Bombyx mori., Journal of Sericultural Science of Japan*, **68(2):** 133-137 (Japanese).

Ullal, S.R., M.N. Narasimhanna (1978) Handbook of practical sericulture. Published by Central Silk Board, Meghdoot, 95-B Marine drive, Bombay, India.

Veeraiah, T.M. (2001) Importance of seed technology support to silkworm *breeding*, In: *Abs. of Silkworm Breeders meet*, Central Silk Board, Dehradun, India, 18-19 Oct. 2001.

Vemananda Reddy, G., Vijayalakshmi Rao and M.V. Samson (1999) Role of embryonic stage during long term preservation of bivoltine silkworm, *Bombyx mori* L. eggs on hatchability. Abs. in *Breeders scientist interaction issues related to germplasm maintenance, protection and utilization*, 10th Feb. CSGRC, Hosur.

Vemananda Reddy, G., C.R. Hegde and T. M. Veeraiah (2001) Impact of cold storage of seed cocoons on moth emergence, laying recovery, fertility and fecundity in silkworm, *Bombyx mori* L., *National seminar on Mulberry Sericulture Research in India*, 26th and 27th Nov. 2001, KSSRDI, Thalagattapura, Bangalore. Abstract No. 182.

Table 1: Effect of varied temperatures during male moth preservation on reproductive parameters in CSR2

Treatment Temp (°C)	Treatment Dur. (days)	Pairs (No.)	ULM (No.)	PL (No.)	UFL (No.)	GL (No.)	Fec. (No.)	UF (%)	UH/D (%)	H (%)	Avg. EI	Rank
5	**1**	97	3	2	2	90	576	2.19	1.92	95.90	**57.21**	**IV**
5	**3**	95	3	3	2	87	574	2.67	2.86	94.46	**52.26**	**VII**
5	**5**	92	4	3	3	82	567	3.66	4.07	92.29	**45.29**	**X**
5	**7**	87	7	7	5	68	565	5.33	4.54	90.63	**30.32**	**XIII**
7.5	**1**	97	3	2	1	91	573	1.98	2.28	95.74	**57.79**	**III**
7.5	**3**	96	3	2	1	90	571	1.98	3.20	94.80	**55.57**	**V**
7.5	**5**	93	3	2	2	86	567	2.73	4.23	93.02	**49.57**	**VIII**
7.5	**7**	91	5	3	2	81	566	4.56	4.64	91.32	**43.23**	**XI**
10	**1**	96	2	2	1	91	564	1.81	1.86	96.32	**57.84**	**II**
10	**3**	97	3	2	2	90	559	2.39	3.44	94.18	**53.24**	**VI**
10	**5**	93	3	2	2	86	555	3.14	4.76	92.13	**47.12**	**IX**
10	**7**	89	5	3	3	78	541	3.76	4.53	91.02	**38.85**	**XII**
25	**0**	97	2	2	1	92	574	1.76	0.79	97.44	**61.73**	**I**
CD P<0.001												
Temp.		**0.61**	**0.41**	**0.45**	**0.33**	**0.80**	**3.11**	**0.33**	**0.30**	**0.61**		
Duration		**0.61**	**0.41**	**0.45**	**0.33**	**0.80**	**3.11**	**0.33**	**0.30**	**0.61**		
Temp. x Dur.		**1.22**	**0.83**	**0.89**	**0.66**	**1.60**	**6.21**	**0.66**	**0.60**	**1.21**		

ULM - Unlaid moth
PL - Poor laying
UFL - Unfertilized laying
GL - Good laying
UF - Unfertilized eggs
UH/D - Unhatched/Dead eggs
H - Hatched eggs
EI - Evaluation Index

Table 2: Effect of varied temperatures during male moth preservation on reproductive parameters in CSR4

Treatment Temp (°C)	Treatment Dur. (days)	Pairs (No.)	ULM (No.)	PL (No.)	UFL (No.)	GL (No.)	Fec. (No.)	UF (%)	UH/D (%)	H (%)	Avg. EI	Rank
5	**1**	95	2	2	2	89	525	2.44	2.80	94.80	**56.92**	**IV**
5	**3**	96	3	3	3	87	524	2.59	3.59	93.83	**52.83**	**VII**
5	**5**	94	4	4	3	83	521	3.19	3.94	92.84	**45.46**	**X**
5	**7**	87	4	4	4	75	511	6.24	4.63	89.13	**28.88**	**XIII**
7.5	**1**	97	2	3	2	90	527	2.09	2.68	95.24	**58.90**	**III**
7.5	**3**	96	3	3	2	88	526	2.60	3.32	94.10	**54.83**	**VI**
7.5	**5**	95	3	3	2	87	523	3.00	4.09	92.93	**49.32**	**VIII**
7.5	**7**	93	4	4	3	82	518	3.90	4.54	91.53	**39.97**	**XI**
10	**1**	97	3	2	2	90	529	2.01	3.09	94.92	**59.14**	**II**
10	**3**	97	3	3	2	89	525	2.49	3.59	93.92	**54.87**	**V**
10	**5**	95	4	3	3	85	524	2.73	4.32	92.93	**48.27**	**IX**
10	**7**	93	4	4	4	81	519	3.87	5.16	90.99	**38.45**	**XII**
25	**0**	98	2	2	1	93	529	2.06	2.40	95.54	**62.18**	**I**
CD P<0.001												
Temp.		**0.45**	**0.44**	**0.35**	**0.33**	**0.65**	**1.94**	**0.37**	**0.30**	**0.44**		
Duration		**0.45**	**0.44**	**0.35**	**0.33**	**0.65**	**1.94**	**0.37**	**0.30**	**0.44**		
Temp. x Dur.		**0.90**	**0.88**	**0.70**	**0.66**	**1.30**	**3.87**	**0.73**	**0.59**	**0.89**		

ULM - Unlaid moth
PL - Poor laying
UFL - Unfertilized laying
GL - Good laying
Fec. - Fecundity

UF - Unfertilized eggs
UH/D - Unhatched/Dead eggs
H - Hatched eggs
EI - Evaluation Index

Table 3: Effect of varied temperatures during male moth preservation on reproductive parameters in CSR18

Treatment Temp (°C)	Treatment Dur. (days)	Pairs (No.)	ULM (No.)	PL (No.)	UFL (No.)	GL (No.)	Fec. (No.)	UF (%)	UH/D (%)	H (%)	Avg. EI	Rank
5	**1**	95	3	3	3	86	538	3.06	2.09	94.86	**55.17**	**IV**
5	**3**	94	4	3	3	84	534	3.87	3.17	94.66	**50.64**	**VI**
5	**5**	91	5	3	4	79	530	5.81	4.36	91.99	**42.91**	**X**
5	**7**	86	8	7	5	66	521	9.07	4.86	88.26	**27.21**	**XII**
7.5	**1**	95	3	2	2	88	544	2.39	2.12	95.49	**57.22**	**III**
7.5	**3**	95	3	2	3	87	537	2.78	2.80	95.94	**54.88**	**V**
7.5	**5**	92	3	3	3	83	535	4.31	3.74	93.53	**49.35**	**VIII**
7.5	**7**	91	6	4	3	78	529	6.89	4.49	90.24	**41.07**	**XI**
10	**1**	96	3	2	2	89	546	2.04	1.87	96.09	**58.88**	**II**
10	**3**	95	3	2	3	87	542	2.64	2.68	95.18	**55.17**	**IV**
10	**5**	93	3	3	3	84	536	3.68	3.42	93.50	**50.22**	**VII**
10	**7**	91	5	4	3	79	534	5.47	3.99	90.70	**43.26**	**IX**
25	**0**	96	2	2	1	91	564	2.41	0.71	96.87	**64.01**	**I**
CD P<0.001												
Temp.		**0.50**	**0.43**	**0.41**	**0.40**	**0.78**	**3.65**	**0.42**	**0.24**	**1.59**		
Duration		**0.50**	**0.43**	**0.41**	**0.40**	**0.78**	**3.65**	**0.42**	**0.24**	**1.59**		
Temp. x Dur.		**0.99**	**0.85**	**0.82**	**0.80**	**1.56**	**7.30**	**0.84**	**0.49**	**3.19**		

ULM - Unlaid moth
PL - Poor laying
UFL - Unfertilized laying
GL - Good laying
Fec. - Fecundity

UF - Unfertilized eggs
UH/D - Unhatched/Dead eggs
H - Hatched eggs
EI - Evaluation Index

Table 4: Effect of varied temperatures during male moth preservation on reproductive parameters in CSR19

Treatment Temp (°C)	Treatment Dur. (days)	Pairs (No.)	ULM (No.)	PL (No.)	UFL (No.)	GL (No.)	Fec. (No.)	UF (%)	UH/D (%)	H (%)	Avg. EI	Rank
5	**1**	95	3	3	2	87	478	1.64	2.32	96.02	**56.76**	**IV**
5	**3**	94	3	3	2	86	472	1.96	3.44	94.59	**50.36**	**VIII**
5	**5**	93	4	4	3	82	462	2.64	3.83	94.72	**42.59**	**XI**
5	**7**	89	5	5	4	75	450	4.86	4.23	92.42	**28.05**	**XIII**
7.5	**1**	96	2	2	2	90	481	1.72	2.46	95.80	**59.31**	**III**
7.5	**3**	96	3	3	2	88	476	2.21	3.10	94.67	**53.78**	**VI**
7.5	**5**	95	3	3	3	86	472	2.67	3.29	95.13	**50.12**	**IX**
7.5	**7**	94	3	4	4	83	464	4.04	4.02	92.83	**40.13**	**XII**
10	**1**	97	3	2	2	90	480	1.80	2.24	95.97	**59.48**	**II**
10	**3**	96	3	3	3	87	478	2.04	2.81	95.14	**54.18**	**V**
10	**5**	95	3	3	3	86	475	2.42	3.10	95.14	**50.55**	**VII**
10	**7**	93	4	4	4	81	479	3.39	3.41	93.34	**43.39**	**X**
25	**0**	98	2	2	2	92	487	2.29	2.19	96.12	**61.30**	**I**
CD P<0.001												
Temp.		**0.39**	**0.36**	**0.32**	**0.29**	**0.67**	**4.26**	**0.37**	**0.32**	**1.08**		
Duration		**0.39**	**0.36**	**0.32**	**0.29**	**0.67**	**4.26**	**0.37**	**0.32**	**1.08**		
Temp. x Dur.		**0.78**	**0.72**	**0.64**	**0.59**	**1.34**	**8.53**	**0.73**	**0.65**	**2.16**		

ULM - Unlaid moth
PL - Poor laying
UFL - Unfertilized laying
GL - Good laying
Fec. - Fecundity

UF - Unfertilized eggs
UH/D - Unhatched/Dead eggs
H - Hatched eggs
EI - Evaluation Index

Table 5: Effect of varied temperatures during male moth preservation on reproductive parameters in KA

Treatment Temp (°C)	Treatment Dur. (days)	Pairs (No.)	ULM (No.)	PL (No.)	UFL (No.)	GL (No.)	Fec. (No.)	UF (%)	UH/D (%)	H (%)	Avg. EI	Rank
5	**1**	97	3	2	2	90	534	1.90	1.50	96.63	**52.52**	**VI**
5	**3**	96	4	2	2	88	533	2.03	2.00	96.00	**47.40**	**IX**
5	**5**	94	4	3	3	84	523	2.47	2.10	95.40	**41.68**	**XI**
5	**7**	91	6	5	3	77	520	3.20	2.93	93.83	**29.76**	**XIII**
7.5	**1**	98	3	1	2	92	566	1.47	1.30	97.23	**56.19**	**IV**
7.5	**3**	97	3	2	2	90	560	1.50	1.47	97.03	**55.09**	**V**
7.5	**5**	95	3	2	2	88	565	2.27	2.10	95.70	**49.49**	**VIII**
7.5	**7**	93	5	4	1	83	555	2.83	2.43	94.73	**41.59**	**XII**
10	**1**	98	2	2	2	92	575	1.10	1.00	97.90	**59.64**	**II**
10	**3**	97	2	2	2	91	574	1.20	1.10	97.70	**57.61**	**III**
10	**5**	96	2	2	3	89	565	1.83	1.53	96.60	**51.00**	**VII**
10	**7**	93	5	2	3	83	563	1.90	1.67	96.43	**45.51**	**X**
25	**0**	99	1	1	1	96	577	1.57	0.37	98.03	**62.52**	**I**
CD P<0.001												
Temp.		**0.38**	**0.31**	**0.31**	**0.31**	**0.61**	**4.99**	**0.27**	**0.32**	**0.40**		
Duration		**0.38**	**0.31**	**0.31**	**0.31**	**0.61**	**4.99**	**0.27**	**0.32**	**0.40**		
Temp. x Dur.		**0.76**	**0.62**	**0.62**	**0.63**	**1.22**	**9.99**	**0.54**	**0.64**	**0.80**		

ULM - Unlaid moth
PL - Poor laying
UFL - Unfertilized laying
GL - Good laying
Fec. - Fecundity

UF - Unfertilized eggs
UH/D - Unhatched/Dead eggs
H - Hatched eggs
EI - Evaluation Index

Tasar Silkworm Seed Production in Private Sector under Special SGSY Projects in Bihar and Jharkhand - A Breakthrough

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ABSTRACT

Among non-mulberry silks, which are also termed as vanya silks, tropical tasar culture is practiced by over 1.5 lakh tribal populace in different States of India. Quality tasar silkworm seed, which plays a vital role in productivity, sustainability and profitability of sericulture industry, continue to be the main constraint. Though Basic Seed Multiplication and Training Centres (BSM&TC) under Central Silk Board (CSB) to produce basic seed and Pilot Project Centres (PPC) by States are established for multiplication of basic seed, seed multiplication systems have not reached optimum level in most of the tasar producing States and tasar silkworm seed production/ supply in organized sector has not been able to meet the entire requirement due to various reasons. This warranted the entry of private sector to cater the needs of required tasar basic and commercial seed. Central Silk Board with the help of some reputed NGOs through various development initiatives viz., United Nations Development Programme (UNDP) assisted Project, Catalytic Development Programme (CDP) schemes of CSB during IX and X Plan periods brought in the entrepreneurial thinking among tribals, to produce tasar commercial seed. The concept of private graineurs has proved to be very beneficial in this sector. Moving a step ahead, under Special Swarnajayanti Gram Swarojgar Yojana (SGSY) Projects in Bihar and Jharkhand, Central Silk Board with the help of an NGO, Professional Assistance for Development Action (PRADAN) achieved remarkable success in production of nucleus seed cocoons by Adopted Seed Rearers and processing of the same for production of quality tasar basic seed through private graineur groups, besides augmenting the supply of tasar commercial seed supply by private graineurs. Need for various seed multiplication levels, seed multiplication system adopted under the Special SGSY Projects, progress achieved under nucleus seed cocoon production, preservation and processing of nucleus seed cocoons by graineur groups and production of tasar commercial dfls under the Projects are discussed. Income levels of private graineurs and improvement in their socio-economic status are also discussed besides suggesting the future strategies for a healthy and viable seed multiplication in tasar sector, with lots of opportunities to tribal entrepreneurs.

Key words: Tasar culture, Silkworm seed, Central Silk Board, PRADAN, Private graineurs

INTRODUCTION

Sericulture is an agro-based cottage industry providing income and employment generating opportunities to rural poor and tribals. Among non-mulberry silks, which are also termed as *vanya* silks, tasar culture is practiced by over 1.5 lakh tribal populace in the States of Jharkhand, Chhattisgarh, Orissa, Madhya Pradesh, Uttar Pradesh, West Bengal, Bihar, Maharashtra and Andhra Pradesh of the country. India is the second largest producer of tasar silk next only to China and contributes to about 4% of the India's total silk export earnings. Tasar culture is a continuous chain of several production activities. It starts with either collection of nature grown cocoons from forests or rearing of silkworm on forest/ raised flora by rearers for production of cocoons. These cocoons are utilized by reelers and weavers for production of yarn and fabrics. Earlier, economics from tasar culture could not be compared to the income from other agricultural/ horticultural crops mainly because the tasar farmers used to practice tasar culture as an alternative source of livelihood and not as main source. Tasar culture is practiced as a seasonal activity and in general farmers take up only one or two crops, which involves hardly two to three months of family labour.

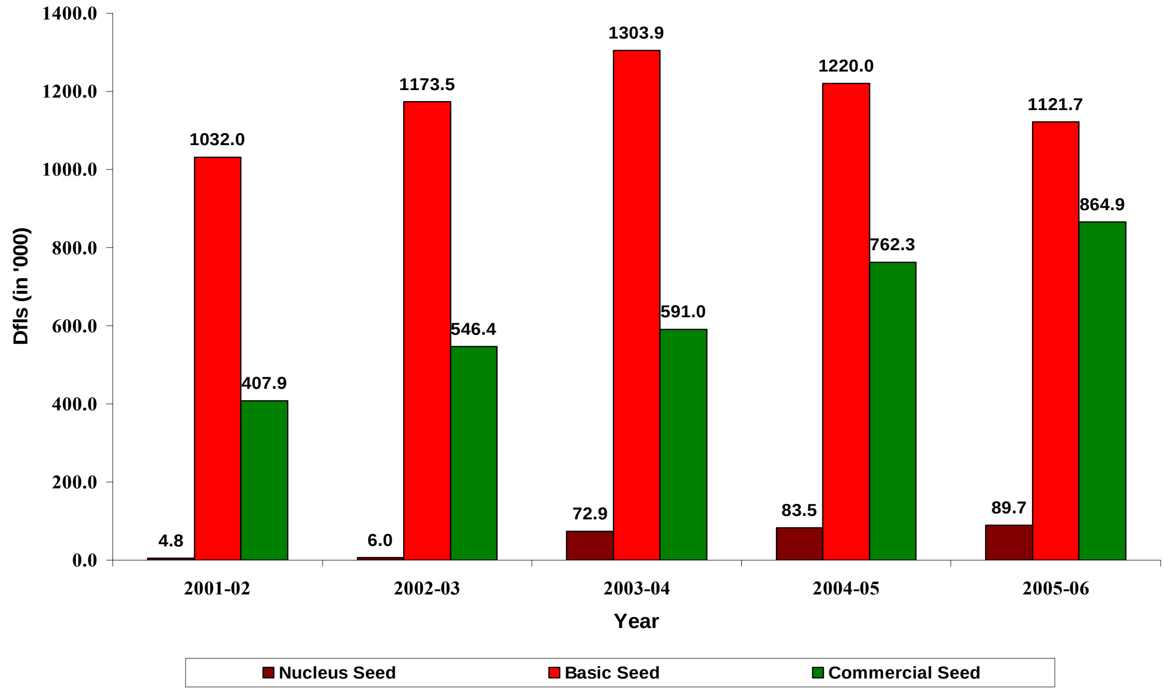
Table-1: BSM&TCs of Central Silk Board in Tasar Producing States

Sl. No.	State	No.of BSMTCs	Location
1	Jharkhand	4	Kathikund, Madhupur, Kharswan, Deogarh
2	Bihar	1	Bhagalpur
3	Chattishgarh	5	Pali, Boirdadar, Bastar, Bilaspur, Ambikapur
4	Madhya Pradesh	1	Balaghat
5	Orissa	4	Nowrangpur, Pallahara, Baripada, Sundergarh
6	Andhra Pradesh	3	Chinnoor, Rampa Choda Varam, Narsapur
7	Maharastra	1	Bhandara
8	West Bengal	1	Patelnagar
9	Uttar Pradesh	1	Dudhi

Of the different stages of life cycle of tasar silkworm, *Antheraea mylitta* D., quality tasar silkworm seed, which is an important seri-input, plays vital role in productivity, sustainability and profitability of sericulture industry, continue to be the main constraint. Seed multiplication in tasar sector is an important area, which calls for immediate attention and improvement.

Seed Multiplication System in Tasar Sector: In order to produce quality silkworm seed in adequate quantity during suitable brushing period several multiplication levels are required. Under the present seed multiplication system in tasar, Central Tasar Research & Training Institute (CTR&TI), Ranchi is supplying the elite seed to Central Tasar Silkworm Seed Station (CTSSS), Kargi-Kota with its field Station at Sehora in Madhya Pradesh which multiplies the same for one generation and supplies the nucleus seed to Basic Seed Multiplication and Training Centres (BSM&TCs) at 21 locations (**Table-1**) for further multiplication. Nucleus seed thus supplied from CTSSS is reared under supervision of BSM&TCs, nucleus seed cocoons processed to produce basic seed. The basic seed is supplied to State Pilot Production Centres (PPCs) for further multiplication and preparation of commercial seed for its supply to the commercial rearers. The BSM&TCs also prepare smaller quantity of commercial seed and supply to the states to supplement the efforts of around 110 PPCs. Each BSMTC has to produce 40,000 dfls and supply 32000 dfls to 8 PPCs @ 4000 dfls per PPC. 8 PPCs in turn have to produce 3.2 lakh dfls covering 3200 rearers @ 100 dfls per rearer. Details of supply of tasar seed by BSM&TCs in the last five years is furnished at **Table-2**.

Table-2: Supply of Tasar Silkworm Seed by CSB Units



However, poor functioning of PPCs in several states has resulted in the gap between demand and supply of tasar commercial seed. Though the required basic seed is almost fulfilled by CSB and assistance provided for strengthening PPCs, still the seed multiplication systems have not reached optimum level in most of the tasar producing states. In order to motivate the States, CSB has even taken up programme of adoption of PPCs and demonstrated the feasibility of achieving optimum multiplication level of commercial seed from basic seed. However, the desired results are still awaited from state run PPCs and growing needs of the tasar silk industry with respect to quality silkworm seed in particular, are not met due to various reasons. Most important being non-multiplication of the tasar seed supplied by CSB to the desired levels by the states. Details of supply vis-à-vis requirement and the present gap in the supply are furnished at **Table-3**. Major constraints in tasar seed multiplication are detailed below.

- Non-multiplication of tasar basic seed at PPCs to the desired multiplication ratio.
- Poor infrastructure, lack of skilled staff and timely supply of required inputs, poor levels of technology adoption at PPCs.
- Absence of demarcated seed zones for seed rearing and quality seed production.
- Lack of clear policy at state level with regard to bivoltine and trivoltine zones.
- Slow implementation of private graineurs scheme and monitoring.
- Non-replenishment of seed stock of CTSSS through supply of breeders' stock.
- Increasing pressure on BSM&TCs to take up nucleus seed rearing, basic seed production and also commercial seed production.

Above constraints coupled with thought process of tasar farmers, treating tasarculture just as livelihood opportunity and not as a commercial venture, have not attracted any entrepreneurial attention. Further, due to ban on new recruitments in government sector, low motivation levels, poor service conditions and shortage of resources, demand for quality tasar sikworm seed is on a constant rise. This warranted the entry of private sector to cater the needs of this important seri-input. Long-term objective of any developmental programme/ activity is to gain insight in to the vision and perspective of stakeholders in the sector with reference to the activities, build sustainable business models, which should be economically replicable, and develop long-term policy and operational perspectives for the future. However, unpredictable group behaviour and the untested ability of the stakeholders to accept new concepts are the some of the issues to be dealt with.

Private participation in tasar silkworm seed production: Central Silk Board with the help of some reputed NGOs through various development initiatives viz., United Nations Development Programme (UNDP) assisted Project, Catalytic Development Programme (CDP) schemes of CSB during IX and X Plan periods brought in the business sense among tribals, roping in their entrepreneurial abilities by building other required capacities and a business model has been built, which is economically replicable. The concept of private graineurs has proved to be very beneficial in this sector. Augmentation of commercial seed through private graineurs in muga and eri sector was reported by Bhat *et.al.,* 2006. In case of Bihar and Jharkhand, NGO, Professional Assistance for Development Action (PRADAN) achieved remarkable success through groups and individuals by creating self reliant and sustainable production enclaves, which was evident through increased incomes, improved lifestyles and quality of life. A notable criterion of success is that the age profile of the new entrants to tasar culture is lesser than the normal averages, indicating that the youth of the area find it an attractive income generation activity. The annual migration out of the project villages has also proportionately decreased. An attempt, however, should be made to have a profit-sharing team approach, without constricting individual initiative. However, some gaps were left unattended like linking with other state programmes and schemes, especially the provision of credit and construction of grainage houses.

Table-3: Demand and supply of Tasar Silkworm Seed

Sl. No.	Particulars	Quantity of tasar dfls (in Lakh nos.)
1	Estimated annual requirement*	144.00
2	Supply by CSB during 2004-05	19.82
3	Actual demand for tasar commercial seed	86.55
4	Estimated supply by the States	50.16
5	Demand and supply gap$	74.02

*** Based on the availability of tasar food plants**
$ Actual gap is around 55-60 lakhs, as private graineurs are expected to supply around 15-20 lakh dfls
(Source: Chakravorty and Khanna, 2007)

MATERIALS AND METHODS:

With the positive response under UNDP Project, where the concept of private graineurs for production of commercial seed was well received by enterprising and educated tribal youth in tasar sector, as a viable rural enterprise, under the Special Swarnajayanti Gram Swarojgar Yojana (SGSY) Projects in Bihar and Jharkhand with the assistance from the Ministry of Rural Development, Govt. of India in the States of Bihar and Jharkhand, Central Silk Board with the help of an NGO, Professional Assistance for Development Action (PRADAN) achieved remarkable success in production of nucleus seed cocoons by Adopted Seed Rearers and processing of the same for production of quality tasar basic seed through private graineur groups, besides augmenting the supply of tasar commercial seed supply by private graineurs. Even the preservation and processing of nucleus seed cocoons by graineur groups for production of basic seed was successfully taken up, though on a small scale. Seed multiplication model adopted under the Projects is detailed at **Table-4**.

Table-4: Seed Multiplication model under Special SGSY Projects

Sl. No.	Particulars	Present System	SGSY Project Model
1	Breeder's / Elite Seed	CTR&TI	CTSSS
2	Elite seed rearing	CTSSS (DR)	CTSSS (DR)
3	Nucleus seed production	CTSSS	BSM&TCs
4	Nucleus seed rearing	BSM&TCs (DR)	BSM&TCs (ASRs)
5	Basic seed production	BSM&TCs	BSM&TCs & Graineur groups
6	Basic seed rearing	PPCs (DR & rearers)	Seed Rearers
7	Commercial seed production	PPCs	Private Graineurs
8	Commercial seed rearing	Commercial rearers	Commercial rearers

DR- Departmental Rearing ***ASR – Adopted Seed Rearers***

The concept of Adopted Seed Rearers (ASR) was introduced under the projects to conduct rearing of Nucleus seed and produce quality seed cocoons, the activity hitherto undertaken wholly by BSM&TCs of Central Silk Board. This has been introduced to strengthen the efforts of BSM&TCs and meet the entire basic seed requirement by the BSM&TCs located in the Project state. Adopted Seed Rearers (ASRs) were selected based on the requirement of each BSM&TC and their location within their vicinity for easy monitoring and supervision. Pogressive tasar rearers with consistent good record in production of tasar cocoons and having well maintained block plantation of 1 ha. were selected as ASRs by BSM&TCs and PRADAN for conducting the rearing of Nucleus seed during the commercial crop season. The selected seed cocoons were procured by the BSM&TC/ Graineur groups concerned for preservation and processing to produce basic seed during the next season. The ASRs entered into a written agreement with the attached BSM&TC for conduction and production of cocoons from the dfls supplied by the BSM&TC under its close supervision and monitoring. Assistance for maintenance of block plantation and rearing equipment was provided besides extending the insurance cover to the silkworm crops as well as the rearers.

Selection of the private graineurs was done by PRADAN by following Participatory Rural Appraisal (PRA) techniques. Priority was given to unemployed educated rural youth/women, progressive seed rearers, and enterprising commercial rearers. Identified private graineurs were trained in latest seed production technology, moth examination techniques for production and supply of quality disease free seed to commercial rearers. These grainages were equipped with all necessary equipment and provided with management inputs for successful running of the enterprise, in maintaining records etc. PRADAN organized these grainures in to suitable manageable groups and assisted them in establishing backward and forward linkages with the seed rearers for seed cocoon and commercial rearers, reelers and spinners for selling the end products.

Each private graineur has capacity to process 20,000 seed cocoons and shall produce 10 kg i.e., 5,000 dfls in a season and supply commercial disease free seed @ 2 gm per dfl. While majority of them conducted only one grainage operation processing Bivoltine race, some of them would be conducting the second grainage operation of Trivoltine race also, thus two grainage operations in a year. Project assistance was extended towards grainage equipment, grainage building and consumables. The graineurs were linked with financial institutions for credit facilities for working capital requirement for purchase of seed cocoons from basic seed rearers and other consumables.

Besides extending assistance for supply of critical inputs to ASRs, Graineur Groups for preservation and processing of nucleus seed cocoons and private graineurs and training, a Technical Committee was constituted by the Central Silk Board with experts to periodically test the cocoons, pupae, moths and eggs to monitor the incidence of any diseases, thus ensuring quality of basic seed and commercial seed produced under the Projects.

RESULTS AND DISCUSSION:

Under the Special SGSY Projects in Bihar and Jharkhand, during the period from 2003-04 to 2006-07, 1395 Adopted Seed Rearers brushed 2.58 lakh nucleus seed and produced 109 lakh nucleus seed cocoons at 45 cocoons per dfl against the target of 50 cocoons. BSM&TCs procured about 40 lakh seed cocoons for production of basic seed.

2792 seed rearers brushed 6.2 lakh basic seed supplied from BSM&TCs during the above period and produced 205 lakh seed cocoons at 34 cocoons/ dfl against the target of 40 cocoons. To process these cocoons, 228 private graineurs were supported to conduct 872 grainage operations resulting in production of 25.6 lakh dfls from 115 lakh seed cocoons at cocoon: Dfl ratio of 4.44: 1 against the target of 4:1.

Besides the above, in order to augment the efforts of BSM&TCs in basic seed production, few enterprising graineur groups were motivated to take up preservation of about 5 lakh nucleus seed cocoons during 2006-07 at seven different Project locations utilizing the infrastructure created under the Projects. Due to rearing in isolated block plantations raised under the Projects, preservation in newly constructed buildings and processing under professional supervision of PRADAN and CSB personnel, the preserved lots revealed less than 1% of disease with minimum preservation loss. It is expected that the groups to produce around 60,000 dfls of basic seed. This is a laudable achievement under the Projects as this activity was taken up successfully under private sector in tropical tasar, for the first time in the country.

Graineur as Private Entrepreneur: Though private graineur concept was introduced in other tasar producing states, it could not sustain on its own without constant monitoring and assistance, as the entrepreneurial capabilities were lacking in them. Under these Projects, PRADAN in addition to equipping the private graineurs with technical capabilities through technical training with the help of BSM&TCs scientists in the Project areas has also trained them in other important aspects like client servicing, labour management, motivation training to built in risk taking behaviour, Accounts training to keep track of inflow and outflows of various financial transaction and understand the cost-benefits, management of working capital and credit recovery. This helped the private graineur to take up grainage operation as and enterprise so that it can sustain even after the completion of the Projects.

Creating a Pool of Service Providers: Under the Projects, in addition to above activities, a pool of resource persons in the villages capable of delivering different kinds of services efficiently and cost effectively to the producers. Their services are critical for strengthening various systems and linkages to sustain and expand this livelihood activity. Services such as technology transfer, providing on-the-job support, quality monitoring, accounts maintenance and sustaining linkage with the input output market are critical functions. Few to name are trainers who are employed to help new producer groups in acquiring technical skills various activities, Microscopists, who are experts in carrying out microscopic examination in the grainages and Input procurers, who procures critical inputs like basic seed etc., from different places and deliver to remote villages located in forests, within the stipulated time.

Graphical presentation of the achievements in the seed sector under the Special SGSY Projects in Bihar and Jharkhand are furnished at **Tables-5 to 7**.

Table-5: Beneficiaries covered in Seed Sector under Special SGSY Projects

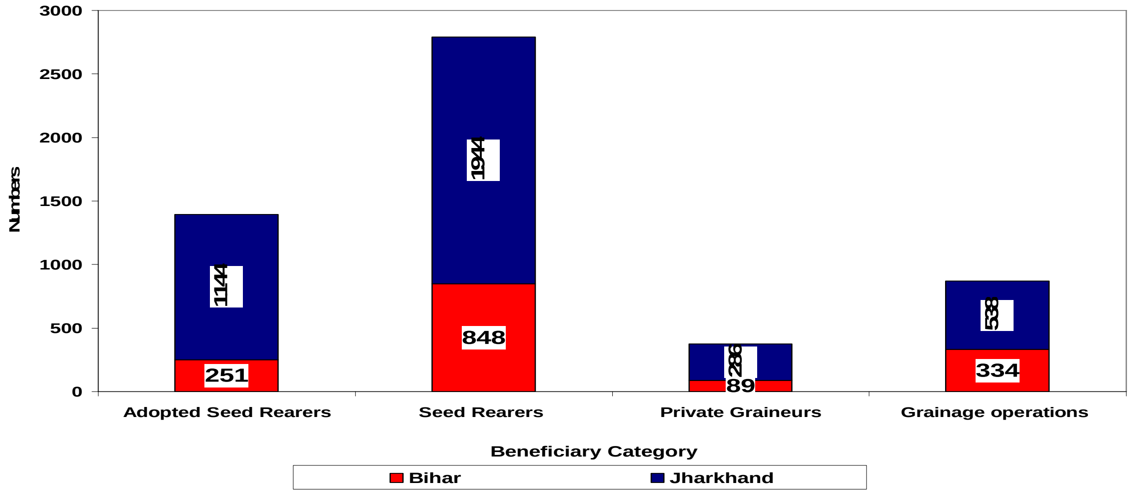


Table-6: Nucleus and Basic Seed brushed under Special SGSY Projects

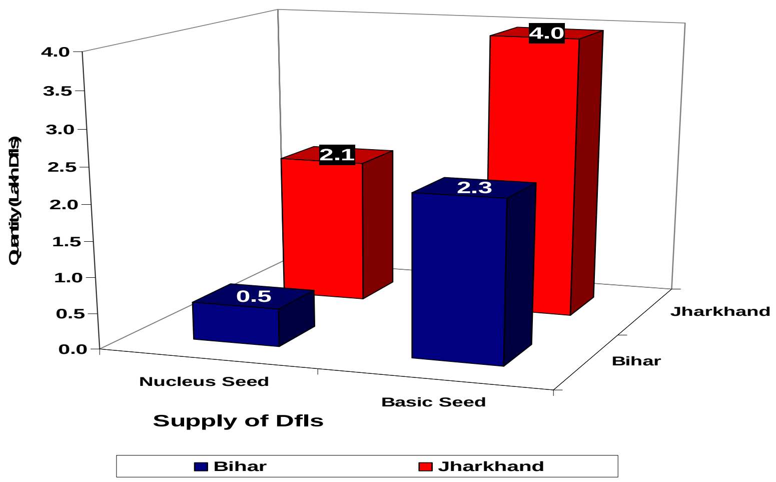
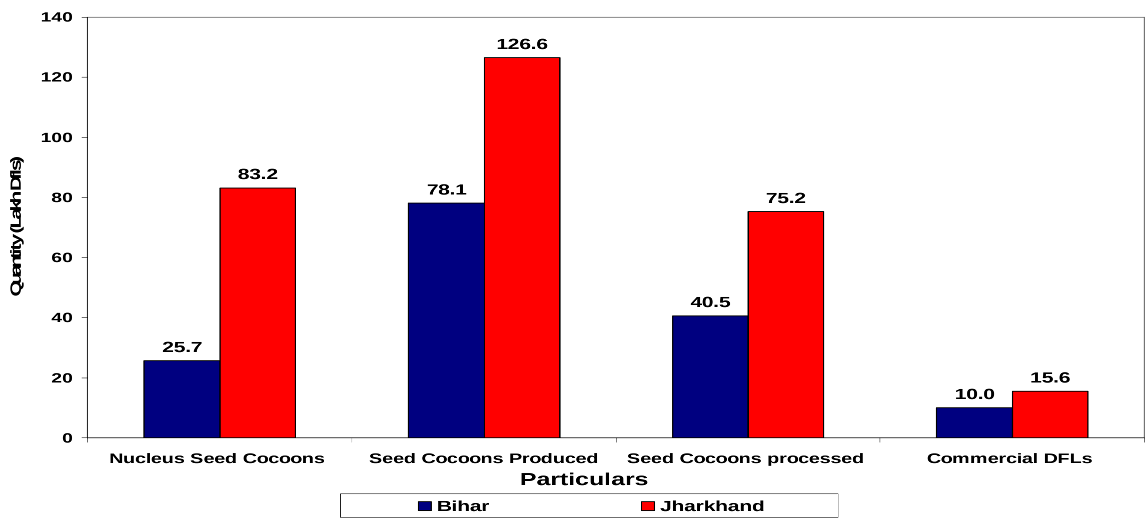


Table-7: Seed Cocoons Processed and Commercial Dfl Production under Special SGSY Projects



Tasar private graineurs incomes under the Projects during 2006-07, ranged between Rs. 15,000/- to Rs. 25,000/- per grainage operation, within a span of around one month. Entire requirement of commercial seed in the Project area was met through these seri-input businessmen i.e., private graineurs, besides extending helping hand to BSM&TCs in various technical activities. A preliminary survey on the utilization of profits out of private grainage operation revealed that the profit utilization was on agriculture (28%), bank/ post office deposits (21%), house construction/ repairs/ renovation (15%), household expenditure (10%), business (9%), loan repayments (7%), marriage of children (5%) and balance on education and health of family members.

Future Strategies:

Though remarkable achievements have been made under the Special SGSY Projects in Bihar and Jharkhand in roping private participation in tasar seed multiplication, this need to be replicated in other tasar producing states for empowerment of tribals involved in this culture. Some of the strategies suggested are mentioned below.

- Development of an integrated and synergetic approach among the Central Silk Board, State Sericulture Departments and Non-Governmental Agencies (NGOs) involved in tasar culture.
- Identification and demarcation of seed zones for procurement of seed cocoons.
- Development of a policy on pricing of seed cocoons and insurance for seed rearers to take up seed rearing during adverse seasons and to graineurs to take care of risk during disease incidence.
- Periodic monitoring of seed multiplication related activities including disease assessment and certification of seed produced at various levels.
- Strengthening of PPCs to take care of basic seed requirement with involvement of NGOs, wherever possible to develop required linkages between private graineurs, seed rearers, commercial rearers and spinners.
- Systematic exposure of bankers at different levels and policy advocacy are required so that Private Graineurs do not face difficulty in accessing credit from banks to meet their working capital requirements.
- A policy decision needs to be taken so that BSM&TCs may concentrate only on basic seed production instead of diluting their efforts in both basic and commercial seed production.

With successful implementation of various initiatives under these Special SGSY Projects in spite of several challenges, it is proved to be profitable beyond doubt that more of private participation can be explored in tropical tasar seed multiplication which can sustain on its own with involvement of professional NGOs like PRADAN, with lots of opportunities to tribal entrepreneurs.

REFERENCES:

1. Bhat M.M., Das P.K., Choudury B. and Singh B.K. (2006): Augmentation of Muga and Eri commercial seed by involving private graineurs. *Proceedings of the Regional Seminar on "Prospects & Problems of sericulture as an economic Enterprise in North-West India, Dehradun, India, 11 & 12th November 2006,* pp 345-348.

2. Chakravorty D. and Khanna, R.P. (2007): Strategy and plan of action for streamlining Tasar seed sector. *Souvenir of Rashtriya Tasar Krishi Mela, Bilaspur, Chhattisarh, India, February 27-28*.

Standardization of seed processing and seed supply for optimization of resource utilization for Oak Tasar development in sub Himalayan region

By

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The optimization of quality seed supply of Oak Tasar silkworm with increased number of eggs or chawki larvae per disease free laying is the key to Oak Tasar popularization and desired economic gain in the sub- Himalayan region. Elite seeds yield more hence may add many steps towards providing a full time job if not to all those who work in oak Tasar sector then at least to an appreciable population. Though the effort is being made to improve the rearing performance at the farmers level, yet the number of cocoons to be harvested on an average level has not been standardized which may allure more farmers and make the said culture more attractive. The effort to yield at least 40-50 cocoons per dfl at farmers level against 10- 20 cocoons / dfls in the recent past years should be the objective of the standardization of elite seed supply to farmers in order to achieve a great mile stone in seed organization of the Oak Tasar sector. Due to poor fecundity, hatchability and yield per dfl, the optimum composite number should be 200 eggs / dfl or a minimum of 100 chawki larvae / dfl to be supplied by the supplying agencies so that farmers are benefited both at the yield and cost realization / dfl level.
Key words: Natural Oak Tasar flora, Sub Himalayan region, egg / dfl . number of chawki larvae / dfl, seed technology, imported disease control.

Results of Biostimulator Effect on Mulberry Silkworm Grain

By

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ABSTRACT

To increase mulberry silkworm productivity and viability biostimulators (spirulina, biorag, bactocide, Asma #1, Asma #2 et al) were used in the form of admixed to mulberry silkworm at the Scientific Research Institute of Sericulture of Georgia and the obtained results were rather good. Experiments proved that application of biostimulator in the worm phase is connected with problems such as: using of any fodder admixture to mulberry leaf while feeding mulberry silkworm greatly decreases quality of fodder assimilation. Solution of biostimulator is sprayed to mulberry leaf 20-30 minutes prior to its giving to silkworm. Wet leaf incites diseases in silkworm and because of it leaf should be dried, which needs 20-30 minutes. Standing of leaf for longer period results in its over-drying and excessively dried leaf is not easy to assimilate.

Therefore application of biostimulator in the form of fodder admix for silkworm in industry is rather complex and is connected with extra costs. This is why experiments were continued towards elaboration of simplified methods of application of biostimulators, namely towards the issue of treatment of grain in biostimulators.

Advantage of treatment of mulberry silkworm grain in biostimulators is expressed in easy penetration of liquid into grain shell, irrespective of the fact that grain shell of various breeds differs in thickness. Thus for example, liquid antibiotics and biostimulators give positive effect, namely the weakening of activity of viruses existing in grain, as a result of which the resistance of mulberry silkworm to diseases increases – that is the immunity of silkworm is increases and at the expense of decrease of cases of diseases the silkworm viability and respectively its productivity – increase.

Mulberry silkworm grain was treated in some concentrations of the biostimulator Asma # 1 and the silkworm obtained from the treated grain was fed. As a result of experiments it became clear that biotechnological indices of mulberry silkworm obtained from the treated grain were better than those of mulberry silkworm obtained from non-treated grain. Thus, for example, they are better in cocoon mass and membrane mass. In experimental versions silk capacity was 1,1-1,3% higher compared with that of the control variant. Likewise higher results were obtained in the experiments with biostimulators spirulina and bactocide. Alongside with it, as a result of treatment of grain in biostimulator the rate of grain vivification increases; volume of preparations used in the process of grain treatment, compared with that used for treatment in various phases is lower, which quite naturally will decrease the self-cost of the product.

Proceeding from the obtained results, the above stated problem is urgent for practical sericulture and the Institute continues its experiments in this direction.

Keywords: Key words: mulberry silkworm, feeding technology, grain.

INTRODUCTION

Sericulture is one of the traditional branches of Georgian agriculture. It was widely distributed in west as well as in east Georgia and it was always considered the source for strengthening of economics of the country, rational application of human resources and increase of foreign currency revenues. In the sixties of the last century this branch of national economics was at a rather high level. Production of cocoon in Georgia reached 4,5 thousand tons and the state exported silk raw material and articles made of it, and what is most important, silkworm grain. Such intense development of sericulture was favored also by the fact that it conforms well to other branches of national economy.

In the sixties of the XX century micro plasma disease distributed in west Georgia - "leaf curl" (rugosity) completely ruined the base of feeding for sericulture and this branch of economy appeared in critical situation. In the nineties of the XX century, due to the situation created as a result of changes taking place in social-economic structure of the country, affected sericulture too. At a certain extent thanks to division of land plots in smaller ones, ruining of feeding base and many other reasons, the situation became still more aggravated and at present the branch – sericulture is in a very desperate state.

The necessary term for rehabilitation-revival of sericulture is strengthening of fodder base for mulberry silkworm, inculcation of highly productive mulberry silkworm breeds (hybrids), perfection of feeding technology and taking measures for decrease of cocoon self-cost.

Perfection of feeding technologies provides inculcation of modern technologies, heightening of mulberry silkworm productivity by elevation of its resistance to diseases through increase of mulberry silkworm immunity. This is possible by application of bio-stimulators, more so as considering the present day international state there is a danger of ecological pollution of environment, which, in its turn results in pollution of mulberry leaf. Polluted mulberry leaf, while falling in the silkworm organism incites various form diseases.

Taking into consideration the above stated situation the strengthening of immunity of mulberry silkworm for the prevention or reduction of bacterial and other diseases which are conditioned by toxic compounds is considered the urgent and most important task.

To prevent this danger the researchers of the Scientific Research Institute of Sericulture of Georgia developed the bio-stimulator Asma No 1 (Patent No 8686, 2005, authors: N.Baramidze, Z.Putkaradze, M.Andguladze). This preparation, together with other preparations, such as Spirulina and Bactocide was tested in worm phase, as admix to fodder. Testing showed that application of bio-stimulators in the worm phase is connected with some problems. Concentrated solutions of preparations are sprayed to mulberry leafs prior to giving leaf to silkworm. Wet leaf when it is given to silkworm results in silkworm disease, therefore the leaf must be dried before giving to silkworm. It needs 20-30 minutes. Standing for longer time results in over drying of leaf and the dry leaf is hardly assimilated by silkworm.

Irrespective of the fact that the above referred preparations increase significantly the immunity of mulberry silkworm and its bio-technological indices, in practice, application of biological stimulators by the use of this method is connected with great problems.

Yield of mulberry silkworm cocoon, cocoon productivity greatly depends on breed characteristics-properties of mulberry silkworm and healthiness of grain. Georgian breeds of mulberry silkworm always were known for high quality of their cocoon and raw silk thread.

Today, among the mulberry silkworm breeds inculcated in industry the Mziuri group breeds are of special interest. These breeds are known for the length of continuously uncoiled thread and for its fineness. Thread obtained from cocoon of these breeds are fit for manufacturing competitive silk fabrics and surgical designation thread. But these breeds due to low viability and high self-cost have problems in establishing on the market.

Considering the above stated, for elevation of immunity of mulberry silkworm and increase of bio-technological indices it was planned to develop simplified method of application of bio-stimulators.

Experiments aimed simplification of a method of application of bio-stimulators and decrease of self-cost of production by the use of bio-stimulators in grain phase, as well as determination of optimal concentration and exposition time of bio-stimulators in treating mulberry silkworm grain.

Preliminary treatment of mulberry silkworm grain in bio-stimulator for the increase of health and immunity is a novelty in the sphere of sericulture. The offered method is unique also because here the biological stimulator is used not in the fodder of mulberry silkworm as admix, which, as it was stated above, is connected with some problems, but in grain phase, which gives double effect: 1. Increase of embryo immunity in grain and resistance to diseases and 2. Increase of biological and technological indices, which finally is expressed in the growth of obtained production volume and its quality.

Application of bio-stimulators in grain phase has advantages compared to its application in worm phase, which is expressed in the following. Irrespective of the fact that grain, according to breeds has various thickness shells bio-stimulators penetrate the shell easily and give positive effect – decrease of activity of viruses existing in grain. When grain is treated in bio-stimulator the effect of bio-stimulator is durable, long-lasting and can be expressed in immunity of the obtained generation.

Quality and duration of the effect of bio-stimulator depends on: bio-stimulator concentration, exposition length, season of grain preparation (spring, summer, autumn), mulberry silkworm breed characteristics etc.

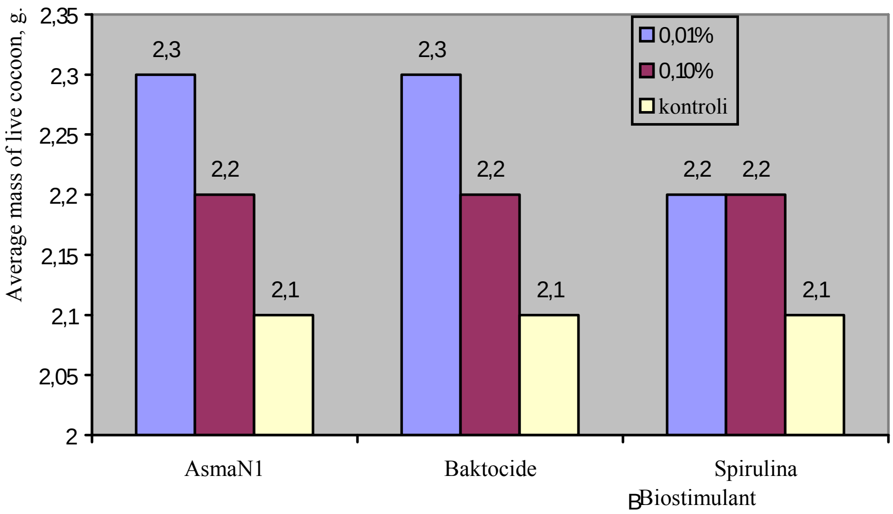
For the study of the effect of bio-stimulator on mulberry silkworm immunity we used the method of artificial infestation of grain and the progress of disease was followed.

Experiments were carried out on the grain of mulberry silkworm breed Mziuri-2. To determine the effect of bio-stimulators (Spirulina, Bactocide, Asma No 1) grain of mulberry silkworm, which was infected in advance, was treated before incubation in the 0,01; 0,1 concentration bio-stimulator for 18 min and at 25 ^{o} C temperature.

Mulberry silkworm feeding was performed and the biotechnological indices of the obtained cocoon were studied.

Diagram 1

Results of effect of bio-stimulators on the mulberry silkworm cocoon mass



According to the Diagram 1 the best result with respect to live cocoon membrane mass (2,3 g) was obtained as a result of treatment of grain in 0,01% concentration solution of bio-stimulator Asma No 1 and Bactocide. Index of grain when treated in 0.1% Spitulina solution comes next, while the control version legs behind by 0.2%. The best concentration in all three versions is 0,01%.

Diagram 2

Results of Effect of bio-stimulators Results on mulberry silkworm live cocoon silk capacity

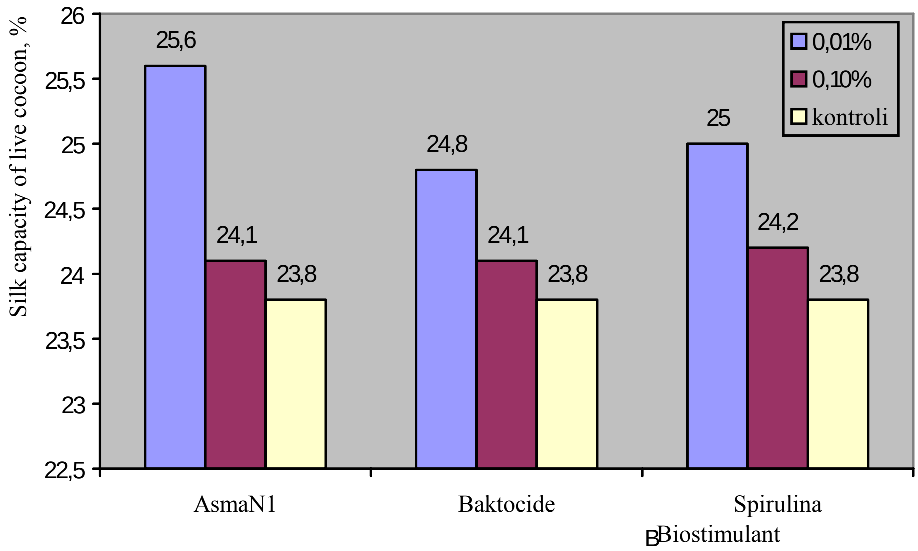


Diagram 2 shows that the best index of live cocoon silk capacity was obtained as a result of grain treatment in 0.01% solution of bio-stimulator Asma No 1. Bactocide legs behind by 0,4%, while Spirulina – by 0.8%. As to the solution concentrations in all three cases the best result was obtained in 0,01% bio-stimulator solutions.

Treatment of grain increases grain vivification capacity and its viability and the rate of mulberry leaf assimilation, which refers to the fact that the above stated preparation enables the mulberry silkworm to transform microelements introduced in the organism into easily penetrable and easily absorbed form. They are well assimilated by the organism and condition increase of a series of biological and economic indices of mulberry silkworm.

The above-described experiment proves that treatment of grain in bio-stimulator is far more advantageous, easy and efficient with the view of labor as well as low expenditures of bio-stimulator, which is rather important for sericulture. Expenditures made for bio-stimulator during grain treatment, compared to those made for treatment in other phases, are lower, which of course will decrease the self-cost of the final product.

REFERENCES

1.N.Baramidze,G.Gigolashvili-Effect of spirulina platensis on some Biological and Economic indices of silkworm (Bombux mori). Bulletin of the Georgian Academy of Sciences. Tbilisi, 166, #1. pp 97-99. 2002

2. N.Baramidze, M. Khutsisvili -Ratio of the Silk Gland and Worm Mass in the Fifth Age of Mulberry Silkworm The Problems of Agrarian Scince. GAU, XXVIII. Tbilisi, pp. 29-30. 2004

3. N.Baramidze,M. Khutsisvili - Some features of variability of quantity offibbers hemolimpheof a silkworm The Problems of Agrarian Scince. GAU, XXIX. Tbilisi, pp. 24-26.2004

4.N.Baramidze, Z.Putkaradze- The Effect of Biological Preparations "Asma №1" and "Asma №2" on Leaf Rugosity of mulberry Seedlings ."Bulletin of the Georgian Academy of Sciences. Volume 171 Number 3 pp 520-523.2005

5. N.Baramidze, M.Khutsisvili -Results of Action of Biostimulator Asma#1 on Weight of a Caterpillar of a Silkworm and its Silk-Gland The Problems of Agrarian Scince, XXXV Tbilisi, pp, gv. 90-91.2006

6. N.Baramidze,M. Khutsisvili -Perspectives of Using Spirulina as an Accessory Nutrient in Sericulture ssau Annals os Agrarian Scince, vol.4,pp.117-119.2006

7. N.Baramidze, M.Khutsisvili -Influence of a Biostimulator „Asma-1" on Biotechnological Parameters of a Silkworm The Problems of Agrarian Scince,XXXVIII, Tbilisi, pp. 86-88.2007

8. N.Baramidze,M Khutsisvili - Influence of Food on the Biotechnological Parameters of a Silkworm Annals of Agrarian Academy of Science, vol.4,pp.121-123.2007

2.4. Silkworm pathology

Efficient preparations to control infections and mikrosporidiosis in the silkworm

By

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There have been tested the Virocide, DZPT – 1, Delaxon, Desvax, Crystal 1000, Neochlorine and Septamine drugs against pathogens of bacteriosis such as septicemia, streptococcal enteritis, and mixed infection; mycosis such as beauveriosis; virosis such as nuclear polyhedrosis; and microsporidiosis such as pebrine using cambric, wooden, metallic and cement test objects, silkworm eggs and caterpillars. All of the drugs have been found to have bactericidal, fungicidal and nosemacidal properties if used at a level of between 0.1% and 1.5%, and with an exposure time of between 40 minutes and 180 minutes except for the Desvax drug which requires a 5% level and a 20 hours' exposure. In addition, the Virocide and Crystal 1000 drugs exhibit virocidal properties and, therefore, are promising for the purposes of both preventive and final disinfection of sericulture objects. Along with virus devitalization, the DZPT 1 and Delaxon drugs if used at a level of between 0.1% and 1.5%, and with an exposure time of between 40 minutes and 180 minutes are safe for eggs and caterpillars and, therefore, are promising for the purpose of a forced disinfection.
Keywords: the silkworm, bacteriosis, micosis, microsporidiosis, virosis, pathogens, disinfection

Bioecological Approaches to Pest Management in Sericulture

By

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ABSTRACT
Widespread use of broad-spectrum chemical pesticides has revolutionized pest management. But there is growing concern about environmental contamination and human health risks - and continuing frustration over the ability of pests to develop resistance to pesticides and hence emphasis was given on integrated pest management. It is thus imperative that the pest management should be oriented on ecological principles that involve judicious use of chemicals, biological control agents and cultural control practices. This concept involves evaluation and consolidation of the available techniques into a unified programme for managing pest populations. Cultural control practices, combined with the advanced biological control strategies, commonly known as ecologically based pest management (EBPM), is the most logical approach for pest management in sericulture. Adoption of Ecologically Based Pest Management is an important method for pest management in sericulture. It promotes both sericultural productivity and a balanced ecosystem. In the present paper an attempt has been made to search for vision and strategies for creating a solid, comprehensive knowledge base to support a pest management system that incorporates ecosystem processes supplemented by a continuum of inputs - biological organisms, products, cultivars, and cultural controls. The result will be safe, profitable, and durable pest management strategies. Research is needed to identify organisms and their functions in the ecosystem. EBPM requires development of biological-control organisms that can be used to mimic natural processes of pest suppression. Ecologically Based Pest Management will be vitally important to the sericulture industry, policymakers, regulators, and scientists in sericulture and forestry, biologists, researchers and environmental advocates and interested farmers. In recent years, many neem seed products like oil, cake, crude extracts and purified fractions have been tested commercially against a variety of insect species. Addition of neem products under EBPM programme will be a very promising approach in insect pest management in sericulture. All these aspects have been discussed in detail.
Keywords: Pest , Parasitoid, Pesticides, Ecological and Biological control

INTRODUCTION

Synthetic chemical pesticides have been used widely on silkworm host plants in the hope that they would control sericultural pests. It is now clear that their use has some unfortunate consequences (Singh *et al*., 1990). Many synthetic chemical pesticides are broad-spectrum, not only killing pests, parasites and predators of silkworms and its host plants but also beneficial organisms that serve as natural pest control systems. Without benefit of the natural controls, farmers become increasingly dependent on chemical pesticides to which pests have developed resistance (Reynolds *et al*., 1975; Osteen and Szmedra, 1989). Chemical control is both uneconomic and impractical because of the pest's broad host range, widespread distribution and presence in areas with high human inhabitation (Rabb and Guthrie, 1972). Further, pesticide applications disrupt the effective natural enemies of other crop pests, leading to the application of additional pesticides to control these pests. These additional pesticide applications can contaminate food, water and farm workers (Bottrell, 1979). Besides this, it causes serious health hazards to farm workers and contaminate environment (DeBach and Ross, 1977). Thus there is an urgent need for an alternative approach to pest management that can complement and partially replace current chemically based pest-management practices.

In the past, attempts have been made to control pest population using cultural, biological and physical control methods (Gates, 2002). Many practices, such as crop rotation, tillage operation, intercropping, and incorporation of organic matter into soils, served to conserve and foster populations and activities of biological control agents that were indigenous components of traditional sericultural ecosystems (Singh and Maheshwari, 2002). It plays an important role in minimizing pest outbreaks and crop disease epidemics (Risch, 1987). Therefore, the application of cultural control with biological control needs to be standardized based on the knowledge available through experience under integrated pest management programme. Pest, predator and parasite control of silkworm and its host plants through management of biological control agents and enhanced cycles and natural processes is a new solution in new century in non-mulberry sericulture. Singh *et al*. (1993) reported an ecological approach to pest management in tasar culture. The tasar silkworm host plant (*T. arjuna* and *T. tomentosa*) are frequently attacked by gall insect, stem borers, defoliators, termites, and sucking pests which causes extensive damage to silk industry. Besides these pests, sporadic occurrence of the Bihar hairy caterpillar (*Spilosoma oblique)* causes much damage to arjun, asan and sal plantation in tropical tasar region of India. Oak tasar silkworm *Antheraea proylei* is reared out door on various species of oak plants (*Quercus sp.)* in north east and western region of India. Various sap sucking, defoliating, meristem feeders, acorn feeders and gall forming insects attack these food plants and reduces the quality and quantity of the oak tasar food plants. Muga silkworm *Antheraea assama* is reared on som (*Persea bombycina* (=*Machilus bombycina*) and soalu *Litsaea polyantha ((= monopetala)*. The quality and quantity of the leaves are deteriorated due to attack of large number of pests from nursery to mature plants. Eri silkworm *Philosamia ricini* Boisduval is reared commercially on castor (*Ricinus communis),* Kesseru (*Heteropanax fragrans* Seem), Cassava (*Manihot utilissima*), Papita (*Carica papaya*), Pyam (*Evodia fraxinifolia* Hook) and Maharukh (*Ailanthus excelsa* Roxb). Several pests attack all these food plants and based on the biology and ecology of the pests control measures have been reported (Singh *et al*. 2000; Singh and Sen, 2001; Thangavelu *et al.* 1988; Thangavelu, 1993).

CONCEPT OF E B P M

Within the past few years some important findings have been published on the prevention, suppression and eradication of pest population in non mulberry sericulture (Singh *et al*., 2000; Singh and Maheshwari, 2002; Singh and Saratchandra, 2003) . These studies have suggested a significant and increasing role for biological control in the future of integrated pest management (IPM). The role of cultural control, biological control, mechanical control and breeding for resistant pest varieties has also been highlighted (Singh *et al.,* 1999). Such practices were very important and widely used prior to the advent of synthetic organic pesticides; indeed, many of these practices are still used today as components of Integrated Pest Management programs. IPM is ecologically based, environmentally conscious method that combines, or integrates, biological and non biological control techniques to suppress weeds, insects, and diseases (Cates and Hinkle, 1993). In non-mulberry sericulture integration of multiple pest suppression techniques has the highest probability of sustaining long term crop protection. An array of technologies and data analysis procedures have been developed about those strategies and tactics most appropriate for use in implementing specific IPM systems. These include economic thresholds, sampling technology, modeling natural controls, geographic distribution, effect of pest migration and movement, host resistance and pesticides (Singh *et al*., 2004). IPM basic framework is acknowledged to be natural controls. These include natural enemies, weather, climate, and food sources. Natural enemies play an important role in regulating populations of all pest classes (Gates, 2002). Biological control is one of the strongest components of IPM. Biological control utilizes natural enemies such as parasites, predators, pathogens or competitors, deriving its energy directly from the pests themselves. It is acknowledged to be the best type of pest control (Singh and Saratchandra, 2002b). The biological control models based on the knowledge of ecological process rather than broad-spectrum pesticides, is known as ecologically based pest management (EBPM). As a vision of research possibilities and priorities for biological control, ecologically based pest management offers many sound and compelling arguments (National Research Council, 1976)

The ecological principles of natural pest mortality factors, pest-predator relationships, genetic resistance, and cultural practices are the strongest component of integrated pest management programme (Smith and Van den Bosch, 1967). This theoretical basis of IPM is similar to EBPM. The practice of IPM, unfortunately, is not always consistent with the theory of IPM. The focus of early IPM programs was devoted to control of insects, setting a precedent for the focus of IPM on arthropod pest management (Adams, 1994). In many cases, this management was limited to pest scouting and precise applications of insecticides (Zalom *et al*., 1992). Consequently, this focus has been at the expense of IPM of pests. The ecological concepts of the IPM framework are the departure point for this new information-rich management strategy (Smith and Reynolds, 1965). EBPM will rely on an improved knowledge base of the complex ecological processes that occur in plant production. Safety, profitability and durability are three fundamental goals of EBPM. It has been reported that all three of these goals are essential to developing and implementing EBPM strategies. EBPM is a total systems approach designed to have minimal adverse effects on no target species and the environment because biological controls are limited by their specificity with respect to the target pest organism or by their distribution or persistence in the environment. The system enhances protective natural enemy habitats as well as conservation/augmentation methods. It develop thresholds for biological, biorational, conventional, chemical controls and provides ecological approaches for control of invasive species based on biology, ecology, adaptiveness, natural enemies, establishment status (National Research Council, 1975).

STRATEGIES

For successful implementation of EPBM programme, it is essential to make it cost effective with lower economic risks (Caltagirone and Huffaker, 1980). The strategies must be long lasting to have a positive impact on crop protection (Putter and Van der Graff, 1989. It should be durable and much of the data should be generated on the pest biology and economic feasibility of pest control options. New pest-resistant varieties should be introduced and resistance of pests to chemical pesticides should be reduced. EBPM is intimately linked with the allelochemical web of plants, pests, parasitoids/ predators, resulting in a triotrophic or sometimes a tetratrophic level of interaction (Ananthakrishnan,1990). For effective manipulation of the communication systems involved in this complex allelochemical relationship, an understanding of direct or indirect, beneficial or detrimental effects of plant secretions on phytophagous insects and their natural enemies is important (Hoffmann and Frodsham, 1993). These organisms constantly evolve and respond to each other, creating a diverse, complex, and ever-changing environment. The occurrence of a pest in silkworm rearing field is not an isolated event and, as such, must be studied in relation to the larger geographic region. EBPM uses knowledge of interactions among pests and naturally occurring beneficial organisms to modify cropping systems in ways that reduce rather than eliminate damage caused by pests; thus, EBPM is designed to enhance the inherent ecological strengths of the system. External inputs—a continuum of biological, physical, and chemical tools—would be added only if they promote the long-term environmental health of soil biota, crops, and other organisms of Sericultural systems. In contrast to the current approach, which often relies predominantly on broad-spectrum chemical methods, with EBPM, new inputs—natural or synthetic—must target specific pests and minimize disruptions to the managed ecosystem. Research is needed to identify organisms and their functions in the seri-ecosystem. Little is known about the diverse competitors, predators, and parasitoids that reside in soil and plant environments; yet, beneficial organisms that control pests within their native environments have been found in these habitats. Understanding the processes of these interactions can lead to science playing a decisive role in controlling pest populations and contributing to the stability of natural systems (Lockwood, 1993). Based on these discoveries, researchers are developing new pest-management strategies to hold pest populations in check.

APPROACH

Earlier studies on the pest management in non-mulberry sericulture indicate that several approaches have been made to minimize pest population in silkworm rearing field. Manipulations of crop production inputs, trap crops, behavioral chemicals and other ecological methods have been adopted to manage pest and beneficial insect species (Mandal and Singh, 1990). Key natural enemies were screened, identified and its efficacy, adaptiveness and potential for introduction, conservation and augmentation were standardized. Recently few new techniques have been used to determine predator efficacy, mark-recapture techniques for dispersal, population dynamics and sampling method research. Apart from this, some interdisciplinary research and cross-disciplinary flow of information is required for implementation of the programme. Implementation research is needed to facilitate the transfer of technology from researchers to farmers in the field. Experience with IPM indicates that the complexity of EBPM may become a major limitation to its implementation. Laboratory discoveries must be moved into sericultural practice to increase adoption of EBPM. Pest suppression activities of biological-control organisms can be demonstrated in the field to farmers and pest managers, emphasizing the region specific nature of EBPM methods. In order to increase the longevity of EPBM, it is necessary to devise strategies to supply farmers with sufficient biological-control inputs and conserve valuable biological-control resources.

CULTURAL CONTROL

Cultural practices are referred as management techniques, which may be manipulated by sericultural farmers to achieve their crop production goals (Singh *et al.,* 2000). Cultural control is the deliberate alteration of the production system, either the cropping system itself or specific crop production practices, to reduce pest populations or avoid pest injury to crops (Adams *et al*., 1990). It is an impediment to pest colonization of the crop. The adverse biotic conditions are created to reduce survival of pest population. The cropping system is modified in such a way that pest infestation results in reduced injury to the crop. It helps in enhancement of natural enemies by manipulating the environment. Cultural practices are integral part of tasar, oak tasar, muga eri cultivation in India. It includes pruning, plucking, cleaning, intercropping, tillage operation, trap crops, sanitation, physical barriers and host plant resistance (Singh and Sen, 2001). These practices directly influence the pest build up. During winter period, when the rearing of tasar silkworm is suspended, the gall infected leaves are plucked and burnt in the field. It is found to be the most convenient way to minimize the pest population. Further, some regular farming practices, viz. weeding, inter cultivation; pruning and pollarding ensure further reduction in gall insect population (Singh and Thangavelu, 1994). Mechanical collection of egg mass and early stage caterpillar is most effective method to minimize the pest population (Singh *et al*. 1993). The use of light trap is highly effective to control schafers, weevils and tussock moths (Singh and Maheshwari, 2002). For this purpose pest-O-flash an illumination device is used in the field to attract, weevils, stem borers, and defoliating insects. The most prominent among them are *Anomala blanchardi, Myllocerus viridinus*, and *Crinorrhinus nebulosus*. Removal of dead barks from the food plants is also effective in minimizing the schaffers beetle and stem borer's population. Stem borers are the major pests of silkworm food plants and adopting various control measures techniques available in sericulture minimizes its population.

Attempts have been made to successfully use potato, oakra, mustard, vegetable and pulses as an intercrop with non-mulberry silk host plants. Farmers get high profit by intercropping with vegetables. Winter vegetables are planted between rows of non-mulberry plantation. The results indicate that the leaf yield was not impaired as a result of growing different intercrops as compared to muga and tasar silk host plants (Annonymous, 2003). Castor can successfully grow as intercrop (medium mixed tree) between rows of tea/coffee as shade tree plants. Besides providing shade, a substantial quantity of leaves can be obtained for silkworm rearing. Further, tillage operations are also conducted to minimize soil-inhabiting insects. It is also used to produce a crop include soil turning and residue-burying practices, seed bed preparation, and cultivation. Some forms of tillage can reduce pest populations indirectly by destroying wild vegetation (weeds) and volunteer crop plants in and around crop-production habitats (Mack and Backman,1990). Sanitation in nurseries and rearing fields where pests are present should be carried out within the core and buffer areas.

BIOLOGICAL CONTROL

Biological control is the use of natural enemies against pest organisms to reduce their population densities (DeBach, 1974). Parasitoids and predators are considered the long-term solution to pest management. The relationship of pests and parasitoids can be correlated in three ways. First when the pests and natural enemies are in equilibrium, there will be no outbreak. Secondly when pests overrun population of natural enemies; there will be periodic pest out break. Third when the population of the natural enemies exceeds that of pest species, there will be potential out break. Actually, these factors disrupt the interaction between polyphage insects and their natural enemies, the essential ecological processes operating in nature that contribute to the regulation of insect population. Whenever, this interaction between polyphage and entomophage insects is disrupted, the population of the polyphage insects increased tremendously and they attain pest status because they become free from the constraints imposed by the entomophages (DeBach and Rosen, 1991). The realization that conventional pesticides could cause problems resulted in the idea that it might be wise to use caution with these toxic chemicals (Flint and Van den Bosch, 1981). Biological control is now identified and considered as alternative method of insect control, together with other non-pesticidal or ecologically based control measures (Frisbie and Smith, 1989). Fortunately, in non-mulberry sericulture, the use of synthetic insecticides is less. It is, therefore, obvious that such prevailing situations in non mulberry sericulture will lead to a more conducive environment for the implementation of biological control programmes designed for native pests, or even for introduction programmes involving the utilization of exotic natural enemies (Singh *et al.,* 1999). The current revival of interest in biological control is also driven by a change from pest control approaches that aim to maximize productivity and to approaches that emphasize efficiency and the long-term sustainability of seri ecosystems. The biological control of pests tends to be a long lasting, and often can be implemented at little direct cost to producers and consumers. For these reasons, biological control is considered a corner stone of many integrated pest management (IPM) programmes (Howarth, 1991). The philosophy of modern insect pest management is based on the management of entire pest population not just localized ones where a single control technique is employed (Stern *et al*. 1959). In IPM, emphasis is placed on the use of combinations of methods, aimed at providing cheap but long term reliability with the minimum of harmful side effects. The philosophy and methodology of modern IPM programme is thus compatible with the philosophy and methodology of biological control. Biological control has been a central core around which IPM has been commonly developed. The reason for this is that natural enemies constitute the major natural control factors that can be manipulated. The parasitoids can be utilized in three major ways viz. importation, augmentation and conservation (DeBach and Rosen, 1991).

Importation or classical biological programmes are generally less pursued in sericulture, where there exists a need to thoroughly explore and evaluate their native natural enemies which may be or are most likely not yet identified as promising biological control agent. DeBach (1974) reported that in spite of its successful record and great promise as an effective method of pest control, the importation of exotic natural has been largely neglected in most countries. Very few efforts have been made to search for and utilize the natural enemies of many important pests. Even well known natural enemies of proven high efficiency still await transfer into many areas where their hosts are serious pests. There is an enormous untapped potential of natural enemies to be utilized in importation programme. Natural enemies fauna of non-mulberry sector is incomplete. In the parasitic hymenoptera, it has been estimated that between 70 to 90 % of all extent species are still undiscovered and that no biological information is available (Caltagirone, 1981; Howarth, 1983). The same is true for other natural enemies. All these unknown species may be regarded as potential weapons to be added to the arsenal of applied biological control. Most of the major pests in sericulture are organisms of foreign origin. Extensive intercontinental travel and commerce over the last several centuries have resulted in the advertent transfer of numerous potential pests into new areas, often unaccompanied by the parasites and predators that had co-evaluated with them in their native lands. Free from the remaining influence of their natural enemies, such invading species may increase rapidly and assume much more serious pest proportions than they had in their original habitats. Importation of natural enemies that they have left behind them is likely to elevate the problem. Such introduced pests are therefore prime targets for applied biological control projects. However it should be emphasized that native pests may also be amenable to biological control by importation of natural enemies. Instead quite a few important pests have been brought under complete biological control in their native biological habitat through the importation of natural enemies of the related exotic pests (Debach, 1974).

Classical biological control is long lasting and inexpensive. Other than the initial costs of collection, importation, and rearing, little expense is incurred. When a natural enemy is successfully established it rarely requires additional input and it continues to kill the pest with no direct help from humans and at no cost (Kogan, 1986). Unfortunately, classical biological control does not always work. It is usually most effective against exotic pests and less so against native insect pests. The reasons for failure are often not known, but may include the release of too few individuals, poor adaptation of the natural enemy to environmental conditions at the release location, and lack of synchrony between the life cycle of the natural enemy and host pest.

Augmentation is the next important technique applied by mass rearing of the most highly efficient parasitoids or predators for mass release in infested areas. It is generally used when natural enemies are absent, occur too late, or are in numbers too small to provide effective pest control when needed (Firsbie, 1989). Augmentation involves the supplemental release of natural enemies. Relatively few natural enemies may be released at a critical time of the season (inoculative release) or literally millions may be released (inundative release). Additionally, the cropping system may be modified to favor or augment the natural enemies. This latter practice is frequently referred to as habitat manipulation. This tactic involves altering the cropping system to augment or enhance the effectiveness of a natural enemy (Hoffman and Frodsham, 1993). There are two basic approaches to augmentation, environmental manipulation and periodic releases (Hoy and Herzog, 1985). Periodic releases can be inoculative or inundative. Inoculative releases are releases of relatively small number of biological control agents, often on seasonal basis. The control in inoculative release programs is expected to come primarily from the progeny of these agents being released. Inundative releases are releases of relatively large numbers of biological control agents, and the control is expected to come from the released agents, not necessarily from their progeny (Flint, 1992). Inundative releases programs usually involve the number of releases during the season, while inoculative release programs may involve only one release. It is possible by sustained release of laboratory-reared parasitoids. Our ability to use periodic releases of the parasitoid to control uzi fly , is to rear, transport and effectively release large number of high quality biological control agents. Periodic release requires continuous release program and thus, has commercial potential and fit IPM programs well. The growing number of commercial suppliers of biocontrol agents is evidence of this potential (Van Lenteren, 1989). Adoption of biological control has had positive economic impact. It must be pointed out that biological control particularly augmentation and conservation does not operate in vacuum. Biological control is the most successful as part of an integrated program involving host resistance and cultural control technology. The efficacy of such natural enemies may be sometimes enhanced through various method of augmentation, or direct manipulation of their populations, such as periodic colonization, genetic improvement, or the use of semio chemicals that affect their performance (Cook, 1990).

Another possible approach is through conservation, or manipulation of the environment, either by adding of asking requisites or by mitigation of various detrimental factors. The conservation of natural enemies is probably the most important and readily available biological control practice (Schwalbe, 1993). Natural enemies are available in the rearing fields. They are adapted to the local environment and to the target pest, and their conservation is generally simple and cost-effective.

With relatively little effort the activity of these natural enemies can be observed. Conservation involve permeated action to protect and preserve existing parasites, predators and pathogens; basically not taking actions that would be detrimental to natural enemies (Frisbie and Smith, 1989). IPM programs that result in a reduction in pesticide use generally contribute to conservation. Conservation and augmentation in biocontrol involves two phases, first the maintenance of existing parasitoids by avoiding harmful practices and secondly, the augmentation of parasitoids either directly releasing them in the field or by indirectly making the field environment more favorable for them(Howarth, 1983). Although a number of species of eulophid parasitoids have been reported, it is rather easy to identify more effective parasitoids based on their parasitization capabilities (Singh *et al*. 2004). *Trichogramma chilonis* has been reported to minimize vapourer tussock moth population in tasar culture. *Trechnites secundus* (Encystidae) and *Aprostocetus niger* (Eulophidae) are important parasitoids of gall insect (*Trioza fletcheri minor)*. Scelionid egg parasitoids (*Psix striaticeps* and *Trissolcus sp.)* have been reported against *Canthecona furcellatta.* Several uzi fly parasitoids viz. *Nesolynx thymus*, *Trichopria* sp., *Dirhinus anthracia*, *D. himalayanus, Spilomicrus karnatakensis*, *Trichomalopsis apanteloctena,* and P*ediobius sp.* have been reported to minimize uzi fly population in tasar and muga culture (Singh and Saratchandra, 2002a&b; Singh *et al*., 2005). *Neoslynx thymus* and *Trichomalopsis apanteloctena* both multivoltine parasitoids have been identified to be highly potential parasitoids against uzifly. These parasitoids which appear after the arrival of uzi fly maggots in the field need to be conserved (Singh and Saratchandra, 2003). Another important aspect of conservation in the field is to find out the means to arrest the depressiveness of the parasitoids from field to field or away from the site of release. The natural enemy complex is diverse and there is evidence to believe that pest population of silkworm and its host plants are maintained at low levels mainly because of their regulating activities. However, scientific research on these aspects in sericulture is yet at the initial stage. Investigation so for is limited to identifying the natural enemies and providing information on their biology. A lot more attention needs to be placed on determining the key natural enemies and their effectiveness. These natural controls are important and need to be conserved and considered when making pest management decisions.

BOTANICAL INSECTICIDES

It was estimated that nearly 2400 species of plants in India possessed insecticidal properties (Baskaran and Narayanasamy. 1995). Neem, Pongamia, Indian privet, Adathoda, Chrysanthemum, Turmeric, Onion, Garlic, Tobacco, Ocimum, Custard apple, Zinger and some other plants have been reported as most common insecticidal plants which can be used to control pest population in sericulture (Singh and Saratchandra , 2005). Most plant species used for plant protection exhibit an insect deterrent rather than insecticidal effect. It indicates that in some way those compounds inhibit normal development in insects. It acts in different ways viz. insect growth regulators (IGR), feeding deterrents, repellents and confusants (Schmutterer,1990). Anti feedant and repellant activity have been evaluated for some of the plants. A true anti feedant gives insect the opportunity to feed on the plants, but the food intake is reduced until the insect die from starvation (Singh and Saratchandra, 2004). The growth regulator causes abnormality in metamorphosis and the insects suffer malformations. It may be sterile, or die.

Feeding deterrence is perhaps the most studied mode of action for plant derivatives used for insect pest management. Feeding deterrent is a compound that once probed by the insect, causes it to stop feeding and starve to death. Many compounds showing this activity are terpenes and most have been isolated from medicinal plants native to Africa and India (Ishman,1997). The extracts of the plants greatly reduced feeding regardless of the method of treatment. This indicates that the extract contained chemicals, which deter feeding. In all plants tested, more feeding was observed on air-dried leaves than on wet leaves. Probably the components of the extract, which deter feeding, were volatilized during drying. The reduced feeding on wet leaves could be either due to direct toxic action of the extract on the larvae and or to the presence of feeding deterrent as exhibited by the *L. camara* leaf extract, which is both toxic and antifeedant. Singh and Thangavelu (1996) reported influence of neem compound on the growth and development of immature forms of the uzifly an important parasite of tasar silkworm. It acts on insects by repelling them, by inhibiting feeding, and by disrupting their growth, metamorphosis and reproduction. Repellents, on the other hand drive the insects away after exposure to the plant without necessarily feeding. The use of plants as repellents is very old but has not received the necessary attention for proper development. The compounds having bad odor or irritant effects are used. Garlic and hot peppers are most common plants under this group.

REFERENCES

Adams C. E. 1994. The role of IPM in a safe, healthy, plentiful food supply. Proceeding of the Second National Integrated Pest Management Symposium/Workshop. Durham, North Carolina State University. pp. 25-34.

Adams, R. G., Ashley, R. A. and Brennan, M. J. 1990. Row covers for excluding insect pests from broccoli and summer squash plantings. J. Econ. Entomol. 83: 948 -954.

Ananthakrishnan, T. N. 1990. Chemical Ecology in biological control. Current Science 59: 1319 - 1322.

Anonymous, 2003. Annual Report, Central Muga Eri Research and Training Institute, Lahdoigarh, Jorhat, Assam, India.

Baskaran, V., Narayanasamy, P. 1995.. Traditional Pest Control. Caterpillar Publications, Mariyappa Nagar, Tamil Nadu, India.

Bottrell, D. G. 1979. Integrated Pest Management Council on Environmental Quality. Government Printing Office, Washington, D.C. U.S.

Caltagirone, L. E. 1981. Landmark examples in classical biological control. Annu. Rev. Entomol. 26: 213-232.

Caltagirone, L. E., Huffaker, C. B. 1980. Benefits and risks of using predators and parasites for controlling pests. Ecol. Bull. 31:103-109.

Cate, J. R., Hinkle, M. K. 1993. Integrated Pest Management: The Path of a Paradigm. National Audubon Society, Washington, D.C.

Cook, R. J. 1990. Twenty-five years of progress toward biological control; in Biological Control of Soil-Borne Plant Pathogens. Hornby, D. (ed.), pp. 1-14, CAB International, Wallingford, U. K.

DeBach, P. 1974. Biological Control by Natural Enemies. Cambridge University Press, New York.

DeBach, P., Rosen D. 1991. Biological Control by Natural Enemies. Cambridge University Press, Cambridge, U.K.

DeBach, P. Rose, M. 1977. Environmental upsets caused by chemical eradication. Calif. Agric. 31, 8-10.

Flint, M. L. 1992. Biological approaches to the management of arthropods. in Beyond Pesticides: Biological Approaches to Pest Management in California. Beall, T. (ed.), pp. 2-30, University of California, Oakland, California.

Flint, M. L., van den Bosch R. 1981. Introduction to Integrated Pest Management. Plenum Press, New York.

Frisbie, R. E. 1989.. Critical issues facing IPM technology transfer. Proceeding of the National Integrated Pest Management Symposium/Workshop. Communications Services, New York State Agricultural Experiment Station, Cornell University, Geneva, New York, pp. 157-162.

Frisbie, R. E., Smith, J. W. 1989. .Biologically intensive integrated pest management: The future; in Progress and Perspectives for the 21st Century, . Menn, J. J and A. L. Steinhauer (eds.), pp. 151-164, Entomological Society of America, New York.

Gates, J. P. 2002.. Integrated Pest Management – Biological Control : Natural Enemies. Alternative Farming systems Information Center , ARS, USDA, Beltsville, Maryland.

Hoffmann, M. P., Frodsham A. C. 1993. Natural Enemies of Vegetable Insect Pests. Cooperative Extension, Cornell University, Ithaca, New York.

Howarth, F. G. 1983. Classical biocontrol: Panacea or Pandora's box. Proc. Hawaiian Entomol. Soc. 24: 239-244.

Howarth, F. G. 1991. . Environmental impacts of classical biological control. Annu. Rev. Entomol. 36: 485-509.

Hoy, M. A., Herzog, D. C. 1985. Biological Control in Agricultural IPM Systems. Academic Press. New York:

Ishman, M. B. 1997.. Leads and prospects for the development of new botanical insecticides. Rev. Pesticide Toxicol. 3: 1 –20.

Kogan, M. 1986. Ecological theory and integrated pest management practice. John Wiley & Sons, New York:.

Lockwood, J. A. 1993 Environmental impacts of classical biological control. Environ. Entomol. 22:

Mack, T. P., Backman, C. B. 1990. Effects of two planting dates and three tillage systems on the abundance of lesser cornstalk borer (Lepidoptera: Pyralidae), other selected insects, and yield in peanut fields. J. Econ. Entomol. 83: 1034-1041.

Mandal K.C., Singh, R. N. (1990) Environmental protection and pest managemnt in tasar culture. Indian Silk 29: 34-35.

National Research Council 1975.. Pest Control: An Assessment of Present and Alternative Technologies, Vol. 1, Contemporary Pest Control Practices and Prospects. National Academy of Sciences, Washington, D.C.

National Research Council. 1976. Ecologically Based Pest Management: New Solutions for a New Century; in Committee on pest and pathogen control through management of biological control agents and enhanced cycles and natural processes. Ralf W. F. Hardy, Roger N. Beachy, Harold Browning (eds.), Board on Agriculture , National Academy Press, Washington, D.C.

Osteen, C. D., Szmedra P. I.. 1989. Agricultural Pesticide Use Trends and Policy Issues. Agricultural Economic Report No. 622, Department of Agriculture Washington, D.C., U.S.

Putter, C. A. J., Van der Graaff, N. A. 1989. Information needs in plant protection; in Crop protection information: An international perspective. Harris, K. M. and P. R. Scott (eds). Pp. 3-11, CAB International, Wallingford, U.K.

Rabb, R. L., Guthrie, F. E. 1972.. Concepts of Pest Management. North Carolina State University, Raleigh.

Reynolds, H. T., Adkisson, P. L., Smith, R. F. 1975. Cotton insect pest management; in Introduction to Insect Pest Management. Metcalf, R. L and W. H. Luckmann (eds.), pp. 379-444, John Wiley and Sons, New York.

Risch, S. J. 1987. Agricultural Ecology and Insect Outbreaks; in Insect Outbreaks . Barbosa , P. and J. C. Schultz (eds.), pp. 217-238, Academic Press, New York.

Schmutterer, H. 1990. Properties and potential of natural pesticides from the neem tree, Azadirachta indica. Ann. Rev. Entomol. 35, 271 – 297.

Schwalbe, C. P. 1993.. Biologically based regulatory pest management; in Pest Management: Biologically Based Technologies Lumsden, R. D. and J. L. Vaughn, (eds.), pp. 404-409 American Chemical Society, Washington, D.C.

Singh, K. C., Sen, S. K. 2001. Annotated compedium on muga culture. Central Muga Eri Research Institute, Lahdoigarh, Jorhat, Assam.

Singh, R. N., Thangavelu K. 1994.. Pest management practices in tasar culture : An approach. J. Insect Sci. 7: 121-124.

Singh, R. N. Saratchandra, B. 2002a. Biological control of the pentatomid stink bug Eocanthecona furcellata (Wolff.) by using their parasitoid, Psix striaticeps Dodd. in sericulture. Int. J. Indust. Entomol. 5: 13 – 22.

Singh, R. N., Saratchandra, B. 2002b. An Integrated Approach in the Pest Management in Sericulture. Int. J. Indust. Entomol. 5: 141-151.

Singh, R. N., Saratchandra, B. 2003. Biological control strategy of uzi fly in sericulture. Int.. J. Indust. Entomol. 6: 125 –132.

Singh, R. N., Saratchandra, B. 2004. Properties and potential of natural pesticides against sericultural pests; in New Horizon of Animal Science. Pandey, B. N., N. Armugam, P. Natraj, S. Pranjith (eds.), pp. 200 –2006 Publ. Zool. Soc. India.

Singh, R. N., Saratchandra, B. 2005. The development of botanical products with special reference to seri- ecosystem. Caspian J. Env. Sci. 3: 1-8.

Singh, R. N., Maheshwari M. 2002. Biological control of pests of non mulberry silkworms and its host plants in India. Int. J. Indust. Entomol. 4 : 83-91.

Singh, R. N., Thangavelu, K. 1996. Influence of neem compound on the growth and development of immature forms of the uzifly Blepharipa zebina. Pestology 20: 16-21.

Singh, R. N., Krishna Rao, J. V., Samson, M. V. 1999. Role of parasitoids in Pest Management in Tasar culture; in Biocontrol Potential and its Exploitation in Sustainable Agriculture. Upadhyay, R. K., K.G. Mukerji and B. P. Chamola (eds.), pp.379-387, Kluwer Academy, Plenum publisher, New York.

Singh, R. N., Maheshwari, M., Saratchandra, B. 2005. Augmentation of natural enemies to control uzi fly in sericulture. Proceeding of National Conference on Tropical Sericulture for Global Competitiveness . pp. 330-333.

Singh, R. N., M., Maheshwari, Saratchandra, B. 2004. Sampling, Surveillance and Forecasting of insect population for Integrated Pest Management in Sericulture. Int.. J. Indust. Entomol. 8: 17 –26.

Singh, R. N., Samson, M. V. , Datta, R. K., 2000. Pest Management in Sericulture. Indian Publishers Distributors Delhi.

Singh, R.N., Bajpayi, C.M., Kushrestha. V., Thangavelu, K., 1993. Changing role of insecticides in pest management in tasar culture . Indian Silk 32 : 47-48.

Singh, R.N., Madal, K. C., Kumar, N., Sinha, S. S. 1990. Insecticides resistance challenge to pest management in tasar culture. Indian Silk 29: 23-24.

Smith, R. F., Reynolds, H. T. 1965. Principles, Definitions, and Scope of Integrated Pest Control. Proceeding of symposium on Integrated Pest Control Rome, U.N. Food and Agriculture Organization, pp. 11-17.

Smith, R. F., Van den Bosch, R. 1967. Integrated control; in Pest Control: Biological, Physical, and Selected Chemical Methods. Kilgore, W. W. and R. L. Doutt (eds.) pp. 295-340, Academic Press, New York.

Stern, V. M., Smith, R. F., Van den Bosch, R., Hagen, K. S. 1959. The integrated control concept. Hilgardia 29, 81-101.

Thangavelu, K. 1993. Natural enemies of muga silkworm, Antheraea assama West wood (Lepidoptera: Satuniidae). J. Insect Sci. 6 : 57 –59.

Thangavelu, K.., Chakraborty, A. K., Bhagowati, A. K. Isa, Md. 1998. Hand Book of Muga Culture, Central Silk Board, Bagalore. pp. 103.

Van Lenteren, J. C. 1989. Implementation and commercialization of biological control in West Europe. Proceedings of International Symposium on Biological Control Implementation. N. Am. Plant Protect. Org. 6, 50-70.

Zalom, F. G., Ford, R. E. , Frisbie,R. E., Edwards C. R., Tette J. P. 1992 Integrated pest management: Addressing the economic and environmental issues of contemporary agriculture; in Food, Crop Pests, and the Environment: The Need and Potential for Biologically Intensive Integrated Pest Management. Zalom , F. G. and W. E. Fry, (eds.) pp. 1-12 , St. Paul, Minn, APS Press.

Scope of Machine Learning Techniques for Disease Forecasting in Sericulture

By

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ABSTRACT

Disease controlling is achieved to a plausible extent through diagnosing the disease symptoms and undertaking disease controlling methods. The mission of expanding sericulture to a wider spread in the years to come, needs the development of an appropriate disease forecasting model that would greatly help a large number of farmers to rescue their crops in a beneficial way. Various techniques of computer modeling and simulation methods are being used to help synthesize and develop scientists' understanding of this complex plant-pathogen-environment relationship in other agricultural crops. Online disease prediction tool has the potential to guide the farmers and researchers to develop various strategies for efficient control of plant diseases by timely forecasting of disease occurrence. A new prediction method based on a powerful machine learning technique, SVM provides an alternative and complement to the present regression analysis approaches for model development. This has a great scope in forewarning the disease occurrence in Sericulture to increase in income of the sericulturists. The present paper deals with the working mechanism of disease forecasting through machine learning techniques.

Key Words: Disease forecasting, SVM learning technique

INTRODUCTION

In Sericulture, diseases like Mildew, Blight, Rust, Rot of silkworm host plants; Pebrine, Bacteriosis and Virosis of silkworm larvae are the greatest hazards for successful income giving cocoon crops. Continuous cultivation of host plants and silkworm rearing crops are favouring the survival, multiplication and build up of pathogen load. Frequent fluctuations in climatic conditions, overlapping crop schedules and cropping patterns are the added causes for the disease infection.

Disease controlling is achieved to a plausible extent through diagnosing the disease symptoms and undertaking disease controlling methods. To manage the diseases effectively, recommended fungicides, insecticides and pesticides are sprayed along with other disinfection and cleaning methods. But, the diversified field problems like finance, labour, time, knowledge of farmers and their attention make them to skip the controlling methods at different levels of activities unavoidingly. Disease management in Sericulture in this fashion has become the habitual experience. But the mission of expanding sericulture to a wider spread in the years to come, needs the development of an appropriate disease forecasting model that would greatly help a large number of farmers to rescue their crops in a beneficial way.

Background

Considerable efforts have been directed towards developing disease resistant cultivars, but due to high variability in disease pathogen, most of the host plant varieties frequently succumb to several diseases. Therefore, the most practical and suggested way to control these disease epidemics has become the use of different disease controlling chemicals at appropriate concentrations. However, due to high cost of chemicals as well as their hazardous effects, use of these chemicals has become invariably uneconomic. Moreover, farmers are sometimes forced to skip the actual date of fungicide application due to lack of knowledge regarding the actual time of appearance of the disease, unavoidable financial constraints and attention. Therefore, for the judicious use of chemicals, forewarning of disease is very important.

Growers many want to know when the disease will start, how severe the epidemic will be, whether chemicals should be applied, and if so, when ? For this, scientists are using computer modeling and simulation methods to synthesize and understand this complex pathosystem. However, there is no online disease prediction tool available that has the potential to guide the farmers and researchers to develop various strategies for efficient control of plant diseases by timely forecasting of disease occurrence.

Purpose

The major aim of many forecasting systems is to predict the disease occurrence accurately, to reduce use of chemicals, and importantly, to synchronize the use of disease control measures to avoid crop losses (1). Weather based forecasting systems reduce the cost of production by optimizing the timing and frequency of application of control measures and ensure operator, consumer and environmental safety by reducing chemical usage. A sound forewarning system prevents the explosive nature of the disease and incites timely application of control measures. A prediction model based on the relationship between environmental conditions at the time of management and late-season disease severity could be used to guide management decisions.

Techniques for disease forecasting

In sericulture, conventional methods are adopted where in the past history of disease occurrence and weather data are superimposed on the crop calendar to understand the disease occurrence and management methods are adopted. Similarly, various techniques of computer modeling and simulation methods are being used to help synthesize and develop scientists' understanding of this complex plant-pathogen-environment relationship in other agricultural crops. The resultant models enable exploration of the factors that govern disease epidemics and the design of control systems that minimize yield losses. The same models have potential to guide breeding programs and work to develop strategies that will prolong the usefulness of disease-resistance genes.

New Approach

A new prediction approach, namely, Machine Learning Technique through Support Vector Machine has been tried and its performance was compared with the existing regression-based prediction approaches. Attempts to describe the relationship between the disease severity and environmental conditions have been made for various agricultural crops in various countries through both the empirical and explanatory simulation models developed. in Japan (2), Korea (3), China (4), India (5-7) and the Philippines (8). However, very limited use of these models has been implemented by farmers to manage the disease because of two plausible reasons:

- firstly, growers/farmers tend to be risk-aversed and are not properly convinced on the use of disease forecasting tools, and
- secondly, the mathematical relationships between the environmental conditions and the specific stages of disease infection cycle are not fully understood.

This makes conventional modeling approaches such as multiple regressions difficult. No such attempts have been made in Mulberry disease fore-warning.

Forewarning models like Multiple Linear Regression (REG) Analysis could not be used successfully as it could neither establish relationship between the disease severity and weather nor it could predict the infection events (9). Diverse modeling approaches have therefore, been followed for advanced understanding and predictability of phenomena associated with diseases in plant populations. Till date, artificial neural networks (ANNs) have been reported to be the good alternative to the conventional multiple regression techniques as ANNs are reputed for using large, multiple and variable data sets without pre-conceived assumptions about model form due to incompletely understood, possibly complex, relationships (10, 11, 12).

Machine learning techniques for disease forecasting

The latest machine learning techniques having higher predictive accuracy that generate more efficient prediction models, helping to explain the factors that govern disease occurrence and in designing control systems that minimize yield losses, was found to be more suitable. Also, 'RB-Pred' web-based server, which is freely available, is an initiative in this direction for forecasting leaf blast severity based on the weather variables which may help the farmers and plant pathologists in their decision making process

Support Vector Machine

A new prediction method based on a powerful machine learning technique Support Vector Machines **(SVM)** originally developed by Vapnik and co-workers at Bell Laboratories as a very effective method for general-purpose supervised predictions (13). SVM provides an alternative and complement to the present regression analysis approaches for model development. It learns how to classify from a training set of feature vectors, whose expected outputs are already known. The training enables a binary classifying SVM to define a plane in the feature space, which optimally separates the training vectors of two classes. When a new feature vector is fed, its class is predicted on the basis of which side of the plane it maps.

To cite an example, Rice blast disease causes between 11% and 30% crop losses annually representing a loss of 157 million tonnes of rice. Progression of the disease varies in different locations and years, depending mainly on weather conditions. Forecasting of blast disease was necessary for the growers to prevent severe yield losses caused by the disease. The usefulness of Support Vector Machines in understanding the relationship between disease severity and its associated environmental conditions has first been studied by Kaundal and co-workers at Bio-informatics Centre, Chandigarh in Rice blast (14), and to predict Rice blast severity based on prevailing weather conditions both within and between the locations/years, and to calculate the overall risk of Rice blast infection at these field sites. The results by using SVM-based regression approach have led to a better description of this relationship between the environmental conditions and disease level which could be useful for disease management.

There is an urgent need to manage the mulberry diseases by better understanding of the mathematical relationships between the environmental conditions and its specific stages of infection cycle. The rationale behind the use of early- and mid-season information to predict late-season disease severity lies in the fact that this disease is strongly influenced by environmental conditions favorable for initial pathogen build-up and infection. Thus, it is necessary to use other empirical approaches in an effort to understand the relationship between the environment and disease development.

Features of Support Vector Machine Technique :

- SVM is known to be robust
- It is a flexible modeling approach
- It has no local minima
- It has sparseness of the solution
- It uses kernel-induced feature spaces
- It works on Support Vector Regression and Cross Validation

- It leaves least correlation coefficient

Advantages of SVM :

- Improvement of r^2 and % MAE (Mean Absolute Error) values with SVM over the existing the conventional regression approaches.
- They are known to be robust to extrapolate sparsely filled high dimensional data-set to perform better than BPNN, GRNN and REG on the dataset used.
- SVM maps data into a high dimensional space where a linear decision boundary can be constructed.
- This modeling approach is flexible that makes possible to fit in non-linear relationships and complex interactions between variables
- The relationships between the environment and disease development are better understood for developing prediction models.
- Results on attempting to predict the severity of the disease using SVM are superior to regression approaches.
- All field sites can be used for cross-sites prediction with equal accuracy as that of within-site prediction models
- In general, the cross-year models showed slightly higher coefficient of determination and lower percent mean absolute error values as compared to the cross-location models
- Location-specific models have better predictability and higher confidence of prediction.
- An important contribution is that, SVM demonstrates that the basic quantitative relationship between disease development and weather does not change from site to site.

CONCLUSION

The wide scope of application of SVM model for plant disease prediction makes an useful tool for disease forecasting. This would help explaining the factors that govern disease occurrence and help in designing of control systems to minimize yield losses. This can best be adopted as a forward step in Sericulture for predicting / forecasting the diseases so as to support / assist / help the whole sericulturist community to see a bright future with increased income generation.

REFERENCES

1. Taylor MC, Hardwick NV, Bradshaw NJ, Hall AM: **Relative performance of five forecasting schemes for potato late blight (*Phytophthora infestans*) I. Accuracy of infection warnings and reduction of unnecessary, theoretical, fungicide applications.** *Crop Protection* 2003, **22:**275-83.
2. Ishiguro K, Hashimoto A: **Computer based forecasting of rice blast epidemics in Japan. Rice blast modelling and forecasting.** *Selected papers from the International Rice Research Conference, 27–31 August 1990, Seoul, Korea Republic*39-51.
3. Choi WJ, Park EW, Lee EJ: **Leaf blast: A computer simulation model for leaf blast development on rice.** *Korean Journal of Plant Pathology* 1988, **4**(1)**:**25-32. .

4. Zhejiang Research Group Computerized Forecast Rice Blast: **A study on computerized forecast of rice blast.** *Zhejiang Agricultural Science* 1986, **2:**74-79.
5. Kapoor AS, Sood GK, Kaushik RP: **Integrated management of rice blast.** *Proceedings of Indian Phytopathology, Soc. Golden Jubilee International Conf. on "Integrated Plant Disease Management for Sustainable Agriculture"* 2000, **1:**218-219.
6. Manibhushanrao K, Krishnan P: **Epidemiology of blast (EPIBLA): a simulation model and forecasting system for tropical rice in India.** *Rice blast modeling and forecasting IRRI Box 933 Manila Philippines* 1991, 31-38.
7. Premanathan T, Rao GSLHVP, Mahana NK: **Forecasting of rice blast disease epidemic in northern region of Kerala.** *Oryza* 1999, **36**(4)**:**364-368.
8. Calvero SB Jr, Coakley SM, Teng PS: **Development of empirical forecasting models for rice blast based on weather factors.** *Plant Pathology* 1996, **45:**667-678.
9. Chakraborty S, Billard L: **Quantitative relationships between *Colletotrichum gloeosporioides* infection of *Stylosanthes scabra* and weather factors under field conditions.** *Plant Pathology* 1995, **44:**63-72.
10. Crisci A, Moriondo M, Orlandini S: **Analysis of downy and powdery mildew infection: modelling and artificial neural network approach.** *Proceedings of the 7th ICCTA – International Congress for Computer Technology in Agriculture Florence Italy* 1998.
11. De Wolf ED, Francl LJ: **Neural networks that distinguish infection periods of wheat tan spot in an outdoor environment.** *Phytopathology* 1997, **87:**83-87.
12. Paul PA, Munkvold GP: **Regression and Artificial Neural Network Modeling for the Prediction of Gray Leaf Spot of Maize.** *Phytopathology* 2005, **95:**388-396.
13. Chtioui Y, Francl LJ, Panigrahi S: **Moisture prediction from simple micrometeorological data.** *Phytopathology* 1999, **89:**668-672.
14. Kaundal R, Kapoor & Amar, Raghava PSG : **Machine learning techniques in disease forecasting : a case study on rice blast prediction.** *BMC Bioinformatics* 2006, **7**:485.

Microbial infection on fifth instar larvae of tasar silkworm, *Antheraea mylitta* eco-race Bhandara

By

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Tropical tasar silkworm *Antheraea mylitta* eco-race Bhandara is wild silkworm feed on the leaves of primary food plant like *Terminalia tomentosa* (yen), *Terminalia arjuna* (Arjun) and some other secondary food plants. Microbial diseases of the tasar silkworm causing heavy loss every year. Present study was therefore undertaken to explore effect of microbial pathogens, to elucidate their cytomorphological structure and their pathogenic effect on fifth instar larvae of tasar silkworm. Haemolymph, fat body and silk gland total protein concentration increases gradually since emergence up to prior to spinning. Biochemical studies show that total Protein, DNA, RNA and Carbohydrate decreases during the various microbial infections in haemolymph, fat body and silk gland. SDS -PAGE Electrophoretic analysis of haemolymph and fat body reveals separation 10-15 protein bands, among which one is pathogen specific found in the infected larvae. The electron microscopic study shows the presence of bacteria, virions of polyhedrosis virus (CPV) and spores of Nosema species in the cells of silk gland.

Key words: *Antheraea mylitta*. Microbial infection.

Section 3. Silkworms as biological models

Immunity Promotion and Proteomic Identification in Mice upon Exposure to manganese superoxide dismutase expressed in silkworm larvae, *Bombyx mori* L.

By

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ABSTRACT

We investigated the effects of silkworm larvae powder containing superoxide dismutase (SOD) on the antioxidation such as the contents of MDA, the superoxide dismutase (SOD) and Glutathione peroxidase (GSH-Px) activities both in mice plasma or liver organ treated with silkworm larvae powder containing manganese superoxide dismutase, and the immunity of mouse such as the ConA-stimulated splenocyte proliferation, PFC assay, phagocytosis of mouse macrophages, hemolysin response, hemagglutination against SRBC, the activity of natural killer (NK) cells, the growth of immunity-related organs, and employed a proteomics approach to examine this phenomenon. These findings demonstrate that administration of silkworm larvae powder containing SOD results in enhancement of antioxidation and immunity activities in mouse. The results also suggested the SOD expressed in silkworm maybe have potential application in medicine.

Keywords: silkworm (*Bombyx mori* L.), manganese superoxide dismutase (SOD), antioxidation, immunity, proteomic identification, Mouse

Introduction

Superoxide dismutase (SOD, EC 1.15.1.1) is a metalloenzyme, which catalyzes the conversion of the superoxide radicals into molecular O_2 and H_2O_2 and thus form a crucial part of the cellular antioxidant defense mechanism [Weisiger and Fridovich, 1973]. The amount of SOD present in cellular and extracellular environment is crucial for the prevention of disease linked to oxidative stress. Mutations in SOD account for approximately 20% of familial amyotrophic lateral sclerosis (ALS) cases [Louvel et al, 1997]. SOD also appears to be important in the prevention of other neurodegenerative disorders such as Alzheimer's, Parkinson's, and Huntington's diseases [Maier and Chan, 2002].

We used the silkworm, *Bombyx mori* larvae as a bio-reactor, and expressed the manganese superoxide dismutase (Mn-SOD) by the recombinant bacmid baculoviruses expression system [Yue et al, 2006]. To study the function of superoxide dismutase and potential practical development, we investigated the antioxidative and immunological function of SOD in the plasma and liver organs of treated mice with SOD-including silkworm larvae powder, suggesting the silkworm larvae powder containing SOD play a positive role in anti-oxidation and immunity promotion in mice. Furthermore we adopted a proteomics approach to identify the protein changes that occur in the plasma of treated mice with SOD-including silkworm larvae powder. The relation between the immunity promotion and protein changes in mice was discussed.

Materials and methods

Preparation of silkworm powder including superoxide dismutase (SOD)

The fifth instar silkworm larvae expressed superoxide dismutase (SOD) 96 h post-infection with recombinant virus (rBacmid/BmNPV/SOD) were collected [Yue et al, 2006], and dried with a vacuum dryer (Brocher CHRIST Beta-16, Germany) under low temperature of -56 . The dried larvae were homogenized to powder and stored at -20 up to use.

Animal and breeding conditions

Seven-five male ICR mice (Animal experiment center of Medical College, Zhejiang University, China) weighing 18-22 g were used. The animals were housed in individual stainless steel cages in an air-conditioned room under a 12:12-h light: dark cycle. A commercial pellet diet and water were provided throughout the experiment. All procedures were conducted in accordance with the P. R. China legislation under No. 8910M047 on the use and care of laboratory animals and with the guidelines established by Institute for Experimental Animals of Zhejiang University, and were approved by the university committee for animal experiments.

Animal Experiments

The mice were randomly divided into groups with 10 or 15 animals in each group: normal mice received distilled water (Control); treated groups, administrated through feeding with silkworm powder including superoxide dismutase (SOD) at the level of 100 mg/kg body weight/day (Low dosage group, Group-L), 200 mg/kg body weight/day (middle dosage group, Group-M) and 400 mg/kg body weight/day (high dosage group, Group-H), and a positive control was set as oral feeding of Huangqi fluid (*Astragalus membranaceus (Fisch.)* Bunge) at level of 0.3ml/day (Positive-C).

In Vivo Splenocyte Proliferation Assay

Spleen of mice exposure to manganese superoxide dismutase expressed in silkworm larvae was collected under aseptic conditions, in Hank's balanced salt solution (Sigma), was minced using a pair of scissors and passed through a fine steel mesh to obtain a homogeneous cell suspension, and the erythrocytes were lysed with NH_4Cl (0.8% (w/v)). The stimulation index (SI) was calculated based on the following formula: SI=the absorbance value for mitogen-cultures divided by the absorbance value for non-stimulated cultures.

Anti SRBC plague-forming cells (PFC) assay

Aliquots of spleen cells in RPMI1640 medium were added to glass test tubes which contained 10% SRBC (v/v, with saline). The contents of each test tube were mixed by vortexing and poured into two chambers. The chambers were incubated for one hour in a 37 , 5% CO_2 incubator, and the number of plague were counted. The data were presented as the number of PFC/ spleen cells.

In vitro macrophage phagocytosis of mouse to chicken erythrocyte

0.5 ml of chicken red blood cells (CRBC, 1% in Hanks' solution) and 0.5 ml of mouse macrophages was added into a test tube, and mixed by vortexing. 0.5 ml of above mixture suspension sample was spread on slide glass, and incubated for 20 min a 37 , 5% CO_2 incubator. After incubation, the glass was washed with saline to remove unattached cells. Then the glass was treated with methyl alcohol for 5 min, and dyed with 4% (v/v) Giemsa-PBS buffer solution. The number of macrophages that ingested chicken red blood cells was calculated under a microscope. The data were presented as phagocytic rate (%) (macrophages that ingested chicken red blood cells/total macrophages) and phagocytic index (ingested chicken red blood cells/total macrophages).

Cytometric assay for assessment of Natural Killer (NK) cell cytotoxicity

Splenocytes were adjusted as above, and the NK activity was detected with the freshly isolated splenic mononuclear cells. The NK cell cytotoxicity was calculated according to the formula: *NK cell cytotoxicity (%)=[(NK+YAC-1)OD – (Yac-1)OD] / [(Yac-1+NP40)OD- (Yac-1)OD]*

Proteomic identification

Blood plasma samples were obtained with anesthesia by resection of the terminal 1-2 mm of the mice' tails; a total of 0.5 ml of blood was drawn into sodium EDTA added tubes. Plasma was separated by centrifugation (3000×*g*, 10 min) and then stored at -30 until analysis. The protein content of plasma samples was determined using the Bradford method with protein assay dye reagent concentrate (Bio-Rad, Hercules, CA). The 2D electrophoresis (2-DE), gel visualization, 2D protein image acquisition and analysis, in-gel digestion, Matrix-Assisted Laser Desorption/Ionization-Time-of-Flight Mass Spectrometry (MALDI-TOF-MS) analysis and protein database searching were conducted as described in our previous paper [Li et al, 2006].

Statistical Analysis

The data were expressed as mean±S.D., and examined for their statistical significance of difference with Student's t test, $P<0.05$ being considered significant.

Results

In Vivo Splenocyte Proliferation Assay

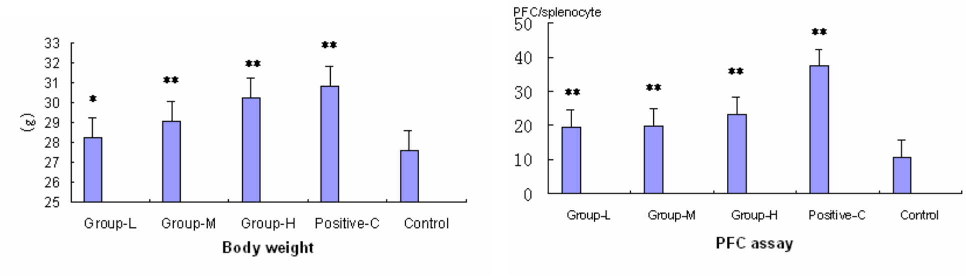
The *in vivo* effect of manganese superoxide dismutase expressed in silkworm larvae on ConA-stimulated splenocyte proliferation was showed in the Table 1. The ConA-stimulated splenocyte proliferation of all three treated groups was higher than that of the control. Among them the stimulation index of 200mg SOD contained silkworm powder treated mouse splenocyte (Group-M) and 400mg SOD contained silkworm powder treated mouse splenocyte (Group-H) were significantly enhanced respectively compare to the control.

Table 1 In vitro splenocyte proliferation assay in mouse upon exposure to manganese superoxide dismutase expressed in silkworm larvae.

Treatment	Animal numbers	Stimulation index*(SI)*	*P* value
Group-L	10	2.55±0.55	
Group-M	10	2.99±0.79	*
Group-H	10	2.78±0.49	*
Control	10	2.33±0.33	

Anti SRBC plague-forming cells (PFC) assay

In order to compare antibody production between mice treated with silkworm larvae powder containing manganese superoxide dismutase and controlled mice, antibody responses to sheep red blood cells (SRBC) were measured. Figure 1 showed the result of body weight and the PFC assay. The mean body weights in treated mice were significantly heavier than that of control (distilled water giving orally) (Fig 1-a). Meanwhile the mean antibody responses in the PFC assay in mice upon exposure to manganese superoxide dismutase expressed in silkworm larvae were also significantly higher that controlled mice (Fig 1 b).



(a) (b)

Figure 1 body weight and anti-SRBC plague-forming cells (PFC) assay in mice upon exposure to manganese superoxide dismutase expressed in silkworm larvae.

In vitro macrophage phagocytosis of mouse to chicken erythrocyte

Table 2 presented the results of phagocytosis of mouse macrophages to chicken erythrocyte administrated through feeding with silkworm powder including superoxide dismutase (SOD). After thirty-day oral giving for mice with silkworm powder including superoxide dismutase (SOD), all three treated groups were enhanced the phagocytosis of mouse macrophages to chicken red blood cells (CRBC) the that of controlled mice. Especially the phagocytic rate (%) of mice macrophages to CRBC in Group-M (200 mg/kg body weight/day) and Group-H (400 mg/kg body weight/day) were significantly higher than that of control (*P*<0.01).

Table 2 Phagocytosis of mouse macrophages to chicken erythrocyte administrated through feeding with silkworm powder including superoxide dismutase (SOD). Values are shown as the mean±SD of 10 animals. * *P* < 0.05, ** *P* < 0.01 in comparisons between treatments.

Treatment	Animal number	Phagocytic rate (%)	*P* value	Phagocytic index
Group-L	12	45.3±9.9	*	1.31±0.29
Group-M	12	52.0±8.0	**	1.26±0.11
Group-H	12	85.4±15.6	**	1.15±0.10
Positive-C	12	41.4±11.8		1.30±0.24
Control	12	40.5±8.4		1.21±0.17

Effect of SOD-contained silkworm larvae powder on cytotoxicity of NK cells

To evaluate the effect of SOD-contained silkworm larvae powder on the activity of NK cells in vivo, we analyzed the cytolytic activity of NK cells obtained from the spleen of SOD-contained silkworm larvae powder –treated mice against YAC-1 cells, a prototypical NK cell-sensitive target. From Figure 2, we observed significant increase in the NK cell cytotoxicity of mice treated with SOD-contained silkworm larvae powder compare to that of control. The average increase rate (%) was come to 38.91 (Group-L), 45.57 (Group-M) and 48.55 (group-H) respectively. The results demonstrated an activation of NK cell function by the SOD-contained silkworm larvae powder.

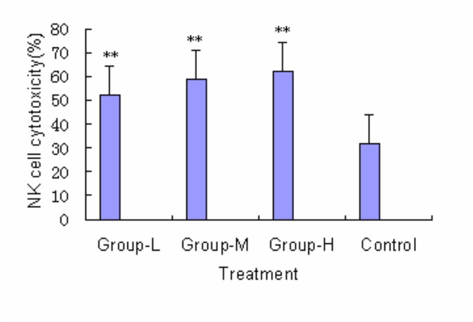


Figure 2 Effect of SOD-contained silkworm larvae powder on cytotoxicity of NK cells.

2-D electrophoresis and protein identification

2D showed as many as 140 of protein spots were expressed in mouse. Among them, most of proteins were concentrated in P*I* 5.0 to 9.0, their number was 95, which reached 67% to the total protein spots. As for the protein molecular sizes, 105 of protein spots concentrated between 30KD and 67KD, which comes to 75% of the total spots.

Analysis of peptide mass fingerprinting (PMF) patterns and homology searching

Total of 25 spots expressed in controlled and treated mouse were analyzed through MALDI-TOF-MS. The results showed 6 spots were related to immunity of mice, and 4 spots were considered as regulation proteins. Here we listed spot number 10 and 22, which identified as immunoglobulin superfamily receptor translocation associated protein 2a and fibrinogen respectively. Figure3 and Table 3 presented the result of spot 10 using peptide mass fingerprinting.

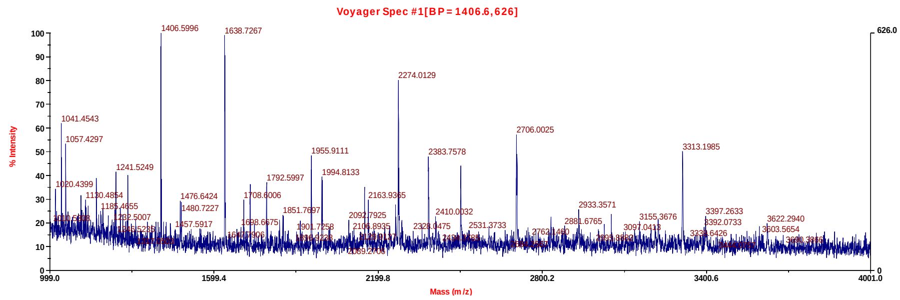


Figure 3 PMF of spot 10 extracted from 2-DE gel

Table 3 PMF Database Searching Results of Protein Spot 10

Homolohous protein name	**NCBI accession NO.**	**Calculated P*I***	**Nominal mass (M_r)**	**Sequence Coverage**
similar to immunoglobulin superfamily receptor translocation associated protein 2a	gi|114560265	8.23	20599	62%

Start - End	**Observed**	**Mr(expt)**	**Mr(calc)**	**Delta**	**Sequence**
1 - 33	3663.1312	3662.1239	3662.0091	0.1149	-.MNQITAVVFLIASLILQAPLSVFEGDFVVLRCR.A
36 - 45	1169.4805	1168.4733	1168.5798	-0.1065	K.AEVTLNTMYK.N
91 - 104	1479.7443	1478.7370	1478.6460	0.0911	R.DGQTLGSGWSSCPK.F
112 - 135	2932.3184	2931.3111	2931.3061	0.0050	R.SEDSWSFWDWNFTLIPITVDDACK.R
142 - 153	1241.5303	1240.523	1240.6451	-0.1222	R.APWEVGSLTPGK

		0			.S
162 - 183	2624.0118	2623.004 5	2623.2304	-0.2259	K.NYPSSLDNWMG LYSLFIKFSEP.-

The matched peptides for spot 10 are shown in bold red font as follows:

1 MNQITAVVFL IASLILQAPL SVFEGDFVVL RCRAKA**EVTL NTMYK**NELFS RPVLRASSSQ PTNGSPVTLT CETRLSLERS EVQLQFCFFR **DGQTLGSGWS**
101 SCPKFQISAM R**SEDSWSFWD WNFTLIPITV DDACK**RPCAP R**APWEVGSLT PGK**SFQQKGS K**NYPSSLDNW MGLYSLFIKF SEP**

GDV

6 spots, which considered as related with immunity, together with 4 regulation proteins were presented herein with protein names, observed masses and matched peptide sequence coverage (Table 4).

Table 4 List of proteins expressed in mouse plasma identified by MALDI-TOF MS analysis

Groups	Spot No.	Protein name	Accession No.	PI/Mr(Da)	Sequence coverage(%)
Immunity-related proteins	4	MHC class I antigen	gi|32400585	5.76/18845	86
	6	protein-tyrosine kinase	gi|57582	6.82/56948	50
	10	Immunoglobulin superfamily receptor	gi|114560265	8.23/20599	62
	13	Apoa4 protein	gi|29477189	5.55/42889	48
	15	XRCC6 binding protein	gi|27754038	7.17/21696	45
	22	fibrinogen, gamma polypeptide	gi|19527078	5.54/49360	45
Regulation proteins	1	GTP Cyclohydrolase I Feedback Regulatory Protein	gi|16975333	6.14/9535	71
	11	Trypsin Inhibitor	gi|49259463	8.70/23318	59
	12	Albumin	gi|55391508	6.09/68714	35
	23	vitamin D-binding protein	gi|193446	5.26/53051	51

The expression profiles of the 6 immunity-related proteins with significant (P□0.05) differential expression were visualized. All 6 matched proteins related immunity showed the increase of expression level in plasma of mouse administrated with silkworm powder including superoxide dismutase (SOD) at the level of 100 mg/kg body weight/day, compared to that of control.

Discussion

Superoxide dismutases (SODs) are metalloenzymes that catalyze the dismutation of the superoxide anion (O_2^{-}) to elemental molecular oxygen (O2) and hydrogen peroxide (H_2O_2) and, thus, form a crucial part of the cellular antioxidant defense mechanism [Malstrom et al, 1975]. In our last report, we used a practical BmNPV bacmid system to express the Mn-SOD enzyme protein in silkworm larvae by the recombinant bacmid baculoviruses. As silkworms can be conveniently reared with mulberry leaves at much lower cost or with artificial diet throughout the year, large scale and successive production of SOD is possible [Yue et al., 2006]. The availability of large quantities of SOD that the silkworm provides should greatly facilitate the future research and testing of this protein for potential application in medicine.

This experiment was designed to investigate the effects of silkworm larvae powder containing SOD on the immune system of mouse, focused on hemagglutination against SRBC and the NK cell cytotoxicity.

The level of a special antibody in the plasma can be used as a measure of the functional status of the humoral immune response. The hemolysin level can reflect humoral immunity. Our data demonstrated that all treated mice with oral feeding of silkworm larvae powder containing manganese superoxide dismutase showed significant increase in hemolysin response to SRBC, which suggest a promotion in humoral immunity.

Natural killer cell (NK) is known as a major immune system in body through mediating cell death via several possible pathways [Smyth et al., 2005]. NK cells are one of three subpopulations of lymphocytes functioning as scavenger of tumor, virus infected cells etc. Our present results found that the SOD-contained silkworm larvae powder caused an enhancement of the effect on NK cell cytotoxicity, which implied this material modulated the immune system in mice in vivo.

The spleen is an important immunological organ, which contains mainly B-lymphocytes. Hence, the spleen can indirectly reflect humoral immunity. Our data on the effects of continuous treatment with SOD contained silkworm larvae powder showed the mean body weights in treated mice were significantly heavier than that of control (Fig 1-a). Meanwhile, the ratio of splenocytes/body weight and the ratios of thoracic gland/body weight in treated mice were significantly enhanced after 30 days treated with silkworm larvae powder containing manganese superoxide dismutase (Fig 1-b). These results imply the SOD contained silkworm larvae powder initiated the growth of the immunity-related organs in mice.

Macrophages are mononuclear phagocytes that are found in various tissues through maturation and differentiation of immigrating blood monocytes. Macrophages, in general, are critical effectors of body's immune system. Macrophages play a critical role in cellular host defense against infection and tissue injury [Valledor and Ricote, 2004]. In response to stimuli, macrophages undergo a series of inflammatory processes, including chemotaxis, phagocytosis, intracellular killing, and release of inflammatory cytokines [Aderem, 2001].

The spleen is an important immunological organ, which contains mainly B-lymphocytes. Hence, the spleen can indirectly reflect humoral immunity. The higher the immunity index, the stronger the immune capability. Our data on the effects of continuous treatment with SOD contained silkworm larvae powder showed the ConA-stimulated splenocyte proliferation of all three treated groups was higher than that of the control (Table 1), which is in agreement with previous reports [Selvan, 1989].

In order to compare antibody production between mice treated with silkworm larvae powder containing manganese superoxide dismutase and controlled mice, antibody responses to sheep red blood cells (SRBC) were measured. The results of PFC assay also revealed that anti body production was higher in all three treated groups than controlled mice.

Macrophages are mononuclear phagocytes that are found in various tissues through maturation and differentiation of immigrating blood monocytes. Macrophages, in general, are critical effectors of body's immune system. Macrophages play a critical role in cellular host defense against infection and tissue injury [Valledor and Ricote, 2004]. In response to stimuli, macrophages undergo a series of inflammatory processes, including chemotaxis, phagocytosis, intracellular killing, and release of inflammatory cytokines [Aderem, 2001]. To evaluate the potential of SOD to activate macrophages, we treated mouse with varying concentrations of SOD containing silkworm larvae powder and investigated the phagocytosis of mouse macrophages. Its treatment led to a dose-dependent increase of phagocytic activity, especially the phagocytic rate (%) of mice macrophages to CRBC in Group-M (200 mg/kg body weight/day) and Group-H (400 mg/kg body weight/day) were significantly higher than that of control (P<0.01) (Table 2 and Figure 2).

Proteomics is a large-scale study of the gene expression at the protein level, which ultimately provides direct measurement of protein expression levels and insight into the activity state of all relevant proteins. As the SOD containing silkworm larvae powder enhanced the immunity response of treated mouse in *in vivo* splenocyte proliferation, anti-SRBC plague-forming cells (PFC) assay and *in vitro* macrophage phagocytosis, a proteome approach was conducted to investigate the relative protein profiles. Using 2D and peptide mass fingerprinting (PMF), we identified 6 proteins which related to immunity of mice. The data showed all these 6 matched proteins related immunity showed the increase of expression level in plasma of mouse administrated with silkworm powder including superoxide dismutase (SOD) at the level of 100 mg/kg body weight/day, compared to that of control.

In conclusion, these findings demonstrate that administration of silkworm larvae powder containing SOD results in the reduction of LPO and changes the activities of antioxidant enzymes in mouse plasma and liver tissue, and enhancement of immunity activities in mouse. The results also suggested the SOD expressed in silkworm maybe have potential application in medicine.

References

Aderem, A. Role of Toll-like receptors in inflammatory response in macrophages. *Crit. Care Med.* 2001, 29, 16–18.

Altuntas I, Delibas N, Sutcu R. The effects of organophosphate insecticide methidathion on lipid peroxidation and anti-oxidant enzymes in rat erythrocytes: role of vitamins E and C. Hum Exp Toxicol 2002a, 21:681–85.

Dominguez-Rodriguez, J. R., Gomez-Contreras, P. C., Hernandez-Flores, G., Lerma-Diaz, J. M., Carranco, A., Cervantes-Munguia, R., Orbach-Arbouvs, S., and Bravo-Cuella, A. In vivo inhibition by antioxidants of adriamycin-induced apoptosis in murine peritoneal macrophages. *Anticancer Res.* 2001, 21(3B), 1869–1872.

Hunter, T., Bannister, W. H., and Hunter, G. J. Cloning, expression, and characterization of two manganese superoxide dismutases from Caenorhabditiselegans. *J. Biol. Chem.* 1997, 272, 28652–28659.

Kushleika, J., Checkoway, H., and Woods, J. S. Selegiline and lymphocyte superoxide dismutase activity in Parkinson's disease. *Ann. Neurol.* 1996, 39(3), 378–381.

Louvel, E., Hugon, J., and Doble, A. Therapeutic advances in amyotrophic lateral sclerosis. *Trends Pharm. Sci.* 1997, 18(6), 196–203.

Maier, C. M., and Chan, P. H. Role of superoxide dismutases in oxidative damage and neurodegenerative disorders. *Neuroscientist* 2002, 8(4), 323–334.

Malstrom, B., Andreasson, L., and Reinhammaer, B. In: Boyer P (ed) In the enzymes, vol XIIB. Academic, New York. 1975, pp 533.

Selvan, R. S., Venkateswaran, K. S., and Rao, A. R. Influence of arecoline on immune system: I. Short term effects on general parameters and on the adrenal and lymphoid organs. *Immunopharmacol. Immunotoxicol.* 1989, 11(2-3), 347-377.

Smyth MJ, Cretney E., Kelly JM, Westwood JA, Street SE, Yagita H, Takeda K, Dommelen SL, Degli-Esposti MA, Hayakawa Y. Activation of NK cell cytotoxicity, Mol. Immunol 2005, 42: 501–510.

Valledor, A. F., and Ricote, M. Nuclear receptor signaling in macrophages. *Biochem. Pharmacol.* 2004, 67, 201–212.

Weisiger, R. A., and Fridovich, I. Superoxide dismutase: organelle specificity. *J. Biol. Chem.* 1973, 248, 3582–3592.

Xing-hua Li, Xiao-feng Wu, Wan-fu Yue, Jian-mei Liu, Guang-li Li, and Yun-gen Miao. Proteomic Analysis of the Silkworm (*Bombyx mori* L.) Hemolymph during Developmental Stage. *J. Proteome Res.* 2006, *5*, 2809-2814.

Yamamoto, K., Zhang, P. B., Banno, Y., and Fujii, H. Superoxide dismutase from the silkworm, *Bombyx mori*: sequence, distribution, and overexpression. *Biosci. Biotechnol. Biochem.* 2005, 69(3), 507–514.

Yue, W. F., Miao, Y. G., Li, X. H., Wu, X. F., Zhao, A. C., and Nakagaki, M. Cloning and expression of manganese superoxide dismutase of the silkworm, *Bombyx mori* by Bac-to-Bac/BmNPV Baculovirus expression system. *Appl. Microbiol. Biotechnol.* 2006, 73, 181–186.

Introduction of Gu-Bm-EK1 Cell Line from Embryonic Tissue of Silkworm, *Bombyx mori*

By

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ABSTRACT
Since the use of insect cell lines for producing bio-pesticides and recombinant proteins is increasing, the establishment of new cell lines will help to enrich this industry. A cell line from embryonic tissue of silkworm, Bombyx mori, was established and its characteristics and susceptibility to BmNPV were studied. Primary cultures were developed using four mechanical and enzymatic methods which with the mechanical method of homogenizing the tissue, GU-Bm-EK1 cell line was established in TC-100 medium enriched with 10% FBS. Morphologically, the majority of the cells in the cell line are fibroblastic cells although with increasing the passage number spherical and fusi form cells were increased. The population doubling time of 20th passage of this cell line at 27ºC was 4 days. Its karyotype was revealed as small multiple chromosomes with dispersed centromers and most of the cells were octaploid or tetraploid. RAPD genetic marker showed that the pattern of Bm-EK1 bonds was similar to the pattern of the bonds obtained from silkworm eggs. This cell line was susceptible to BmNPV and almost 79.2% of the cells showed cytopathic effects including granulation and suspending in the culture.
Keywords: *Bombyx mori,* GU-Bm-EK1, Cell line, Embryonic tissue

INTRODUCTION

Insect cell culture has found many applications in the fields of physiology, biochemistry, genetics, developmental biology and insect pathology. More than 500 insect cell lines have been established from different orders (Lynn, 2001), particularly Lepidoptera, mainly due to the desire to propagate Baculoviruses as biocontrol agents. Among lepidpterous species silkworm, *Bombyx mori* L., in addition to being a beneficial insect, has always been the center of attention for its use as a model in biochemical and molecular studies. Using silkworm as *in vivo* bioreactor for production of recombinant proteins confirms this claim (Maeda *et al.*, 1989). This could be due to its availability as a commercial insect and its unique characteristics.

Embryos are the source of most of the cell lines and this is because they can usually be obtained in abundance and the insect chorion is resistant to the permeation of disinfectants. Many *B. mori* cell lines have been established from embryo (Inoue and Mitsuhashi, 1984; Imanishi and Ohtsuki, 1988; Pandharpande, 1994; and Imanishi *et al.*, 1999) although a few cell lines have been established from larval and pupal ovary (Grace, 1967; Quiot, 1982) and larval midgut (Baines *et al.* 1994) too. This research provides information on the characteristics of a cell line established from the eggs of *B. mori* in order to gain better understanding of its ability to be used in cell culture industry and baculovirus production.

MATERIALS AND METHODS

Primary cell cultures

Silkworm eggs, which were kept at 4ºC until they had completed diapause, were obtained from Iran Sericultural Research Center. and maintained in 27ºC for 48 h prior to generating primary cultures from them. To set up embryonic primary cultures, the sterile eggs were homogenized and passed through a mesh in order to separate the eggs' shell from the embryos. Then the embryonic mixture was washed several times with Rinaldini's solution (Mitsuhashi, 2002) and finally the obtained pellet was transferred to TC-100 medium supplemented with10% FBS in 25cm² flasks. The flasks were incubated at 27 ºC and 3ml medium was replaced weekly.

Subculturing

Subcultures were made when confluent cell sheets covered the bottom of the flasks judged by microscopic examination. The cultures were split at 1:2 after detaching the cells from the bottom of the culture vessels by flushing them with medium. The flasks were incubated at 27 ºC. The interval between subcultures varied for the early cultures but after 12 passages, subcultuing was required weekly.

Karyotype

The cells were treated with 5 $\times 10^{-6}$ M colchicin for 5h. the harvested cells were spun down at 1500 rpm. The cells were processed according to Mitsuhashi (1988). After treatment by hypotonic solution, cells were fixed by Carnoy's fixative and stained by Giemsa (diluted ten times with phosphate buffer) for 10 min.

Preparation of the viral inoculum

Virus inoculum, derived from infected larvae and stored at 4ºC, was used to infect the cell cultures. The BmNPV infected silkworm larvae were triturated in distilled water. The homogenate was filtered through muslin cloth. The filtrate was subjected to repeated centrifugation until clear white OBs were obtained.

The polyhedra were dissolved in 0.05M NaCl-0.01M Na_2CO_3 (pH 10.8) by stirring at 37ºC for 10 min. pH was lowered by adding 1N HCl to pH 7.5 and the sampled was centrifuged at 1000g for 10 min to remove undissolved polyhedra. The supernatant was mixed with 10 ×volume of TC-100 medium and sterilized by 0.22µ membrane filter.

Virus susceptibility

The cells were transferred to 6-well cell culture plates. The cells were allowed to attach for 2h at 27 ºC and the medium were removed. Immediately after removing the medium from the plates, the wells were inoculated with virus at three concentrations of 0.5, 1 and 2 ml of viral suspension **(**The cells were infected with BmNPV at MOI 0.5 using 10^5 pfu/ml). The volumes of 0.5 and 1 ml viral suspension were made up to 2 ml by fresh medium. Three replicate wells were set up for each cell/virus combination. After infection, plates were stored at 25ºC in the dark for 2h, and then the virus inocula were replaced with fresh medium. The cells were tested for virus susceptibility at intervals up to one week.

RESULTS AND DISCUSSION

Morphology and growth

The cells started to migrate from explants of embryonic tissues. Mitosis occurred in fibroblast-like cells and networks of fibroblast-like cells formed around explants. Spindle shaped cells and epithelial-like cells were the other types of the cells which were present at culture in large numbers. A few hemocyte-like cells were also seen in the cultures but these apparently were overwhelmed by the vast proliferation of fibroblast-like cells (Figure 1).

At first passages the cells firmly attached to the surface of the flasks and the majority was with fibroblast-like cells but with the increase of subculturing times they were loosely attached to the surface and by 30th passage they became suspended in the culture and most of the cells were fusi-form. By the advancement of the passage numbers, growth rate increased in a way that in the 30th passage was about 3 days at 27 ºC although the doubling time reported from other cell lines obtained from silkworm embryo range from 1.96 to 5.41 days (Imanishi and Tomita, 1992). The cell line was named GU-Bm-EK1. The cell pellet obtained from culturing Bm-EK1 cells in TC100 medium fortified with 10% FBS was white after centrifugation but Inoue and Mitsuhashi (1988) reported that silkworm cell line obtained in MM medium had a dark cell pellet.

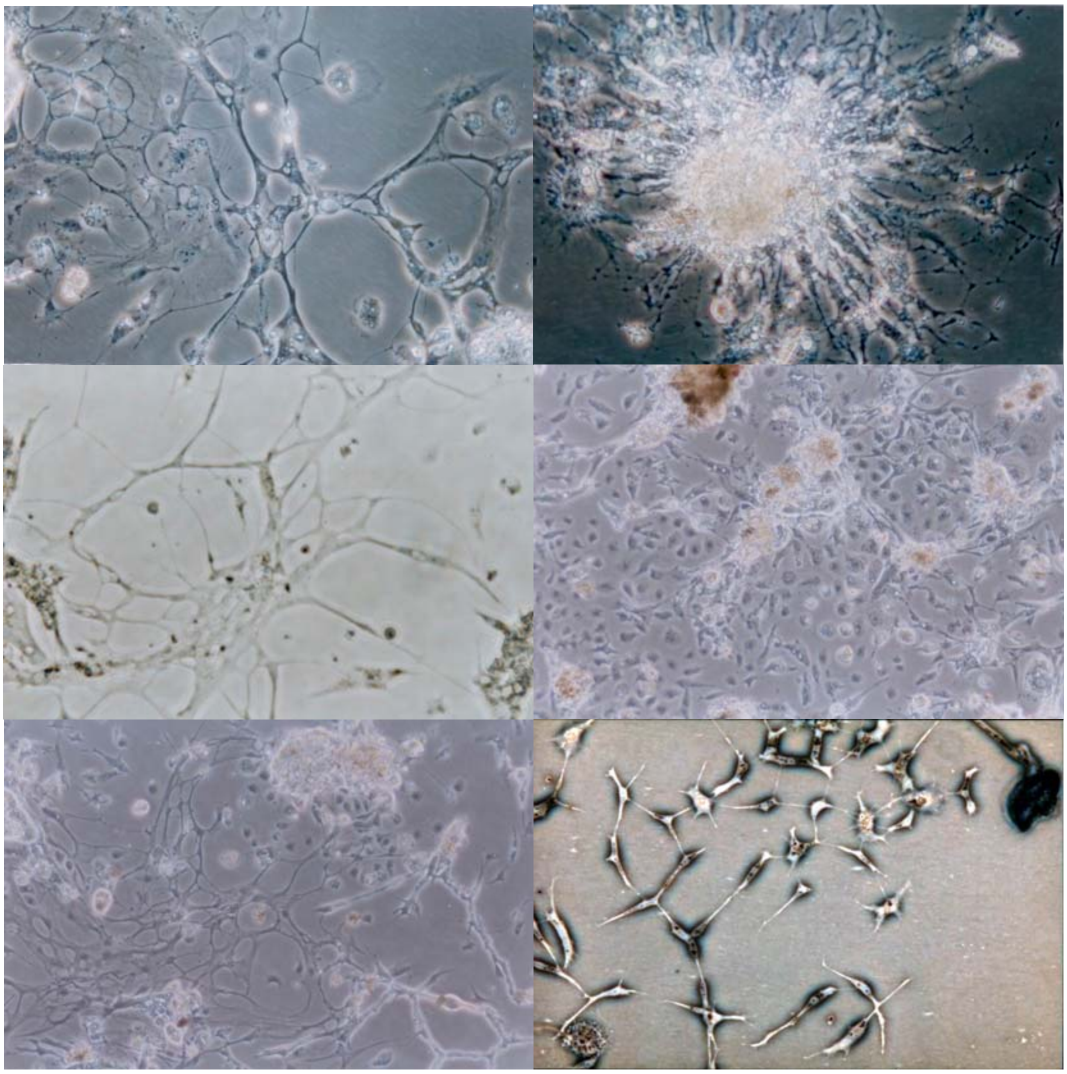

Figure 1. Different cell types of GU-BmEK1 cell line, which established from embryonic tissue of silkworm, *Bombyx mori*

Karyotype

The cell line showed the chromosomes distribution pattern typically associated with cell lines obtained from *B. mori*. The mode of chromosome number was about 110 and 180, showing most of the cells were octaploid or tetraploid. Imanishi and Tomita (1992) also showed that BoMo-J125 (embryonic) cell line had the chromosome number of 20 to 220.

Susceptibility to virus

GU-Bm-EK1 cells were susceptible to BmNPV. The cytopathic effects were observed 3 days post infection by newly formed polyhedra in inoculated cultures. Almost 79.2% of the cells showed cytopathic effects including granulation and suspending in the culture (Fig 2).

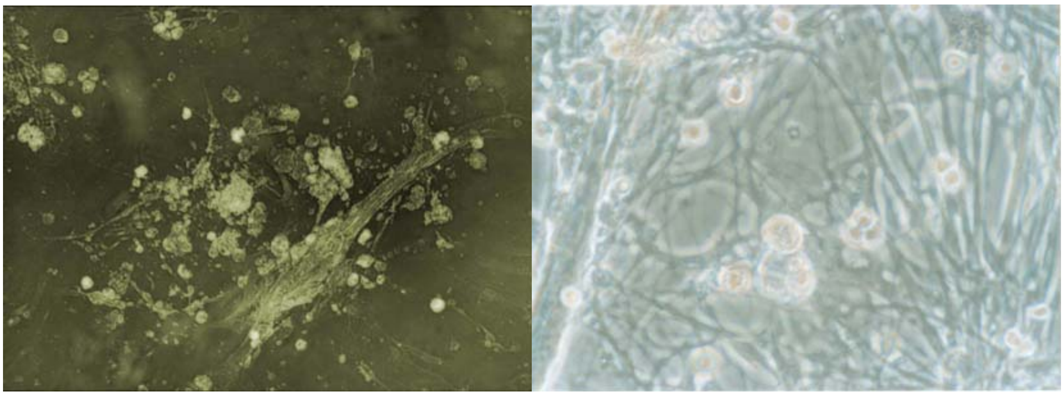

Figure 2. The infected cells of GU-BmEK1 with BmNPV

REFERENCES

Baines, D., Brownwright, A. and Schwartz, J. L. (1994) Establishment of primary and continuous cultures of midgut epithelial cells of the spruce budworm, gypsy moth and silkworm. *J. Insect Physiol.* **40:** 347-357.

Grace, T. D. C. (1967) Establishment of a line of cells from the silkworm *Bombyx mori. Nature* **216**: 613.

Imanishi, S. and Ohtsuki, Y. (1988) Characterization of cell lines established from embryonic tissues of several races of the silkworm, *Bombyx mori*, cultured in vitro. *J. Sericul. Sci. Jpn.,* **57:** 184-188.

Imanishi, S.; Cho, E. S. and Tomita, A. (1999) Novel *Bombyx mori* cell lines cultivable at 37ºC. *Appl. Entomol. Zool.* **34:** 259-266.

Imanishi, S. and Tomita, S. (1992) Suspension-type cloned cell lines from embryo tissues of *Bombyx mori. Japan Agricul. Res. Quarterly*. **26**: 196-202.

Inoue, H. and Mitsuhashi, J. (1988) Characterization of a new continuous cell line from silkworm (*Bombyx mori*) embryos. *Appl. Ent. Zool.* **23:** 8-14.

Inoue, H. and Mitsuhashi, J. (1984) A *Bombyx mori* cell line susceptible to a nuclear polyhedrosis virus. *J. Sericul. Sci. Jpn.* **53:** 108-113.

Lynn, D. E. (2001) Novel techniques to establish new insect cell lines. *In Vitro Cell. Dev. Biol.-Animal* **37**: 319-321.

Maeda, S., Obinata, T., Fujiwara, M., Horiuchi, H., Saeki, T., Sato, Y., and Furusawa, M. (1989) Production of human α-interferon in silkworm using a baculovirus vector. *Nature* **315:** 592-594.

Mitsuhashi, J., (2002) *Invertebrate Tissue Culture Methods* Springer-Verlag, Tokyo, p. 446.

Pandharipande, T. N. (1994) Two new continuously growing cell lines from *Bombyx mori* (Lepidoptera: Bombycidae) *Appl. Entomol. Zool.* **29:** 604-607.

Quiot, J. M. (1982) Establishment of a cell line (S. P. C. Bm36) from the ovaries of *Bombyx mori* (Lepidoptera). *Sericologia* **22:** 25-31.

Studies concerning the utilization of *Morus alba* root bark cultivated in Romania for the obtaining of some pharmacological active fractions

By

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The studies carried out for the obtaining of some pharmaceutical active products from Morus alba root bark have triggered the realization of certain fractions with antimicrobial activity. By the extraction of active elements from vegetal material in water, alcohol-water, acetone-water, ahloroform and the processing of the extractive solutions, different fractions under the form of solutions in EtOH 30% containing 0-0,15%flavones (ruthozide) and 0,07-0,61% polyphenols (gallic acid) have been obtained. „In vitro" testing for antimicrobial activity, the fractions presented surely weak antibacterial activity for Gram + bacteria (Staphylococcus aureus and Streptococcus salivarius), weak antifungal activity for Candida albicans, and lack of activity for Gram – bacteria.
Keywords: Morus alba, root bark, flavones, polyphenol, antimicrobial activity

Differentiation of silkworm, *Bombyx mori* strains measured by RAPD analyses

By

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ABSTRACT

We examined the patterns of random amplified polymorphic DNA (RAPD) variation among six silkworm (Bombyx mori) strains with different origins. A total of ten RAPD primers were used and all of the loci were polymorphic. The genotypic diversity (H') inferred from Shannon's index (0.4459 for all populations) was higher than gene diversity (H_t) (0.2896 for all populations), which suggests that diversity is distributed among lineages. Estimates of gene diversity in populations were higher in total (H_t) as compared to within population diversity (H_s). Highest genetic differentiation was obtained between China 23 and the other five strains. The highest genetic distance was determined between China 23 and Shova (0.1713). The highest gene flow (6.8048) was obtained between Asahi and Gindga 8 strains, whereas the lowest - between China 23 and Shova. The highest G_{st} value corresponds well with the lowest Nm value which designates that there is a small amount of gene flow. The dendogram was constructed by using the UPGMA method based on Nei's (1978) genetic distance and separated the China 23 strain from all the others that formed together a large cluster. The genetic diversity in the studied strains was moderately low.

Key words: silkworm, *Bombyx mori*, DNA polymorphism, genetic variability, RAPD.

INTRODUCTION

RAPD technique has been used to determine the phylogenetic relationships, genetic diversification of populations and strain identification of different species (Aufauvre-Brown *et al*., 1992; Ballinger-Crabtree *et al*., 1992; Lehmann *et al.*, 1992; Kambhampati *et al*., 1992; Kazan *et al*., 1993). Some of the studies were made on the basis of mulberry silkworm (*Bombyx mori*) species, which is presented with hundreds of geographical races and genetically improved strains (Promboon *et al*., 1995; Thananánta, 1997; Abe *et al*., 2000; Nagaraju *et al*., 2001). Biodiversity among the strains kept in Bulgaria has been studied mainly on the basis of selection characteristics (quality and quantity) and some biochemical markers (Shabalina, 1990; Stoykova *et al*. 2003; Petkov *et al*. 2006; Staykova, 2006). The RAPD technique has not been previously used in studying the genetic diversity. This study presents data of the genetic diversity in six strains of *B. mori* with different origins using random amplified polymorphic DNA markers.

MATERIALS AND METHODS

1. Silkworm strains

Six monovoltine strains of mulberry silkworm with different origins were studied: Gindga 8 and Maiak 5 - from Azerbaijan, Asahi and Showa – from Japan, China 23 – from China and Plovdiv 14, which has been created in Bulgaria. All races were bred in the sericultural research station of the Agricultural University in Plovdiv since 1990. For the mass rearing 50 batches of each strain were hatched separately, and only those, having a hatchability more than 98% (20-30) were chosen for mass larval rearing. After the second molt 4 replicates, each consisted of 250 larvae were reared until the cocoon spinning.

2. RAPD analysis

Genomic DNAs were isolated from silk glands of the fifth instar larvae using modified method of Hunt (1992). A total of 10 primers of arbitrary sequences (Operon Tech. Inc. Alameda, CA) having high G+C content (60%), OPB1, OPB2, OPB3, OPB4, OPB5, OPB6, OPB7, OPB8, OPB9 and OPB10 were tested on silkworms. RAPD reactions were carried out on final volume of 15 µl containing 25 ng DNA, 100 µM each of dATP, dTTP, dCTP, dGTP (Fermentase), 15 ng primer, 1U Taq DNA polymerase (Fermantase). Reactions were submitted to 35 cycles of 30 s at 94°C, 1 min at 94°C, 1min at 35°C, 2 min ramp to 72°C , 2min at 72°C (5 cycles), 10s at 94°C, 30 s at 35°C, 30 s at 72°C (30 cycles). After the cycles were completed, a 5 min elongation at 72°C was performed. Amplification products were resolved by electrophoresis in 1.2 % agarose gels that were run in 0.8xTBE buffer and UV- visualized after staining with ethidium bromide.

3. Data analysis

Polymorphic and monomorphic bands were determined and markers scored as present (1) or absent (0) for all individuals in a data matrix which was used to calculate the genetic distances and similarities using the formula proposed by Nei (1978). Genetic distances were utilized to construct a dendrogram using UPGMA procedure of POPGENE version 1.31 (Yeh *et al*. 1999). The gene flow values for the studied populations were estimated according to McDermott and McDonald (1993). Gene Diversity in populations was calculated according to Nei (1987).

RESULTS AND DISCUSSION

The genotypic diversity (H') for all populations inferred from Shannon's index (0.4459) was higher than gene diversity (H_t) for all populations (0.2896) (Table 1 and 2). This suggests that the diversity is distributed among lineages. Estimates of gene diversity in populations were higher in total (H_t) as compared to within population diversity (H_s). Highest genetic differentiation (Table 2) was determined between China 23 breed and the other five strains (G_{st} ranged between 0.2158 and 0.3032) but not among the other strains (G_{st} = 0.0684 - 0.1670).

The highest genetic distance obtained was between China 23 and Shova with a value of 0.1713 (Table 3).

Table 1. Shannon's index values among populations

	Shannon's index					
	China 23	Maiak 5	Gindga 8	Plovdiv 14	Asahi	Shova
China 23 (China)	***					
Maiak 5 (Azerbaijan)	0.3982	***				
Gindga 8 (Azerbaijan)	0.4466	0.4699	***			
Plovdiv 14 (Bulgaria)	0.3174	0.3859	0.4088	***		
Asahi (Japan)	0.3687	0.4214	0.4485	0.3647	****	
Shova (Japan)	0.3867	0.4306	0.4333	0.3846	0.3933	****
	For all Populations	0.4459				

The highest gene flow (6.8048) obtained between Asahi and Gindga 8 strains followed by Gindga 8 - Shova, Gindga 8 – Maiak 5, and Gindga 8 - Plovdiv14 with N_m values of 5.4639, 4.8413 and 4.3732 respectively. The lowest N_m value was determined between China 23 and Shova strains. The highest G_{st} value corresponds well with the lowest N_m value which means that there is a small amount of gene flow.

Table 2. Gene diversity and Gene Flow values between population pairs

		H_t	H_s	G_{st}	N_m
China 23	Maiak 5	0.2401	0.1779	0.2590	1,4302
China 23	Gindga 8	0.2656	0.2072	0.2197	1,77540
China 23	Plovdiv 14	0.1936	0.1519	0.2158	1,8171
China 23	Asahi	0.2306	0.1719	0.2547	1,4632
China 23	Shova	0.2429	0.1692	0.3032	1,149
Maiak 5	Gindga 8	0.3058	0.2771	0.0936	4,8413
Maiak 5	Plovdiv 14	0.2578	0.2218	0.1398	3,0753
Maiak 5	Asahi	0.2751	0.2418	0.1211	3,629
Maiak 5	Shova	0.2842	0.2392	0.1586	2,6519
Gindga 8	Plovdiv 14	0.2798	0.2511	0.1026	4,3732
Gindga 8	Asahi	0.2911	0.2712	0.0684	6,8048
Gindga 8	Shova	0.2931	0.2685	0.08388	5,4639
Plovdiv 14	Asahi	0.2493	0.2158	0.1344	3,2207
Plovdiv 14	Shova	0.2558	0.2131	0.1670	2,4947
Asahi	Shova	0.2657	0.2332	0.1224	3,5854
Total		0.2896	0.2207	0.2378	1.6027

Table 3. Genetic Identity and Genetic distance values among populations

	China 23	Maiak 5	Gindga 8	Plovdiv 14	Asahi	Shova
China 23	****	0.8755	0.8853	0.9191	0.8866	0.8426
Maiak 5	0.1330	****	0.9520	0.9271	0.9424	0.9030
Gindga 8	0.1218	0.0492	****	0.9475	0.9799	0.9589
Plovdiv 14	0.0843	0.0757	0.0539	****	0.9364	0.9049
Asahi	0.1203	0.0593	0.0203	0.0657	****	0.9396
Shova	0.1713	0.1020	0.0420	0.1000	0.0623	****

==

Nei's genetic identity (above diagonal) and genetic distance (below diagonal).

The dendogram was constructed by using the UPGMA method based on Nei's (1978) genetic distance and separated the China 23 strain from all the others that formed a large cluster (Figure 1). Within that cluster, Plovdiv 14 diverged from strains Maiak 5, Ginga 8, Asahi and Shova.

```
 +-------------------------------------------------China 23
 !
 !                        +---------------------------Maiak 5
--5                       !
 !                    +--3                 +-------Gindga 8
 !                    !   !       +------------1
 !                    !   +------2            +-------Asahi
 +-------------------4          !
                      !         +-------------------Shova
                      !
                     +----------------------------Plovdiv 14
```

Figure 1. Dendrogram generated by UPGMA illustrating genetic distances between regions

Nagaraju *et al.* (2001) reported that the RAPD markers reliably discriminated the silkworm varieties although the lowest diversity index was observed for RAPDs in comparison to the other markers. In the study of Nagaraja & Nagaraju (1995) silkworm genotypes were clustered into two groups, one consisting of six diapausing and the other of seven nondiapausing genotypes by RAPD analysis. Thananunta (1997) reported the use of the RAPD technique, which detected the differences between the strains of silkworm, which are not differentiated morphologically.

On the basis of the results obtained in this work we conclude that the genetic diversity among the strains we studied was moderately low. This should be taken into account in development of breeding programs.

Acknowledgments

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REFERENCES

1. Abe H., Sugasaki T., Kanehara M., Shimada T., Gomi S., Ohbayashi F., Oshiki T. 2000. Identification and genetic mapping of RAPD markers linked to the densonucleosis refractoriness gene, *nsd-2*, in the silkworm, *Bombyx mori*. Genes Genet. Syst., **75**, 93-96.
2. Aufauvre-Brown A., Cohen J., Holden D.W. 1992. Use of randomly amplified polymorphic DNA markers to distinguish isolates of *Aspergillus fumigatus*. J. Clin. Microbiol., **30**, 2991 -2993.
3. Ballinger-Crabtree M. E., Black W. C. V., Miller B. R. 1992. Use of genetic polymorphisms detected by the random amplified polymorphic DNA polymerase chain reaction (RAPD-PCR) for differentiation and ldentification of *Aedes Aegypti* subspecies, and Populations. Amer. J. Trop. Med. & Hyg., **47**, 893-901.
4. Hunt G. J., Page R. E. 1992. Patterns of inheritance with RAPD molecular markers reveal novel types of polymorphism in the honeybee. Theor. Appl. Genet. **85**,15-20.
5. Lehmann P. F., Lin D., Lasker B. A. 1992. Genofypic identification of characterization of species and strains within the genus *Candida* by using random amplified polymorphic DNA. J. Clin. Microbiol., **30**, 3249-3254.
6. Kambhampati S., Black W. C., Rai K. S. 1992. Random amplified polymorphic DNA of mosquito species and populations (Diptera; Culicidae): Techniques, statistical analysis, and application, J. Med. Ent., **29**, 939-945.
7. Kazan K., Manners J. M., Cameron D. F. 1993. Genetic relationships and variation in the *Stylosanthes guianensis* species complex assessed by random amplified polymorphic DNA. Genome, **36**, 43-49.
8. Mcdermott J.M., Mcdonald B.A. 1993. Gene Flow In Plant Pathosystems. Annual Review Of Phytopathology, **31**, 353-373.
9. Nagaraju J., Damodar Reddy K., Nagaraja G. M., Sethuraman B. N. 2001. Comparison of multilocus RFLPs and PCR-based marker systems for genetic analysis of the silkworm, *Bombyx mori*. Heredity, **86**, 588-597.
10. Nagaraja G. M., Nagaraju J. 1995. Genome fingerprinting of the silkworm, Bombyx mori, using random arbitrary primers. Electrophoresis 16 (1):1633-1638.
11. Nei M. 1978. Estimation of average heterozygosity and genetic distance from a small number of individuals. Genetics, **89**, 583-590.
12. Nei M. 1987. Molecular Evolutionary Genetics. Columbia University Press, New York.

13. Petkov N., Tzenov P., Petkov Z., Natcheva Y., Vasileva Y. 2006. Silkworm, *Bombyx mori* L. germplasm resources in Bulgaria. National Centre for Agrarian Sciences – Sofia, Sericiltural Experiment Station – Vratza. 264.

14. Promboon A., Shimada T., Fujiwara H., Kobayashi M. 1995. Linkage map of random amplified polymorphic DNAs (RAPDs) in the silkworm, *Bombyx mori*. Gen. Res., **66**, l-7.

15. Shabalina A. 1990. Esterase genetic polymorphism in haemolymph of larvae *Bombyx mori* L. Comptes rendus de l'Academie bulgare des Sciences, **43**, 105-108.

16. Stoykova T., Popov P., Dimitrov B. 2003. Electrophoretic analysis of non-specific haemolymph esterases during silkworm (*Bombyx mori* L.) ontogenesis. Sericologia, **43**, 153-162.

17. Staykova T. 2006. Genetic control of phosphoglucomutase in mulberry silkworm (*Bombyx mori* L.). International Jubilee Scientific Conference "Problems of maintenance and utilization of mulberry and silkworm genetic resources", September 25 – 29, 2006, Vratza, Bulgaria (in press).

18. Thananganta N. 1997. RAPD technique in silkworm (*Bombyx mori*): strain differentiation and identification. Thammasat Int. J. Sc. Tech., **2**, 47-51.

19. Yeh F.C., Yang R. and Boyle T. 1999. Microsoft window-based freeware for population genetic analysis. Popgene version 1.31.

The Changes of Aminotransferase in Silkworm Larvae through Different Biological Conditions

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ABSTRACT

Biochemical changes of silkworm larvae under different stress conditions creats better understanding of physiological phenomena. We measured the level of alanine aminotransferase (ALT) and aspartate aminotransferase (AST) as biochemical markers in hemolymph of silkworm larvae during Grasserie disease and insecticide residue stress. Also to determine the normal range of these enzymes, AST and ALT were measured in 20 groups of silkworm which were reared in Iran silkworm germplasm bank. In all twenty group samples, the activity level of AST is more than ALT, in a way that the average of ALT activity in larva is 153.2 IU/liter and its normal range is about 47.2-241.1 IU/liter, while the AST activity changed between 167- 421.2 IU/liter and its mean is 315.2 IU/liter. Grasserie caused a significant increase in the amount of both enzymes while the treatment of silkworm larvae with pyriproxyfen, as an insecticide, caused a considerable decrease in the level of activities.

Keywords: silkworm, Biochemical changes, Aminotransferase, Grasserie, pyriproxyfen

INTRODUCTION

Silkworm rearing and silk industry plays an important role in many Asian and some European countries. In the long history of sericultural practice, introduction of silkworm strains with high resistance to different stresses has greatly improved cocoon and silk quality and productivity. Our information about differences of various silkworm lines and strains is very important for planning of a silkworm breeding program. So, breeders have been using different markers in this issue and in recent research we study some enzymes as biochemical markers. Also investigations on biochemical changes of silkworm larvae under different stress conditions give us more information for better understanding of physiological phenomena.

Many enzymes present in the hemolymph and midgut fluid of silkworm are known as appropriate biochemical markers (Chatterjee *et al.*, 1993). The aminotransferases are the important components of amino acid catabolism; which is mainly involved in transferring an amino group from one amino acid to another keto acid (Etebari *et al.*, 2007). The aspartate aminotransferase (AST) and alanine aminotransferase (ALT) serve as a strategic link between the carbohydrate and protein metabolism and are known to be altered during various physiological and pathological conditions (Etebari *et al.,* 2005).

These biochemical markers are also used to determine the strains resistant to pesticides and disease. Shakoori *et al.* (1994) determined that the levels of ALT and AST activity of *Tribolium castaneum* strains resistant to malathion, are more than sensitive strains. Reddy and Benchmain (1992) showed that parasitism of silkworm fifth instar larvae by uzi fly increases the amount of ALT and AST in fat body and hemolymph of larvae. The increase in temperature causes the enhancement of ALT and AST activities (Reddy and Benchmain, 1992). Therefore in this study the level of two aminotransferases, as biochemical markers in hemolymph of silkworm larvae, during grasserie disease and insecticide residue stress were measured. Also for determining the normal range of these enzymes, the level of AST and ALT were measured in 20 groups of silkworm which were reared in Iran silkworm germplasm bank.

MATERIALS AND METHODS

Experimental groups

The silkworm lines, 107 and 103 with Japanese origin which are respectively resistant and susceptible lines to BmNPV were selected. Fourth instar larvae were divided into 2 experimental groups. Each group consisted of 100 larvae with three replications. The NPV treated groups of larvae were orally inoculated with BmNPV-diluted polyhedra at a 550 ppm concentration by spraying on mulberry leaves. In 3rd and 7th days of 5th instar, 20 larvae were selected randomly from each group. The larval hemolymph was taken with a cut through one of the prolegs.

In another experiment silkworm larva were collected from rearing stock and divided into batches for pyriproxyfen treatment. A 10% emulsion concentrate (EC) of pyriproxyfen was prepared and diluted to 1, 10, 75, 150 and 500 ppm concentrations. Fresh mulberry leaves were soaked in each concentration for 10 seconds and then were dried in air. Treated leaves were fed by fifth instar larva only once. In 24 and 120 hrs after treatment, 20 larvae were selected randomly from each group. From each larva 0.5ml hemolymph was extracted and pooled hemolymph for each treatment used to biochemical measurement.

Twenty lines of silkworm with Japanese (31, 103, 107, 151, 1126, 101433, 2029), Chinese (32, 104, 110, 152, 154, 726, Y and 3132) and Iranian (Bagdadi, Orange Guilan, Orange Khorasan, Pink, Lemon) origins, which are usually used for mass production, were obtained from Iran Sericultural Research Center (ISRC). They were fed by Shin Ichinose variety from the first larval instar to the end of larval stage and were grown under standard temperature and humidity. In the fifth day of 5th instar 20 larvae were selected randomly from each groups and their hemolymph was extracted.

Aminotransferases measurement

To avoid the activity of prophenol oxidase followed by melanization of hemolymph, 1 mg phenylthiourea was added to the hemolymph samples. Then they were centrifuged for 10 min in 10000 rpm. The supernatant was transferred to new tubes and was kept in -20°C until the beginning of the experiments. ALT (EC 2.6.1.2) and AST (EC 2.6.1.1) were measured utilizing Thomas (1998) procedure.

RESULTS AND DISCUSSION

The effect of grasserie disease on aminotransferases

AST and ALT contents of hemolymph was measured in resistant and susceptible lines pre and post infection by BmNPV in order to see the differences in these enzymes activity through the resistance phenomenon. The activity of both enzymes in all the infected treatments had significantly increased. The interesting point is that this considerable increase in the third day is significantly higher for resistant line while in the 7th day is considerably higher for susceptible line (Figures 1 & 2).

Gowda *et al.,* (1976) showed that in third instar larvae Polyhedrosis enhanced the aspartate-2-oxoglutarate aminotransferase activity several-fold in both young and old larvae. The enzyme was detectable in the final instar, and polyhedrosis produced a pronounced increase in its activity.

The effect of insecticide residue on aminotransferases

In the present investigation the level of both enzymes decreased considerably in 24 hrs after treatment but AST and ALT can recover their activity level as control in some concentration of JHA by 120 hrs post-treatment. Whereas in some treatments this level is lower than control. Zera and Zhao (2004) reported that the application of Juvenile hormone analogue, methoprene on cricket, *Gryllus firmus*, showed a significant decrease in transaminase activity. Ender *et al.* (2005) reported that the diet with high level of methyl parathion significantly increased the activities of ALT and AST in greater wax moth, *Galleria mellonella* (L.) larvae. But, the activity levels of aminotransfreases were decreased by low level of this insecticide. Therefore the changes of these enzymes during different stress condition show a dose dependent variation.

The normal range of aminotransferase in 20 groups of silkworm lines

According to Table 2 the highest level of AST was measured in line number 2029 with Japanese origin and the lowest level of activity was measured in an Iranian native line. Also a significant direct correlation was found between both aminotransferase and cocoon shell weight (Table 3). Our pervious study showed that the most value of this enzyme was measured in the larvae of line 104 and its least activity also was detected in line Xihang 1 with Chinese origin in normal condition. Also ALT compared to AST has a lower activity level in different groups, although that its maximum activity similar to AST is observed in group 104 and its minimum which is 30.8 IU/lit was in line Xihang 1 (Etebari *et al.,* 2005).

Generally ALT activity is mentioned as an index for breakdown of amino acids and AST as a sign for entrance of amino acid to glucogenesis process. Glucogenesis is a main path for sugar synthesis from non carbohydrate substrates (Lehninger, 1982). The carbon sources for glucogenesis in these series of reactions are amino acids and the activation of this metabolic pathway is usually associated by intensive decrease of free amino acids in fat body and hemolymph. Because often with ALT activity, alanine transforms to pyruvate and enters the above pathway for energy supply.

The researches have shown that silkworm larvae under different stress factors like parasitism with parasitoid flies, being affected by phosphorus pesticides and juvenile hormone analogues have fluctuations in the activities of amino transferase enzymes (Devi and Sarma, 2000). Therefore the activity levels of these two enzymes can be used as an appropriate biochemical marker to better understanding of physiological phenomena of different stress and also it is a powerful tool for breeders to study the intraspecific biodiversity of silkworm strains.

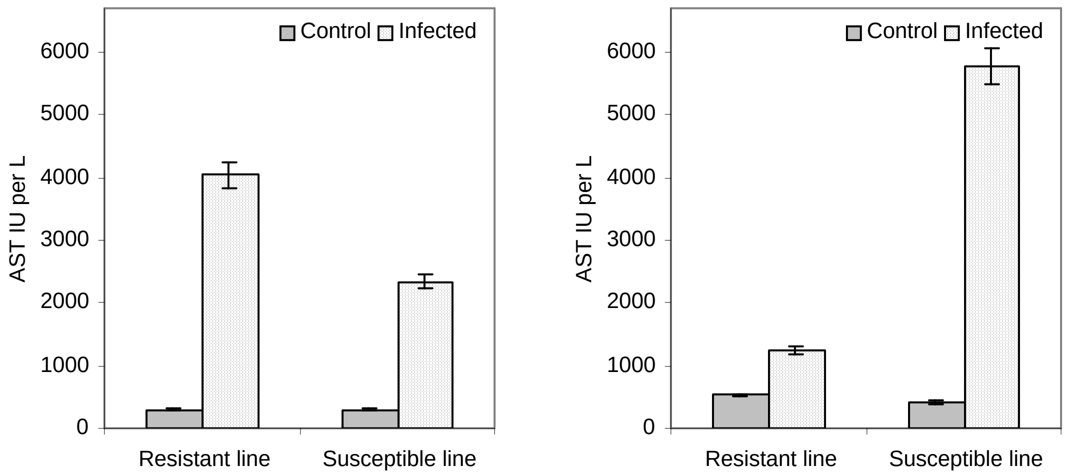

Figure 1. The changes in activity level of AST due to BmNPV infection in resistant and susceptible lines of silkworm in 3rd day (Left) and 7th day (right) of 5th instar

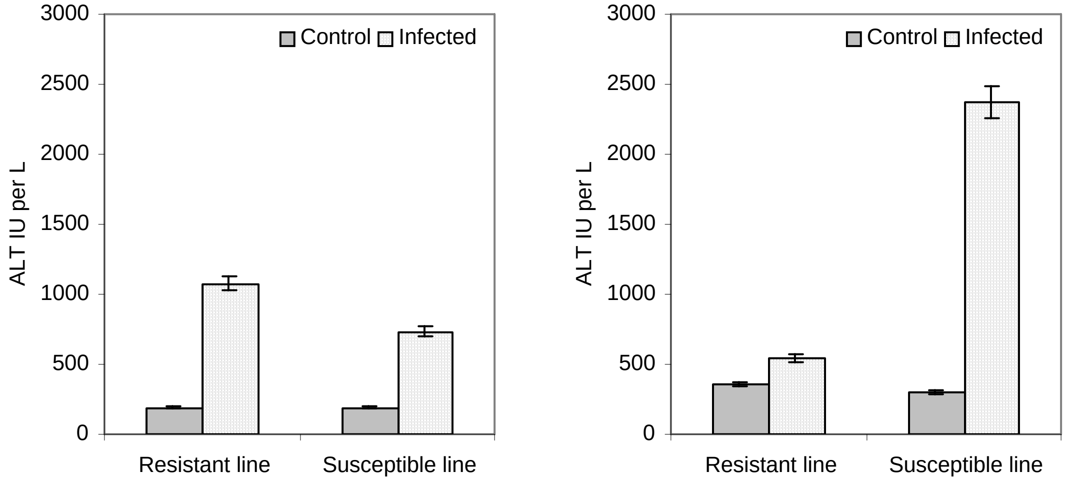

Figure 2. The changes in activity level of ALT due to BmNPV infection in resistant and susceptible lines of silkworm in 3rd day (Left) and 7th day (right) of 5th instar

Table 1. The effects of pyriproxyfen on level of enzyme activity in 5th instar larvae

Treatment (ppm)	AST (IU/L)		ALT (IU/L)	
	24 hr	120 hr	24 hr	120 hr
1	337.0±5.6 b	333.0± 23.8 a	168.0±4.24 b	182.5±29 b
10	309.5±19 b	236.5±9.7 b	162.1±7.53 b	110.2±9.0 c
75	297.7±11 b	384.7±25.0 a	152.2±7.14 b	214.2±4.9 a
150	337.7±4 b	268.5±15.5 b	155.7±9.07 b	121.2±5.3 c
500	305.2±31 b	241.0±11.4 b	154.0±21.5 b	121.5±7.3 c
Control	386.0±42.2 a	324.7±10.8 a	210.2±29.4 a	214.7±5.8 a

Means with the same letter in columns are not significantly different at P>0.05
AST: Aspartate Aminotransferase **ALT: Alanine Aminotransferase**

Table 2. The level of ALT and AST activity in 20 groups of 5th instar silkworm larva in normal condition (n = 120)

Silkworm Lines	AST	ALT	Silkworm Lines	AST	ALT
31	308.2	158.2	**1126**	280.7	190
32	249.2	111.5	**2029**	421.2	217
103	238.7	149.2	**Bg**	304.5	199.2
104	304.5	146	**Ye**	288.2	87.5
107	270	154.5	**Le**	167	47.25
110	327.2	169.5	**OG**	418.5	116
151	340	124.5	**3132**	342.5	241.5
152	323.2	184.7	**Pi**	380.7	122.5
154	391.5	161	**101433**	338.2	165
726	354.2	202	**OK**	257	117.3
Mean	315.28	153.22	**Maximum**	421.25	241.5
Sd	63.01	46.45	**Minimum**	167	47.25

Table 3. The correlation matrix between aminotransferases and cocoon parameters

	AST	ALT	FCW	FSW	MCW	MSW
AST	1.000					
ALT	0.489**	1.000				
FCW	0.143	0.067	1.000			
FSW	0.182	0.260*	0.779**	1.000		
MCW	0.186	-0.029	0.850**	0.730**	1.000	
MSW	0.225*	0.248*	0.663**	0.935**	0.751**	1.000

REFERENCES

Chatterjee S N, Rao C, Chatterjee G K, Ashwath S K, Patnaik A K. 1993. Correlation between yield and biochemical parameters in the mulberry silkworm, *Bombyx mori* L. *Theoretical and Applied Genetics*. 87: 385-391.

Devi D, Sarma DK. Aminotransferase activity of muga silkworm (*Antheraea assama* Ww.) Proceedings of the third international conference on wild silk moths, India, 246-248, 2000.

Ender, I. A. Ferah, B. Kemal, G. Ahmet (2005) Biochemical Stress Indicators of Greater Wax Moth Exposure to Organophosphorus Insecticides. J. Eco. Ento. 98, 358-366.

Etebari, K., Matindoost, L., Mirhosieni, S.Z. and M.W. Turnbull (2007) The Effect of BmNPV Infection on Protein Metabolism in Silkworm (*Bombyx mori*) Larva. *Invertebrate Survival Journal.* 4(1)13-17.

Etebari, K., Bizhannia, A.R., Sorati, R. and L. Matindoost (2007) Biochemical Changes in Hemolymph of Silkworm Larva Due to Admiral Residue. *Pesticide Biochem. Physiol.* 88(1):14-19.

Etebari, K., Mirhoseini, S.Z. and L. Matindoost (2005) Study on interaspecific biodiversity of eight groups of silkworm (*Bombyx mori*) by biochemical markers. *Insect Science* 12*,* 87-94.

Shakoori A R, Tufail N, Saleem M A. 1994. Response of malathion resistant and susceptible strains of *Tribolium castaneum* (Herbst) to bifenthrin toxicity. *Pakistan Journal of Zoology* 26: 169-178.

Reddy K V, Benchamin K V. 1992. Heat shock effect on testicular composition: a biochemical study in silkworm, *Bombyx mori*. *Proceedings of the Indian National Science Academy. Part B, Biological Sciences.* 58: 329-332.

Thomas L. 1998. *Clinical Laboratory Diagnostics*. Frankfurt, TH Books Verlasgesellschaft. 89-94 pp.

Zera, A.J. and Z. Zhao (2004) Effect of a Juvenile Hormone Analogue on Lipid Metabolism in a Wing-Polymorphic Cricket: Implications for the Endocrine-Biochemical Bases of Life-History Trade-Offs. Physiol. Bioch. Zoo. 77, 255–266.

Differential Expression Of Temperature Induced Protein Synthesis In Two Races of Silkworm *Bombyx mori.L*

By

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A study was conducted to analyze the differential expression of temperature induced protein synthesis in two silkworm races exhibiting different temperature tolerance. A temperature tolerant race namely Nistari and another temperature non-tolerant race namely CSR2 were used for the study. Experimental animals of both the races were subjected to high temperature treatment at 36°C and 40°C for two different durations, viz., 1 h and 6h on the 2^{nd} day of 3^{rd}, 4^{th} and 5^{th} in star. Proteins purified from the haemolymph collected from the treated larvae immediately after treatment and after four recovery periods (1h, 6h, 24h and 48h) were subjected to SDS PAGE analysis to observe the protein kinetics. The protein profiles of both the races under various treatments when compared with control indicated deviations mostly in the 68-97 kDa region apart from the appearance of new bands. Both the races showed similar protein banding patterns, though the intensity of the bands varied with treatments. Induction of absolutely new bands was observed in the of 97-205, 68-97 and 29-43 kDa molecular weight region possibly representing Hsp: 100, 90, 70 and 34-35kDa. Families. The results are indicative of the differential capability of the races to respond to heat shock by temperature induced protein synthesis. The study results suggest the possibility of using heat shock protein based breeding strategy for inducing robustness in productive breeds.

Silk gene expression with respect to supplementation of hydrolysed soy bean protein (P-Soyatose) in the fifth instar larva of *Bombyx mori*.

By

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Silk glands of *Bombyx mori* have been used as model system in molecular biology because of their specialization in the production of huge amounts of silk proteins prior to cocoon spinning. Hence, the present study reports the changes in the silk gene expression induced by supplemented P-soyatose (hydrolyzed soy protein) during the fifth instar larvae of *B. mori*. The amount of P-soyatose protein needed by a single larva to increase the synthesis of silk protein is 4mg soy protein/male/day and 2mg P-soyatose/female/day, during the fifth instar development. The uptake of higher amount of P-soyatose was observed in males rather than females. The silk gland protein profile in the soy protein supplemented group demonstrated higher staining intensity of H and L chains. The rate of protein synthesis in the posterior silk gland of *B. mori,* recorded by labeling with ^{3}H leucine showed higher rates in the larva supplemented with P-soyatose, when compared to control group. The incorporation of radioactivity by the H and L chain of fibroin was also higher in the P-soyatose supplemented larva than the control. Northern blot analysis prove unequivocally that supplementation of soy protein increases the amount of synthesis of silk fibrion, as it increases the levels of fibrion mRNA, which reflects the economic characters of *B. mori.*

Keywords: *Bombyx mori*, P-soyatose, silk gene, fibrion supplementation, ^{3}H leucine, Hydrolyzed proteins.

SILK MATRICES FOR PHARMACY, BIO-AND NANOTECHNOLOGY: FROM BULLET PROOF CLOTHES TO “MAGIC BULLET” CONCEPT

By

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Natural silk which has come to us from a deep antiquity and never ceasing to stagger us with the surprising properties will discover to us in new millennium still incomprehensible paths of its application. The main traditional direction of R&D in silk science and technology was so-called “textile” or “clothing” direction, the last achievement of which in last millennium was a creation bullet-proof clothes from silk due to interdisciplinary approaches.

So-called “non clothing” direction in a science and technology of silk usage was fast developed at last decade of the twentieth century. Its achievements were - a creation of fine products for food industry, medical food, wound dressing, additives for cosmetics, biomedical prosthesis, membranes for biosensors and improvement of proliferation cultivated cells, etc. Wide variety of physico-chemical properties of silk biopolymers caused by their inter transitions of water soluble, gel and crystal forms together with biocompatibility, hygienic properties and biodegradability make these materials irreplaceable in design of new biotechnological products. Self-assembling of silk proteins (similarly to collagen or polyhedrin) with mild entrapment of low molecular drugs or biological objects (biopolymers, organelles and alive cells) provides preservation of physiological activity of immobilized active ingredients with simultaneous opportunity of modification of this activity in necessary direction.

Different kinds of fibroin preparations with wide range of solubility (from completely soluble up to practically insoluble) have been obtained using different chemical, physico-chemical and biochemical methods in present investigation. For achievement of the necessary properties of matrix materials in some cases alongside with fibroin both other natural and synthetic polymers were used. Industrial wastes of silk processing manufactures were used as initial raw material. Soluble forms of fibroin can be used for formation of films, threads, porous membranes and nanoparticles. Kinetics of release of model entrapped substances with different molecular weight (methylen blue, vitamin B_{12}, cytochrom c, hemoglobin and dextran blue) and several lipolitical enzymes included in matrix and some functional properties of immobilized enzymes have been studied on the example of films and nanoparticles. Conditions for fixed capture of biocatalysts (including cells) were selected. Mode of entrapped enzymes action are dramatically changed. Insoluble forms of enzymes entrapped by fibroin nanobeads can be used in water-organic and nonaqueous reaction media. Methods of fibroin matrices protection against effect of proteolytic enzymes and on increasing of their antibacterial properties are developed. At the present approaches for creation the systems of drugs, proteins and gene delivery as well as mimicry of peritrophic membrane of insects, intestinal mucouse of animals, capsids, viral inclusion body and other biomolecular devices are being developed.

Such usage of natural silk as unique structural biopolymer will lead to real creation of Paul Erlich’s “magic bullets” in pharmaceutical industry.

Keywords: Silk. Fibroin. Matrices. Biotechnology. Nanotechnology. Pharmacy.

Impact of Bacillus thuringiensis on protein and lipid profiles in the mid gut of silkworm, Bombyx mori L.

By

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ABSTRACT

The effect of Bacillus thuringiensis on the protein and lipid profiles in the mid gut of fifth instar silkworm larvae were studied in the present investigation. The changes in the protein and lipid profiles reflects on the absorption, digestion and transportation of nutrients in the mid gut of silkworm.
Key words : Silkworm, *Bombyx mori* L., *Bacillus thuringiensis, proteolysis, lipolysis.*

INTRODUCTION

Theδ-endotoxin primarily acts on the gut epithelial surface membrane of the larvae. Theδ-endotoxin of *Bacillus thuringiensis* is toxic to some susceptible lepidopteran larvae. When the insect ingests crystalline toxin produced by this bacterium, the toxin is dissolved by mid-gut juice and the resultingδ-endotoxin produces pathological symptoms. Depending on the toxin dose and the insect species, the toxic responses can vary from temporary cessation of feeding to complete paralysis.

Effect of Bacillus thuringiensis and Serratia macescens on the alkaline phosphatase activity in the mid gut of silkworm has been investigated (Miao and Bharathi, 2001).Microscopic examination reveals that the epithelial cells are disrupted and may eventually breakdown completely (Nishistsutsuji- Uwo and Endo,1979). The histopathological changes in the mid-gut epithelium of *Bombyx mori* following administration of delta-endotoxin *in vivo* was studied (Endo and Nishistsutsuji-Uwo, 1979). The effect of *Bacillus thuringiensis* on ultra-structural studies of silkworm mid-gut was studied (Percy and Fast, 1983).

Bacillus thuringiensis preparations consisting of spores and proteinaceous parasporal inclusions (Popularly, Crystals) produced during sporulation are widely used for control of defoliating lepidoptera (Percy and Fast, 1983).The ALKP was related to the physiological situation of silkworms and reflects on the absorption, digestion and positive transportation of nutrients in the mid-gut (Eguchi and Iwamoto,1975 and Eguchi *et al*., 1990; Yoshitake ,1966).

MATERIAL AND METHODS

Experiment animals

The egg layings of hybrid silkworms were Huahe(Chinese)X Dongfei(Japanese) , supplied by Sericulture Department of Zhejiang Agricultural Bureau, Hangzhou, Zhejiang, China. The silkworms larvae were reared on fresh mulberry leaves at 25, RH 75-80% and 12L:12D photoperiod. Each experiment was conducted for three replications, 200 larvae per replication were reared.

Administration of Bacillus thuringiensis:

The bacteria, *Bacillus thuringiensis* was cultured in a sterile medium and suspended in distilled water at a concentration of 10^6 CFU (colony forming units) per ml. The dose was inoculated feeding to silkworm on first day of fourth instar. Distilled water was used for control larvae.

The total proteins (Lowry *et al*., 1951), free amino acids (Moore and Stein, 1954), protease activity (Colowick and Kaplan, 1957; Moore and Stein, 1954; Peter *et al.,* 1972 and Van Hoof and Hens, 1968), total lipids (Folch *et al.,* 1957), phospholipids (Bieri and Prival, 1965), free fatty acids and triglycerides (Natelson *et al.,* 1948), glycerol (Burton, 1957) and lipase activity (Bier, 1955) were estimated in mid gut of control and experimental fifth instar silkworm larvae from day-5 to day-8.

RESULTS

The data presented in tables 1–9 reveal the extent of changes in the protein and lipid profiles of mid gut of silkworm, *Bombyx mori* L. infected with *Bacillus thuringiensis.*

Total proteins

A significant effect ($P<0.001$) in the total protein content of mid gut showing a per cent decrease of 21.61 inday-5, 28.09 in day-6, 34.97 in day-7 and 43.78 in day-8 of fifth instar larva over control.

Free amino acids

A significant effect ($P<0.001$) was observed in the free amino acid content of mid gut showing a per cent decrease of 22.11 in day-5, 28.69 in day-6, 34.69 in day-7 and 44.93 in day-8 of fifth instar larva over control.

Protease activity

The protease activity was significantly increased and the per cent increase in the mid gut was 17.46 in day-5, 25.12 in day-6, 31.03 in day-7 and 40.37 in day-8 of fifth instar larva over control.

Total lipids

A significant effect ($P<0.001$) was observed in the total lipid content of mid gut showing a per cent decrease of 18.24 in day-5, 25.49 in day-6, 33.23 in day-7 and 43.09 in day-8 of fifth instar larva over control.

Phospholipids

A significant effect ($P<0.001$) in the phospholipids of mid gut showing a per cent decrease of 17.36 inday-5, 22.83 in day-6, 27.71 in day-7 and 34.25 in day-8 of fifth instar larva over control.

Free fatty acids

A significant effect ($P<0.001$) was noticed in free fatty acids of mid gut showing a per cent decrease of 16.16 in day-5, 23.48 in day-6, 30.93 in day-7 and 35.58 in day-8 of fifth instar larva over control.

Triglycerides

The triglycerides were significantly decreased and the per cent decrease in the mid gut was 19.82 in day-5, 23.21 in day-6, 28.18 in day-7 and 36.97 in day-8 of fifth instar larva over control.

glycerol

The glycerol content was significantly decreased and the per cent decrease in the mid gut was 19.35 in day-5, 24.59 in day-6, 27.27 in day-7 and 36.62 in day-8 of fifth instar larva over control.

Lipase activity

The lipase activity was significantly increased and the per cent increase in the mid gut was 20.45in day-5, 25.49 in day-6, 32.20 in day-7 and 38.24 in day-8 of fifth instar larva over control.

DISCUSSION

Bacillus thuringiensis caused damage to the epithelial cells of the mid gut through crystalline parasporal body which could release the toxic parasporal crystals under alkaline condition in the intestinal juice (Endo and Nishiitsutsuji,1980; Percy and Fast, 1983 and Mathavan *et al.,* 1989). *Bacillus thuringiensis* are the indicators of general cell injury and/or necrosis and are attributable to specific toxic action of crystal toxin (Percy and Fast,1983). Fas*t et al*., (1978) reported indirect evidence that the toxin acted at the cell surface of mid gut.The crystalline toxin has cytotoxic activity and primarily acts on the gut epithelium which swells and eventually disintegrates.

The results showed that except protease and lipase acivities, all the other protein and lipid profiles of mid gut were decreased significantly. This might affect the biosynthetic activities in the body of the larva leading to decreased metabolic activities. The decreased protein, free amino acid contents and increased protease activity in the mid gut of silkworm larva showed an impairment in the protein digestion of the larva. The enhanced protease activity might indicate its role in proteolysis.The decreased free amino acids might be due to either increased amino acid oxidation or their active uptake from haemolymph. The depleted protein and free amino acids indicates the protein degradation and/ or deranged biosynthetic activity which will not be congenial for the physiology of digestion and the healthiness of silkworm.

The observed decrease in the total lipid content and enhanced lipase activity of mid gut indicates the active uptake of lipid components by haemolymph from mid gut for utilization at cellular level or increased lipolysis of mid gut (Bharathi and Miao,2003). The decrease in the phospholipid content indicates its role in the maintenance of active transport mechanism in the larva. The free fatty acid content was significantly decrease which might be due to higher fatty acid oxidation in mid gut and its active uptake by haemolymph.

The decrease in triglycerides shows the possible existence of lipid oriented metabolism of mid gut. The glycerol content was depleted which might be actively mobilized towards glucose formation in the haemolymph. Since glycerol forms an important precursor for gluconeogenesis (Harper *et al.,* 1979) and glucose was accumulated into the blood of animals exposed to stress condition (Reddanna and Govindappa, 1979).

The increase in the activity levels of protease and lipase in the experimental larva affects the absorption, digestion and transportation of nutrients in mid gut (Eguchi and Iwamoto, 1975, Eguchi *et al*.,1990 and Yoshitake *et al*., 1966). The results showed the mobilization of mid gut lipid components towards haemolymph metabolism or their lipid oriented metabolic pattern. The decrease in the protein and lipid profiles might be due to pathological symptoms such as disruption of epithetlial cells of mid gut (Nishiitsutsuji and Endo, 1979).

Hence it can be concluded that the larvae infected with *Bacillus thuringiensis* showed the action of toxin on the cells of mid gut was extremely rapid which affect the assimilatory capacity in the alimentary tract and biosynthetic activities in the body and general metabolic breakdown occurs. Thereby the growth of the silkworm was affected which might be due to physiological damage.

Table-1 : Levels of total proteins (mg/gm wet wt) in the mid gut of control and experimental (*Bacillus thuringiensis*) fifth instar (from day -5 to day-8) silkworm larva, *Bombyx mori* L. Values are the mean of 10 individual observations. Mean±S.D.; '+' and '-'indicate percent increase and decrease over control respectively. 'P' denotes the statistical significance. Univoltine hybrid silkworm, Huahe (Chinese) × Dongfei (Japanese).

S.No.	Day	Control	Experimental (***Bacillus thuringiensis***
1.	Day-5	64.24 ± **3.81**	50.36 **±5.44** **-21.61** **P<0.001**

2.	Day-6	**57.82 ± 4.17**	**41.58** **±3.29** **-28.09** **P<0.001**
3.	Day-7	**51.39 ± 4.84**	**33.42** **±2.83** **-34.97** **P<0.001**
4.	Day-8	**47.56 ± 4.35**	**26.74** **±2.49** **-43.78** **P<0.001**

Table-2 : Levels of free amino acids (mg/gm wet wt) in the mid gut of control and experimental (*Bacillus thuringiensis*) fifth instar (from day -5 to day-8) silkworm larva, *Bombyx mori* L. Values are the mean of 10 individual observations. Mean±S.D.; '+' and '-'indicate percent increase and decrease over control respectively. 'P' denotes the statistical significance. Univoltine hybrid silkworm, Huahe (Chinese) × Dongfei (Japanese).

S.No.	Day	Control	Experimental (***Bacillus thuringiensis***
1.	Day-5	11.26 ± **1.03**	8.77 **±0.74** **-22.11** **P<0.001**
2.	Day-6	**10.14 ± 0.94**	**7.23** **±0.68** **-28.69** **P<0.001**
3.	Day-7	**9.37 ± 0.84**	**6.12** **±0.54** **-34.69** **P<0.001**
4.	Day-8	**8.09 ± 0.69**	**4.52** **±0.31**

			-44.13 **P<0.001**

Table-3 : Changes in the protease activity (µm tyrosine equivalents/ mg protein / hr) in the mid gut of control and experimental (*Bacillus thuringiensis*) fifth instar (from day -5 to day-8) silkworm larva, *Bombyx mori* L. Values are the mean of 10 individual observations. Mean±S.D.; '+' and '-'indicate percent increase and decrease over control respectively. 'P' denotes the statistical significance. Univoltine hybrid silkworm, Huahe (Chinese) × Dongfei (Japanese).

S.No.	Day	Control	Experimental (***Bacillus thuringiensis***
1.	Day-5	2.52 ± **0.21**	2.96 **±0.24** **+17.46** **P<0.001**
2.	Day-6	**2.11± 0.16**	**2.53** **±0.18** **+25.12** **P<0.001**
3.	Day-7	**1.74 ± 0.13**	**2.28** **±0.19** **+31.03** **P<0.001**
4.	Day-8	**1.09 ± 0.08**	**1.53** **±0.12** **+40.37** **P<0.001**

Table-4 : Levels of total lipids (mg / gm dry wt) in the mid gut of control and experimental (*Bacillus thuringiensis*) fifth instar (from day -5 to day-8) silkworm larva, *Bombyx mori* L. Values are the mean of 10 individual observations. Mean±S.D.; '+' and '-'indicate percent increase and decrease over control respectively. 'P' denotes the statistical significance. Univoltine hybrid silkworm, Huahe (Chinese) × Dongfei (Japanese).

S.No.	Day	Control	Experimental (***Bacillus thuringiensis***
1.	Day-5	432.26 ± **32.48**	353.40 **±31.78** **-18.24** **P<0.001**
2.	Day-6	**456.38** **±26.37**	**324.73** **±25.49** **-28.85** **P<0.001**
3.	Day-7	**481.74** **±40.86**	**304.73** **±22.14** **-33.23** **P<0.001**
4.	Day-8	**522.69** **±32.45**	**297.48** **±24.14** **-43.09** **P<0.001**

Table-5 : Levels of phospholipids (mg / gm dry wt) in the mid gut of control and experimental (*Bacillus thuringiensis*) fifth instar (from day -5 to day-8) silkworm larva, *Bombyx mori* L. Values are the mean of 10 individual observations. Mean±S.D.; '+' and '-'indicate percent increase and decrease over control respectively. 'P' denotes the statistical significance. Univoltine hybrid silkworm, Huahe (Chinese) × Dongfei (Japanese).

S.No.	Day	Control	Experimental (***Bacillus thuringiensis***
1.	Day-5	48.34**±2.94**	39.95 **±2.86** **-17.36** **P<0.001**
2.	Day-6	**52.69±4.63**	**40.66** **±3.84** **-22.83** **P<0.001**

3.	Day-7	**58.14±5.14**	**42.03 ±3.94 -27.71 P<0.001**
4.	Day-8	**68.72±4.92**	**45.18 ±4.12 -34.25 P<0.001**

Table-6 : Levels of free fatty acids (mg / gm dry wt) in the mid gut of control and experimental (*Bacillus thuringiensis*) fifth instar (from day -5 to day-8) silkworm larva, *Bombyx mori* L. Values are the mean of 10 individual observations. Mean±S.D.; '+' and '-'indicate percent increase and decrease over control respectively. 'P' denotes the statistical significance. Univoltine hybrid silkworm, Huahe (Chinese) × Dongfei (Japanese).

S.No.	Day	Control	Experimental (***Bacillus thuringiensis***
1.	Day-5	22.46±**2.01**	18.83 **±1.27 -16.16 P<0.001**
2.	Day-6	**25.38±2.24**	**19.42 ±1.68 -23.48 P<0.001**
3.	Day-7	**29.52±1.86**	**20.39 ±1.78 -30.93 P<0.001**
4.	Day-8	**33.47±2.94**	**21.56 ±2.16 -35.58 P<0.001**

Table-7: Levels of triglycerides (mg / gm dry wt) in the mid gut of control and experimental (*Bacillus thuringiensis*) fifth instar (from day -5 to day-8) silkworm larva, *Bombyx mori* L. Values are the mean of 10 individual observations. Mean±S.D.; '+' and '-'indicate percent increase and decrease over control respectively. ‘P’ denotes the statistical significance. Univoltine hybrid silkworm, Huahe (Chinese) × Dongfei (Japanese).

S.No.	Day	Control	Experimental (***Bacillus thuringiensis***
1.	Day-5	14.58±**1.28**	11.69 **±1.08** **-19.82** **P<0.001**
2.	Day-6	**16.72±1.53**	**12.84** **±1.16** **-23.21** **P<0.001**
3.	Day-7	**18.49±1.66**	**13.28** **±1.27** **-28.18** **P<0.001**
4.	Day-8	**22.67±2.01**	**14.29** **±1.38** **-36.97** **P<0.001**

Table-8: Levels of glycerol (mg / gm dry wt) in the mid gut of control and experimental (*Bacillus thuringiensis*) fifth instar (from day -5 to day-8) silkworm larva, *Bombyx mori* L. Values are the mean of 10 individual observations. Mean±S.D.; ‘+’ and ‘-’indicate percent increase and decrease over control respectively. ‘P’ denotes the statistical significance. Univoltine hybrid silkworm, Huahe (Chinese) × Dongfei (Japanese).

S.No.	Day	Control	Experimental (***Bacillus thuringiensis***
1.	Day-5	3.36±**0.29**	2.71 **±0.23** **-19.35** **P<0.001**
2.	Day-6	**3.74±0.33**	**2.82** **±0.24** **-24.59**

			P<0.001
3.	Day-7	**4.18±0.38**	**3.04** **±0.25** **-27.27** **P<0.001**
4.	Day-8	**5.38±0.47**	**3.41** **±0.32** **-36.62** **P<0.001**

Table-9 : Changes in the lipase activity (µm of PNPA cleaved / mg protein / hr) in the mid gut of control and experimental (*Bacillus thuringiensis*) fifth instar (from day -5 to day-8) silkworm larva, *Bombyx mori* L. Values are the mean of 10 individual observations. Mean±S.D.; '+' and '-'indicate percent increase and decrease over control respectively. 'P' denotes the statistical significance. Univoltine hybrid silkworm, Huahe (Chinese) × Dongfei (Japanese).

S.No.	Day	Control	Experimental (***Bacillus thuringiensis***
1.	Day-5	0.44± 0.036	0.49 **±0.041** **+20.45** **P<0.001**
2.	Day-6	**0.51± 0.048**	**0.64** **±0.058** **+25.49** **P<0.001**
3.	Day-7	**0.59± 0.051**	**0.78** **±0.063** **+32.20** **P<0.001**
4.	Day-8	**0.68± 0.056**	**0.94** **±0.076** **+38.24** **P<0.001**

REFERENCES

Bharathi, D. and Miao, Y. 2003. Changes in the protein and lipid profiles of silkworm, *Bombyx mori* L. infected with NPV.

Bier, M. 1955. Lipase: Methods in Enzymlogy. S.P.Colowick and N.O. Kaplan (Eds), Academic press, New York, USA. 1: 627.

Bieri, J.G. and Prival, E.L.1965. Lipid composition of testes of various species.Como.Biochem. Physiol. 15: 275-281.

Burton, R.M. 1957. The determination of glycerol and dihydroxy acetone. Methods in Enzymology. S.P. Colowick and N.O. Kaplan (Eds), Academic press, New York, 3: 246-24.

Colwick, S.P.Kaplan, N.O. 1957. Methods in Enzymology, Academic press, New York, USA.63: 28.

Endo, Y. and Nishiitsutsuji Uwo, J., 1979.Ultra structural changes in the mid gut epithelium of *Bombyx mori* induced by *Bacillus thuringiensis* crystals. Japanese J. Entomol. Zool. 23: 183-185.

Endo, Y. Nishiitsutsuji and Uwo, J., 1980, Mode of action of *Bacillus thuringiensis* δ-endotoxin: Histopathological changes in the silkworm midgut. J. Invert. Pathol., 36:90-103

Eguchi, M. And Iwamoto A., 1975, Changes in protease, esterase, and phosphatase in the alimentary canal of the silkworm during metamorphosis. Insect Biochem., 5, 495-507

Eguchi, M., Azuma M., Yamamoto H., and Takeda S., 1990, Genetically defined membrane-bound and soluble alkaline phosphatase of the silkworm: their discrete localization and properties. Isozymes:Structure, function and use in biology and Medicine, Wiley-Liss Inc., New York. Pp.267

Fast, P.G., Murphy, D.W. and Sohi, S., (1978). *Bacillus thuringiensis* δ-endo toxin: Evidence that toxin acts at the surface of susceptible cells. Experientia. 24: 762-763.

Folch, J.M., Lees, M.P. and Stane-Stanely, G.H., 1957. A simple method for isolation and purification of total lipids from animal tissues. J.Biol.Chem. 226: 497-509.

Harper, H.A., Rodwell, V.W.,aand Mayers, P., 1979. Review of Physiological Chemistry, 17th edition, Lange Medical publication, California, USA.

Lowry, O.H., Roserbrough, N.J., Farra,L. and Randall, R.J., 1951.Protein measurement with the folin phenol reagent. J.Biol.Chem.,1933:265-275.

Mathavan,S., Sudha, P. M. And Pechimuthu, S. M., 1989, Effect of *Bacillus thuringiensis israelensis* on the midgut cells of *Bombyx mori* larvae: A histopathological and histochemical study. J. Invertebr. Pathol., 53(2),217-227.

Miao, Y. and Bharathi, D., 2001. Effect of *Bacillus thuringiensis* and *Serratia macescens* on the alkaline phosphtase activity in the mid gut of silkworm, *Bombyx mori* L. Ind. J. Seric. 40: 103-105.

Moore,S. and Stein,W.A., 1954. A modified ninhydrine reagent for the photometric determination of amino acids and related compounds.J.Biol.Chem.,211:907-913.

Natelson, S., Pincus, J.B. and Lugovoy, J.K., 1948. Micro estimation of citric acid. A new ccolorimetric reaction for penta bromo acetone. J.BIol.Chem. 175: 745-750.

Nishiitsutsuji-Uwo, J. and Endo, Y., (1979).Mode of action of *Bacillus thuringiensis*. δ-endo toxin: Effect on TN-368 cells. J. Invert. Pathol. 34: 267-275.

Percy, J. and Fast, P.G., 1983. *Bacillus thuringiensis* crystal toxin: Ultra structural studies of its effect on silkworm mid gut cells. J. Invert. Pathol. 41: 86-88.

Peter, J.B., Bernard, R.J., Edgerton, V.R., Gillespie, C.A., and Stempel, K.A., 1972. Metabolic profiles of three fibre types of skeletal muscles in guinea pigs and rabbits. Biochemistry. 14: 2627-2633.

Reddanna, P. and Govindappa, S., 1979. Effects of in vivo muscular stimulations. 11. Influence on hepatic carbohydrate metabolism. J.Anim. Morphol.Physiol. 26: 151-161.

Van Hoof. And Hens, H.G., 1968. Abnormalities in lysosomal enzymes in muco polysaccharides. Eur.J. Biochem. 7: 34-44.

Yoshitake, N., Eguchi, M. aand Akiyama., 1966. Genetic control on the alkaline phosphatase of the mid gut in silkworm, *Bombyx mori* L. J. Seric. Sci. Japan. 35: 1-6.

The Quantitative of Crude Oil and Qualitative Analysis of the Mulberry Silkworm, „Bombyx mori" and Applied its Perspective

By

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ABSTRACT

It's known that oil of mulberry silkworm Bombyx mori, is widely used in pharmacology and perfumery, from which the unique preparations are made.

We've learnt about mulberry silkworm „Bombyx mori" 's quantity and qualitative compositions by the thin-layer and preparational chromatographic, the research object is taken some distinguished Georgian sorts: „Mziuri 1", „Mziuri 2", „Georgia 1", „Georgia 2", „D-1", „D-2", „D-3".

After having some experimental researches it's ascertained that the crude oil of mulberry silkworm „Bombyx mori" percentile composition on a pupa is: „Mziuri 1"-3,2%, „Mziuri 2"-5,45%, „Georgia 1"-5,5%, „Georgia 2"3,7%, „D-1"-6,4%, „D-2"-4,3%, „D-3"-3,2%, but qualitatively composition, which is learnt by the thin-layer chromatographic with the standard models we used organic solution hexane -etil alcohol -vinegar acid with proportion 90:10:1. Chromatographic research showed us, that larvae's damp oil main compositions are: carbonic acids, sterin alcohol, vitamin A, threeglycerides, oil acid and stearines, among them, almost every researchial object there are threeglycerides in damp oil, which degree is about 50% and up.

Key words: mulberry silkworm, Damp oil , chromatographic, pupa

INTRODUCTION

The mulberry silkworm has been many-side used in medicine as in industry. Eggs, Larvae, Pupa, cocoon, thread and ready products of Silkworm are very dear products in medicine.

The mulberry silkworm has been known in national medicine during the centuries. It's known that pupa consists of adipokinetic hormone (AKH), Chymotrypsin inhibitors, β-N-acetylglucosaminidase, sex pheromone bombykol, amino acids, etc.

The preparations made from pupa are used for cardiac and diabetic patients, bronchial asthma, primary trigeminal neuralgia, vocal nodules and polyps, hepatitis, acute pancreatites, chronic nephritis, stomach and gastric disorders, Leukocytopenia, blood cholesterol, etc.

In sericulture, apart from silk, there are many other byproducts obtained at different stages of silkworm rearing. Eggs, Larvae, pupa, and feses find their use in pharmaceuticals, cosmetics and the paper and leather industry.

Silk fibroin is reported to have a high proportion of the amino acids, glicine, alanine, and tyrosine. The mulberry silkworm, Bombyx mori is reviewed in this paper as a potential medicinal insect providing a variety of products with wide aplications.

MATERIAL AND METHODS

The development of silkworm culture paid great attention in Georgia and it's very interesting today too. Nino Sanadze (now she is dead) and her employs have been taken out sorts, which had long clear thread, and physical-mechanical quality; and they have been called „Mziurebi".

They had bio-technical indicators, which gives 1,56 toxy-line solidity three threads. It's very fit to made very thin textile crapshipon, which is very dear.

In Georgia the sorts with high bio-technical indicators took out from selection called: Georgia-1, Georgia-2, Mziuri-1, Mziuri-2, D-1, D-2, D-3.

There are great scientific interest to study oil, because it has been used in pharmaceutical, cosmetic from this we prepare unmatched preparations.

The mulberry silkworm crude oil has been taken by us from using Soxslet-aparatus.

We did the test with Hexan and got that the quantitative of crude oil of Bombyx miri has such percent in Georgia-1 – 5.5 %, Georgia-2 – 3.7%, , Mziuri-1- 3.2%, Mziuri-2-5.45% ,D-1 – 6.4%, D-2 – 4.3%, D-3 –3.2%.

We have been learned qualitative composition of crude oil using the thinlayer and preparational chromatography: Hexane, etil- alcohol, vinegar acid 90X10X1, and phosphorus molibden acid and and 10% solution of phosphorus volpram in alcohol.

1 2 3 4 5 6 7

photo 1.Gorgia-1; 2.Mziuri-1; 3.D-3; 4.D-4; 5.Gorgia-1; 6.Mziuri-2; 7.D-1.

As chromatography analysis has been shown, research object contains lipid substances: carbonic acid, sterin alcohol, vitamin A, threeglyceride, oil acid, stearine. From oil of these there are great amount of threeglyceride in every model. The crude oil quantitative of pupa has three glyceride until 50-60%, carbonic acid 3-5%, vitamin A- 0,5%, sterin alcohol-2-4%, oil acid 4-7%, stearine- 5-8% , and others are unidentification substances.

Chrysalises separated from pelade contain palmitic, stearic, oleic, and linoleic acids and serve as a food additive and in pharmaceutical preparations.

DISCUSSION AND CONCLUSION

The mulberry silkworm, Bombyx mori, the sourse of natural silk, from eggs to adults, has been reported to have wide potential in pharmaceutical, cosmetic and food industries. In this review an attempt has been made to highlight its potential as a medicinal insect.

There are great scientific interest to study oil, because it has been used in pharmaceutical, cosmetic from this we prepare unmatched preparations.

The crude oil quantitative of pupa developed in Georgia has three glyceride until 50-60%, carbonic acid 3-5%, vitamin A- 0,5%, sterin alcohol-2-4%, oil acid 4-7%, stearine- 5-8% , and others are unidentification substances. In Georgia the sorts with high bio-technical indicators took out from selection called: Georgia-1, Georgia-2, Mziuri-1, Mziuri-2, D-1, D-2, D-3.

There are great scientific interest to study oil, because it has been used in pharmaceutical, cosmetic from this we prepare unmatched preparations.

REFERENCES

1. K.P.Singh and R.S.Jayasomu. Bombyx mori-A Review of its Potential as a Medicinal Insect.Parmaceutical Biology 2002.vol.40 No1. Pp.28-32. Delhi. India
2. A.Akhrem. Thinlayer chromatography. Moscow 1965. Pp175
3 Kirkhner I. Thinlayer chromatography Moscow 1980.v.I-II

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Section 4.Post cocoon technology and by products: Cocoon drying and storage, silk reeling ,gradation, silk handcraft cottage industries etc.

The silk fibers' characterisation for chemical - physical modifications

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ABSTRACT

The silk produced by the silkworms, it is not only a source for a very good textile materials quality, but it's also a biopolymer with remarcable mechanic qualities. These qualities, especially the excelent resistance to biological attacks and a good biological compatibility, make the silk fiber adequate for biomedical and biotechnological aplications.

The silk produced by the silkworms belonging to the species Bombyx mori, is a material with a special gloss and a powerfull resistance to extension. These qualities give it a good reputation amoung the textile materials for different aplications. There are some research studies regarding the silk biocompatibility with the human tissues for using it on human surgeries.

Due to its unique physical and chemical exploatation's properties, the silk can be processed into membranes, gelies or pouders, in such a way that can result different materials for different aplications.

For a long time and still in process, the silk was used to make sutures, thanks to his excelent mechanic properities and his resistance. There is a tendency to use silk for different biomedical products. Tendons, artificial ligaments, blood-vessels and skin grafts owe a lot to the silk mechanic resistance.

By some specific chemical modifications, the silk can be adjust to the osseous compounds functions having antibacterium properties, witch makes it usable for a large forms of medical applications. It can be used for permeability or semi permeability membranes, contact lens or even in the process of tissues reability or burns treatment.

These silk qualities are a result of a particular composition. The secreted silk fiber in order to bring out the cocoon has a cover structure which compounds two filaments. The cover structure or the exterior part of the fiber is represented by the sericin, a protein rich in sericin who includes, in the same time, glycine, aspartic acid, tyrozine, glutamic acid and glutamine.

In the present paper work we tried to persue the silk fibron's separation from the natural silk fibers of the two species: Bombyx mori and Philosamia ricini, we tried also, to characterize these two species in order to obtain biomaterials as a result of chemical modifications, with medical and industrial applications.

There were made some determinations, regarding the chemical composition of the silk fibers: the humidity, the crude protein, sericin and fibroin content, also the amino acids compound. It was also determinated the fibroin's IR specter, obtained from the two silkworms' species.
Keywords: silk fibers, chemical compositon, fibroin, sericin, amino acid.

INTRODUCTION

For a long time and still in process, the silk was used to make suturs, thanks to his excelent mechanic properities and his resistance. There is a tendency to use silk for different biomedical products. Tendons, artificial ligaments, blood-vessels and skin grafts owe a lot to the silk mechanic resistance.

The silk produced by the silkworms belonging to the species Bombyx mori, is a material with a special gloss and a powerfull resistance to extension. These qualities give it a good reputation amoung the textile materials for different aplications. There are some research studies regarding the silk biocompatibility with the human tissues for using it on human surgeries. Due to its unique physical and chemical exploatation's properties, the silk can be processed into membranes, gelies or pouders, in such a way that can result different materials for different applications.

These silk qualities are a result of a particular composition. The secreted silk fiber in order to bring out the cocoon has a core structure which compounds two filaments. The core, or the exterior part of the fiber is represented by the sericin, a protein rich in serine who includes glycine, aspartic acid, tyrosine, glutamic acid and glutamine.

The sericin becomes soluble by the cocoon's alcalin treatment during the reeling proces. It has a gumish aspect and it can be found in proportion of 17% to 25% in the fiber, depends of silkworms's species, origin or breeding conditions.

The other silk component is fibroin. It is obtained as raw fibers that are used for textures. It is an insoluble protein, with an important percentage in raw fiber: 75 – 83%. The fibroin has a special structure that helps it against the denaturing agents.

The fibroin as the sericin are proteins with a large molecular weight, hard soluble in water. The fibroin can be decomposed into amino acids through acid or alkaline solutions' boiling process.

The silk fibroin is composed from large and small subunit, beeing synthesize into the posterior side of silk gland. The large subunit has a molecular weights of 350 KDa and a rich amino acid composition of glycine, alanine and serine. The small subunit is rich in amino acids with acids and hydrophobic groups (glycine, alanine).

The fibroin represents a fiber insoluble compound, having in its composition: amino acids, like glycine – over 43%, alanine – over 25%, serine – over 10%, leucine – over 5%. According with different authors, the fiber's fibroin content is between 70 – 80%.

The silk proteins chemical structure is especially made of two simple amino acids: glycine and alanine that absorb about 75% (mol) from protein. To the nonmulberry silkworm species the glycine content is higher then domestic species (Bombyx mori sp), as results there are visible differences in primary silk structure.

The silk proteins crystalline structure from Bombyx mori sp. compound several basic shot repetitions (Gly – Ala – X) with X= serine or tyrosine, while the silk proteins from nonmulberry silkworm species are like: $(Ala)_n$- . The amorphous regions mainly contain residual amino acids with voluminous and polar molecular chains and they are more abundant in silk fibroin from nonmulberry silkworm species.

The scientific informations about amorphous and crystalline areas are important because the fiber's tensil properties depend especially on crystalline structure, while the phisical properties, such as water absorbation, paiting capacity and chemical rezistance are lincked to amorphous regions. Thanks to X rays diffraction, there were identified predominant crystalline structures inside the Bombyx mori and nonmulberry fibers.

MATERIALS AND METHOD

As experimental variants there were used cocoons from two silkworm breeds: Bombyx mori and Phylosamia ricini.

The studied samples are the following:

1. Bombyx mori sp. cocoons
2. Phylosamia ricini sp. cocoons

There were made analysises regarding the fiber's chemical structure such as: humidity, raw protein, sericin and fibroin content and amino acids composition.

There were determinated the IR specters of some silk samples from Bombyx mori sp. and Phylosamia ricini after the sericin was moved away.

The silk humidity was determinated by driing at 105^0C till a normal weight refered to the initial weight.

For raw protein content determination we used Kjeldahl method.

The content of fibroin and sericin was made according to the following method: the silk sample was initialy introduced into a softening bath (1 g to 150 ml) of 2 g $Na_2\ CO_3$, 0,003 g $Na_2\ SO_3$ at 1 to 1. The softning lasted about 30 minuts and it happened into a thermostat bath at 50^oC. The next step was degumming throgh boiling for 40 minuts into a degumming bath with 1,4 g Na_2CO_3, 0,2 g Na_2SO_3 and looking during the boiling process, to keep the 1g silk to 150 ml record through adding distilated water. After 10 minuts of boiling the silk samples have been recurrently washed with hot distilated water and also with cold distilated water. It follow the acidifying with CH_3COOH as a raport of 1,3 g/l for 40 minuts, at room temperature and finaly, the distilated water washing (1g to 100 ml) for 30 minutes at a temperature of 30^oC.

At the end of this process, the silk was dried at 105^oC to a constant weight. From the sample weight the rezidue weight was declined (the fibroin), the difference beeing the lost sericin through degumming process.

From the initial sample weight, the content in fibroin and sericin was expressed in percentage.

The amino acids content was determinated through chromatography and was expressed in % toward the sample weight.

It was also determinated the IR specter of silk fibroin of Bombyx mori and Phylosamia ricini sp.

RESULTS AND DISCUSSIONS

The fibroin represents, as we said already, the fibers insoluble component having its specific compozition in amino acids the most important beeing the glycine – over 43%, alanine – over 25%, leucine – over 5%. According to different authors, the fiber's fibroin content from Bombyx mori sp. is about 70 – 80%, while for Phylosamia ricini sp. is higher, between 83 – 88%.

The sericin – silk's soluble component represents 20 – 30% from Bombyx mori sp. fiber's weight, and 12 -17% for cocoons from Phylosamia ricini sp.

The obtained experimental data join these limits and are presented in table 1.

The sample	Humidity (%)	Protein (%SU)	Fibroin (%SU)	Sericin (%SU)
1. Bombyx mori sp silk	5,54	93,63	74,24	25,76
2. Phylosamia ricini sp silk	7,96	92,89	87,68	12,32

The results show a lower content in fibroin and higher in sericin for the Bombyx mori sp silk, comparatively with Phylosamia ricini sp. silk. The humidity presents a higher value for the Phylosamia ricini sp. cocoon samples, comparatively with the ones from Bombyx mori sp.

Also, we can see a very high rate in protein, between 92, 89 – 93, 63%, results who confirm the silk proteic structure.

The results regarding the fiber's amino acids content, expressed in g/100 g sample, are presented in table 2.

AMINO ACID	SAMPLE'S NAME			
	BOMBYX MORI SP. SILK	PYLOSAMIA RICINI SP. SILK	BOMBYX MORI SP FIBER	PYLOSAMIA RICINI SP FIBROIN
Alanine	21,376	36,349	28,001	38,457
Glycine	33,620	30,826	36,519	27,428
Serine	15,517	7,138	10,584	5,218
Tyrosine	5,828	6,287	6,097	8,362
Valine	1,803	0,807	3,060	0,953
Aspartic acid	5,495	3,772	2,504	2,796
Glutamic acid	1,308	0,904	1,123	1,716
Threonine	1,966	0,765	1,188	0,523
Lysine	0,674	2,199	1,652	3,254
Histidine	2,072	0,457	0,501	0,327
Isoleucine	0,661	0,433	0,901	0,364
Leucine	0,766	0,508	0,888	0,718
Arginine	0,034	0,288	0,093	0,428
Methionine	0,088	0,079	0,129	0,107
Proline	0,312	0,106	0,389	0,158
Cysteine	0,052	0,030	0,069	0,078
Phenyl-alanine	0,052	0,029	0,111	0,036

The natural fibers silk contein 17 amino acids types, but in higher percentages we find the alanine, glycine, serine, tyrosine, valine, lysine and aspartic acid.

The results show that the main amino acids from Bombyx mori sp silk are: glycine (33,62%), alanine (21,38%), serine (15,52%), tyrosine (5,83%), aspartic acid (5,50%), threonine (1,97%), valine (1,80%).

To the nonmulberry silkworm species the glycine content is higher comparatively with the silk from domestic silkworms (Bombyx mori sp), beeing significant differences in its primary strucure.

Significant differences are also visible to our results regarding the amino acids content between the silk of the two species: Bombyx mori and Phylosamia ricini. The main amino acids of the silk from Phylosamia ricini sp are: alanine (36,35%), glycine (30,83%), serine (7,14%), tyrosine (6,29%), aspartic acid (3,77%), lysine (2,20%).

Regarding the amino acids content of Bombyx mori sp silk, we find a pretty high percentage of: glycine (36,52%), alanine (28,00%), serine (10,58%), tyrosine (6,10%), valine (3,06%), aspartic acid (2,50%), lysine (1,65%).

CONCLUSIONS

Therefore, the fiber has a double filament with an insoluble protein – the fibroin, surrounded by a water soluble proteine, the sericine. Beside the sericin and fibroin, the silk contents also, in small quantities: minerals, pigmy, and cerous substances.

The sericin as the fibroin are proteins with a big molecular weight, difficult to become water soluble. The fibroin can be separated into amino acids and, through boiling, into basic or acid substances.

The fibroin, or the silk itself, represent the fiber's insoluble component, with amino acids in its structure, more important beeing: the glycine – over 43%, alanine – over 25%, serine – over 10%, leucine – over 5%. According with different authors, the fiber's content in fibroin is between 70 – 80%.

The major difference between the two esential silk components – the fibroin and the sericin – is refered to their crystalline structure. While the sericin exists as an amorphous form only into one crystalline form (β stratum type), the fibroin can exist as an amorphous form too, but also into two crystalline different forms: a pliable β structure and an unstable one, named α silk or I silk.

For the Phylosamia ricini sp. the fibroin and sericin content is 67,68% and 12,32%, respective lower and higher than the one of Bombyx mori.

The protein register a high level, varing between 92,89 – 93,63%, results who confirm the silk proteic structure.

The natural fibers have 17 amino acids types, but in a higher quantities are: glycine, serine, tyrosine, valine, lysine, aspartic acid.

The obtained results prove that the main amino acids from Bombyx mori sp's cocoon are glycine (33,62%), alanine (21,38%), serine (15,52%), tyrosine (5,83%), aspartic acid (5,50%), threonine (1,97%), valine (1,80%), while the main amino acids from Phylosamia ricini's silk are alanine (36,35%), glycine (30,83%), serine (7,14%), tyrosine (6,29%), aspartic acid (3,77%), lysine (2,20%).

The glycine quantity is higher to the nonmulberry silkworms' species (Phylosamia ricini) then domestic ones (Bombyx mori), beeing remarkable differences into its primary structure.

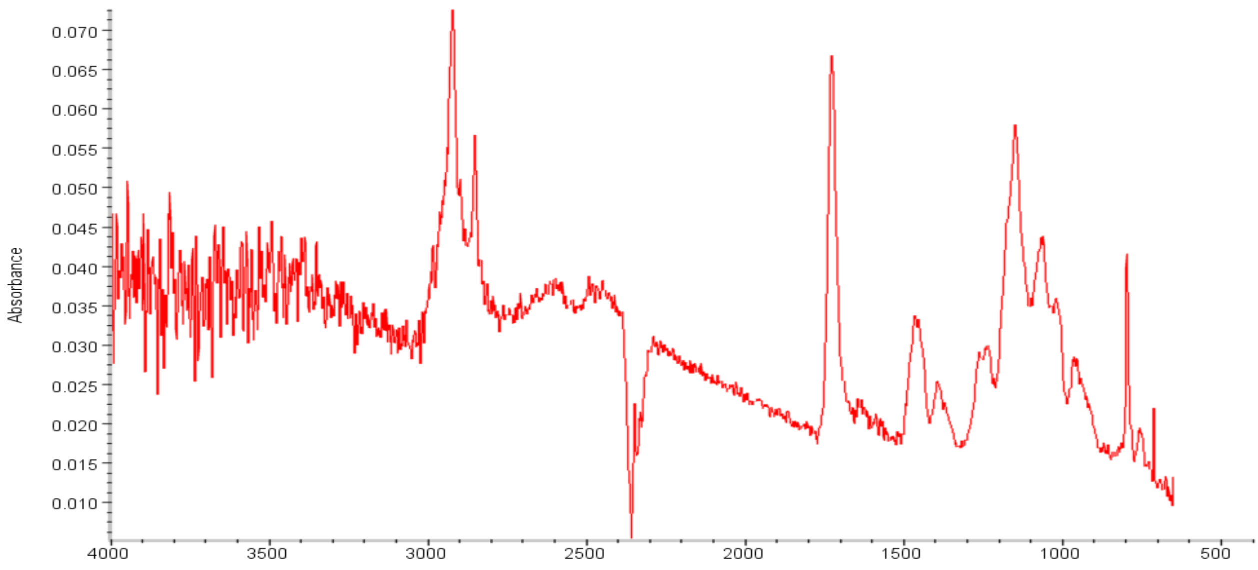

Fig.1 The FTIR specter of Bombyx mori's fibroin

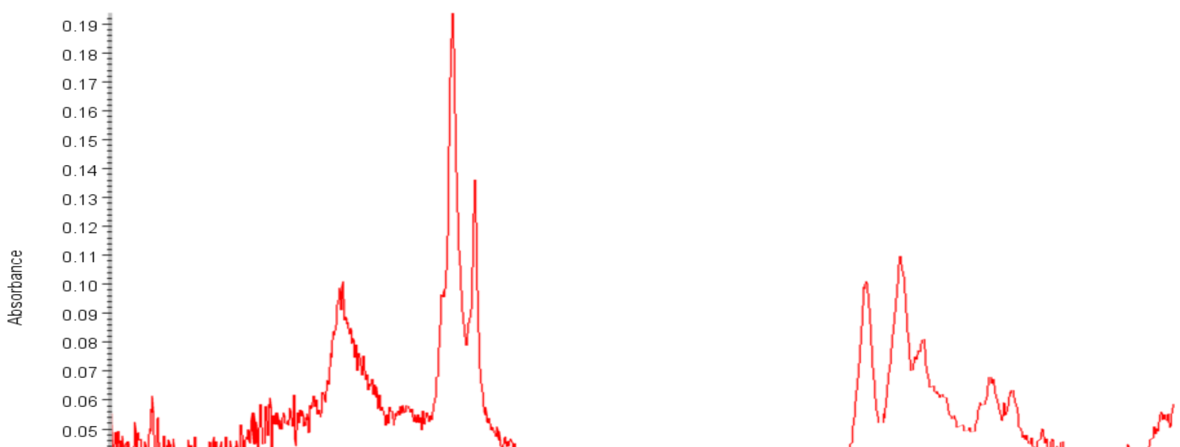

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Fig.2. The FTIR specter of Phylosamia ricini's fibroin.

REFERENCES

1. Gamo T. (1973) - Electrophoretic analyses of the protein extracted with disulphide cleavage from cocoon of the silkworm Bombyx mori - J. Sericult.Sci. Japan, 42(1), 17-23.

2. Gamo T., Inokuchi T., Laufer H. (1977) - Polypeptides of fibroin and sericin secreted from different section of the silk gland in Bombyx mori - Insect Biochem., 7, 285-295.

3. Ifrim Savel (1998) – Natural silk - Editura CERES, Bucuresti, 253 pg.

4. Inoue S., Tsukada H., Tanaka H. (2001) - Degummed silk fibers of Bombyx mori consist of an H-chain, L-chain and P25 (fibrohexamerin) in a 6:6:1 molar ratio - Sericologia, 41(2), 157-165.

5. Lotz Bernard, (1982) – Structures cristallines de la fibroine de la soie du Bombyx mori L.: aspects cristallographiques et morphologiques, Sericologia, 22(2-3), p. 93-94

6. Minoura N., Tsukada N., Nagura M. (1991) – Physico-chemical properties of silk fibroin membrane as a biomaterial, Biomaterials, 11: 430-434.

7. Shimura K. (1988) – The structure, synthesis and secretion of fibroin in the silkworm, Bombyx mori – Sericologia, 28(4), 457-479.

8. Sofia S., McCarthy M.B., Gronowicz G., Kaplan D.L. (2001) – Functionalized silk-based biomaterials for bone formation. J. Biomed, Mater. Res., Vol. 54, 139-148.

9. Tsubouchi K. (2001) - Silk protein - refinement, characterization and medical application - Misc. Publ. Natl. Inst. Seric. Entomol. Sci., 28, 77-81.

10. **** - Silk-based bio-materials – Indian silk, July 1999, 14.

STUDY ON AVERAGE DISSOLUTION VELOCITY OF SERICIN IN RAW SILK FILAMENT FROM SILKWORM HYBRIDS (B. MORI L.)

By

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Five silkworm hybrids [C_1xX_2, 1013x1014, 19x20, (19x1013)x(20x1014) and (CH_1x$И_1$)x (M_2xH_2)] were studied for average dissolution velocity of sericin in raw silk filament by means of ultraviolet absorbance spectroscopy method at 280 nm in wave length. Average dissolution velocity of sericin was determined for each sericin fractions (I^{-st}, II^{-nd}, III^{-rd} and IV^{-th} sericin fraction). Highest average dissolution velocity had first sericin fraction. For every next fraction the average dissolution velocity of sericin was lower than previous (with 2.9 times was lower in II^{-nd} fraction than I^{-st}, 3.6 times was lower in III^{-rd} fraction than II^{-nd} and 5.6 times was lower in IV^{-th} fraction than III^{-rd} average for the both of sex). The best characteristic for average dissolution velocity of sericin was registered by 1013x1014 and 19x20.
Analysis of variance showed that the hybrid had highly significant effect ($p \leq 0.001$) on average dissolution velocity of sericin. The sex and interaction between both of the factors had not significant influence on variations of the above mentioned trait.
Keywords: silkworm, sericin, dissolution velocity of sericin, ultraviolet spectroscopy, raw silk filament

Section 5. Economy: Domestic and international markets, prices, trading, economic analyses of projects etc

SERICULTURE IN HIGHER EDUCATION – CHALLENGES IN INDIAN PERSPECTIVES

By

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Silk is a way of life in India and occupied a prime position and carries an aura of royalty. It has a sacred place in cultural heritage of Indians and it has merited mention at several places in the epic scriptures. It has also become the religious tradition for the Indian brides to wear silk saree in the marriage ceremony. Truly, silk has a fine blend with the cultural heritage of the Indians. Silk is indispensable in ceremonies and religious rituals, being a must in weddings and festivals. From this, it is very clear that it has very strong domestic market which is the real strength of Indian sericulture industry. A country like India with enormous man-power and untapped natural resources is still not able to emerge as one of the sericulturally advanced countries because of improper understanding of various aspects involved in sericultural practices and their integrated management. Even though, India has the distinction of being second largest country in the world in the production of silk, it is not yet possible for her to produce high-grade quality silk. Under World Trade Organization (WTO) regime and General Agreement for Trade and Tariff (GATT) with liberalized trade polices, India not only has to increase its silk production but also improve silk quality standards, if it really wants to be competitive in the world silk market. Apart from this the fashions are changing with the changing times in the domestic market also which demands for quality silk.

No doubt, India has a strong and growing domestic market that could absorb what is being produced, yet this very favorable factor should not be an obstacle to achieve the best. There is a felt need for quality silk with reasonably less cost, which enables more and more product diversification not only to meet the export requirement but also to satisfy the domestic market. However, changing consumer tastes in the domestic market, especially from the traditional heavy silk sarees to lighter material, are also sending signal to the industry to reorient its production plans to suit the changing demand patterns.

In this context, development of human capital in sericulture is not only highly essential but also it warrants for future development of the Industry. In view of the above need-based education in sericulture is to be strengthened to solve many issues of sericulture industry in view of the changing consumer tastes and globalization.

BEAUTY OF INDIAN SILK SAREES

By

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India, the second largest silk producer of silk in the world, as unique distinction of being the only country producing all the four commercially known verities of silk viz., Mulberry, Tassar, Eri and Muga. The unstitched single piece garment, which is draped, knotted or tucked in, saw many variations to suit functions, occasions and aesthetics. This evergreen fashion apparel of Indian women is called Sari. These silk sarees are known around the world for their beauty, elegance and intricate trim and pallu. The beauty of the silk is the key to having wonderful silk sarees. India has the largest domestic market for silk goods. About 85% of the silk goods sold in domestic market consist of traditional items such as sarees, sari-blouse material, Pavadas and Dhotis. India has estimated 20 million customary users of silk raising standard of living will mean increased demand for the silk goods. There is a steady raise in domestic demand for silk products. Silk products in India carry distinct identity of their own depending on the place of its production. Each region has its own tradition dating back to a few centuries at least in certain cases. Unique features of the design and also the artistic appeal of the fabric is the preference of the customers. A wide range of silk fabric is produced at different production centers in India in both handloom and power looms. The full length paper discusses about different types of silk sarees produced in INDIA.

Key words: Fabric, India, Sarees, Sericulture, Silk.

MANAGERIAL ABILITIES OF SERICULTURAL FARMERS – A STUDY IN CHHATTISGARH STATE OF INDIA

By

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Planned improvement in productivity and economic efficiency require in-depth understanding of managerial and organizational problems of the farms and consequent intelligent application of good management principles for profit maximization. In present scenario, the challenge before the farmer is how well he can manage the farm to enhance returns on a sustainable basis by way of increasing productivity, improving economic efficiency and raising managerial ability. Management factor plays a significant role in increasing productivity of farm enterprises, which is clear from the fact that for the same level of inputs, some farmers obtain distinctively higher yields than others and conventional inputs do not explain all increments in output. Sericulture, being a labour-intensive agro-based cottage industry combining both agriculture and industry, is no exception and the role of human factor is very crucial for getting higher productivity and quality. Hence, it becomes desirable to investigate different management factors responsible for higher productivity and quality so that appropriate policy decisions may be taken for steady growth of the industry. Comparative study on managerial abilities of Mulberry and Tasar Farmers in Chhattisgarh State of India has revealed that the managerial ability of Tasar farmers (25.675 ± 1.799) is significantly higher than Mulberry Farmers (22.246 ± 2.007). On an average, managerial ability of Sericultural Farmers in Chhattisgarh State is 23.880 ± 2.021. Among the sericultural farmers, male farmers possess significantly higher managerial ability than the females, irrespective of whether he or she is cultivating Tasar or Mulberry silkworms (23.938 ± 2.587 in males and 23.071 ± 2.817 in females). It has been seen that young (upto 25 yrs age), educated (upto matric class) and small farmers have higher managerial ability in comparison to aged (above 50 yrs age), illiterate and landless farmers. Statistical analysis of sector-wise pooled data has revealed that the managerial ability of Mulberry and Tasar farmers, whether belonging to different districts, age, sex, or education groups, is statistically significant at 5% level of significance. 74.66% Tasar and 71.31% Mulberry farmers are found to belong to Medium Managerial Ability Index (medium MAI) group (Mean managerial ability index plus-minus one standard deviation) while only 15.16% and 13.53% farmers fall in the High Managerial Ability Index group (high MAI; above Mean managerial ability plus one standard deviation) respectively. Step-down regression analysis indicates that there are only six and eight independent variables, arranged in decreasing order of their contribution to the final multiple regression equation, which influences the managerial ability of Tasar and Mulberry farmers respectively. In case of Tasar farmers, the variables are achievement motivation, exposure to mass media, size of land holding, sericulture experience, competition orientation and economic motivation while these are education, sericulture experience, level of aspiration, size of land holding, competition orientation, contact with extension agencies, participation in training and cosmopoliteness in case of Mulberry farmers. These variables together explain 70 to 80% of the variation in the managerial abilities of sericultural farmers. Hence, it can be concluded that the extension functionaries shall emphasize on management aspects and motivate farmers to improve their managerial abilities so as to get higher returns from the avocation.

Keywords: Managerial ability, Step-down regression, Standard deviation, Productivity, Quality

Current State of Sericulture in Georgia and the Possibilities of its Further Development

By

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ABSTRACT

In Georgia, sericulture has always been considered as the source of strengthening of the economics of the country, source of rational application of labor resources, that of increase of foreign currency inflow. Silkworm cocoon, grain, fabrics and other products were exported from Georgia.

Sericulture was widely distributed in Georgia, both in its west and east regions and it enjoyed great popularity of the local population. At about 100-120 thousand families were attracted to this branch of economy, and 5-6 thousand workers were employed in processing of its products.

Unfortunately mycoplasm disease of mulberry leaf, leaf curl, rugosity encompassed west Georgia from 1964, which ruined 15 million mulberry trees and cocoon output decreased catastrophically and from 2003 it was stopped absolutely as such.

Irrespective of the ruin of the branch, material-technical base of sericulture has been preserved in mainly. There is a great desire in the local population to produce cocoon.

At the current stage it is necessary to define correct, adequate directions and to elaborate concrete measures for the development of the branch, namely improvement of the obtained production (grain, cocoon, raw silk thread) and production of competitive products, restoration and strengthening of fodder base, perfection of scientific-research activity and improvement of selection activity, search of guaranteed market and what is most urgent, the care of the state for the development of the branch through realization of protectionistic policy.

Key words: sericulture, economics, rehabilitation

INTRODUCTION

Sericulture is the most ancient branch of agriculture of Georgia. It was always considered as the source of economic progress of the country, rational use of human resources and income of currency as well as the object of constant care. High quality Georgian silk was highly evaluated at the world market.

Georgian silk gained special appraisal and medals on the international exhibitions organized in Turin and London in 1850 and 1862, correspondingly. In 1998 silk fabric made of thread which was reeled from cocoon of Georgian mulberry silkworm breed (Mziuri-1 and Mziuri-2) by the use of the progressive technology developed at the Institute of Sericulture of Georgia, was awarded with the highest prize - Platinum Star, at the resolution of Europe Quality Committee, on the exhibition held in Spain.

Invaders, due to the strategic significance of sericulture, to decrease economic status of the country, used to extirpate mulberry plantations, alongside with the vineyards.

Development of sericulture in Georgia was favored not only by the favorable geographical location and perfect natural conditions, but also by the fact of small territory and excess of working power in its rural places, which today acquired more scaly character than before.

During the fifteenth century development history the middle of the nineteenth century was the period of flourishing of sericulture, when the country produced 6,5-7,0 thousand tons of cocoon. Unfortunately namely at that stage of its development, thanks to the disease of grain, pebrin imported from foreign countries, sericulture, as such, was practically ruined. In the shortest tome cocoon production in Georgia decreased 10-folds, which sharply deteriorated social-economic state of local population.

To overcome the crisis, in 1887 the Caucasian Station of Sericulture was created in Tbilisi and, on its base, in 1930 the Scientific Research Institute of Sericulture was created, which played the decisive role in a deed of shifting this branch to the scientific rails. At this period, granage factories were built at the enhanced rate and silk production industry progressed greatly. Highly productive mulberry trees and mulberry silkworm breeds and hybrids were inculcated in the industry. Production of hybrid grain was started, highly skilled personnel was prepared and other necessary measures were carried out.

In the sixties of the last century production of cocoon reached 4,2 –4,5 thousand tons. At about 100-120 thousand families were occupied in this branch, while in silk production – 6,0-6,5 thousand persons.

Unfortunately namely at this stage of sericulture development the unknown till that time disease of mulberry leaf curl (rugosity) was distributed in west Georgia, which practically ruined sericulture of Georgia. More that 15 million mulberry trees was rooted out and destroyed and cocoon production decreased catastrophically.

It was thanks to the researchers who led selection activity in the Institute that in the shortest time possible they managed to define the reasons conditioning that disease and the ways of its distribution and to plan the selection, biological, agri-technical, chemical, quarantine and other measures of organized system of struggle against the disease. As a result of their devoted work the breeds and forms which were practically stable to leaf curl were developed, which were widely inculcated in industry. As a result of the realized measures sericulture as the branch of industry was enlivened, but starting from 90ies, due to heavy political and economic situation in the country, production of cocoon gradually decreased and by 2000 it practically stopped.. In the referred to period mulberry plantations, which were planted in 1970-1980 was almost completely ruined and everything was to be started from the beginning. It was added also by the fact that this year Coordination Center for Sericulture "House of Sericulture" and the joint-stock company "Sakabreshumi" ("Georgian Silk") were abolished, which still more aggravated the situation.

According to the demands of market economy, sericulture passed from the social sector to private one, and it greatly hindered the development and progress of the branch.

In this heaviest period for the branch, Institute of Sericulture undertook the obligation to secure and rehabilitate the branch and it did its best in this deed.

At the background of the reforms going on in the state, irrespective of the fact that the Institute is forced to lead its activity in the heaviest conditions, it still continues successful activity and has potential chance to improve further its activity.

In recent fifteen years 9 mulberry and 6 mulberry silkworm breeds (hybrids) were selected at the Institute and zoned. Simultaneously, the progressive technologies of the initial treatment of cocoon and the elite mulberry planting material were also developed, introduction of which will greatly intensify the matter of rehabilitation of the branch. At the same time, it should be stated that there are favorable geographical location and good natural conditions for the development of sericulture in Georgia.

At the same time, there is a scientific potential and there are qualified specialists, fodder base for sericulture (5 million mulberry trees) including 2.0 thousand ha plantations. There are also small forest massifs and groves of common mulberry trees and the new systems of exploitation of mulberry plantations have been developed which are biologically justified and economically adaptable; there is a possibility to grow great volume of elite planting material of disease-resistant mulberry trees by express method; there are highly productive mulberry silkworm breeds and hybrids, technological indices of cocoon of which are approximated to the indices of the world standards, there is a possibility to restore grainage factories, which will enable us to reject the import of foreign origin costly grain, we have the chance to perfect organization of breed selection work at selection stations, to use new technologies of silkworm feeding and initial treatment of cocoon developed at the Institute and there are other factors of organizational-economic character.

According to our opinion, at this stage specific attention should be paid to the improvement of production quality and manufacturing of competitive production.

The thing is that situation of market economic, which was established in the post Soviet space countries, created problems to many traditional branches of industry and in some countries even the issue of existence of sericulture as such was faced by a danger. Quite naturally, when the decisive factor of economic efficacy of branches and cultures is the minimum profitableness, sericulture, viticulture and fruit growing branches turned out less competitive ones. In such a situation even the attempts of non-substantiated increase of prices of the products of sericulture or the protectionism policy of the government will not give desirable results. Here other reserves should be started.

Many factors make influence on the efficacy of sericulture and it is impossible to define its efficacy by any integrated index. Therefore to analyze its efficacy we have to use reciprocally associated several indices, of which one principal index must be isolated which defines the principal tendencies of development of the branch at this stage and which will make it possible to make thorough economic analysis.

While making assessment of economic efficiency of the measures implemented in sericulture, we must base on the criterion of economic efficiency, which expresses the significance, essence of production order of production and its major goal, which unites in itself all principal indices.

For preservation and development of sericulture and for elevation of its economic efficiency at the terms of the most strict competition and globalization, the following is necessary:

a) Improvement quality of the produced goods (grain, cocoon, raw thread) and production of competitive products;
b) Care of the state for the development of the branch by means of policy of protectionism, although this measure bears temporary character and in the perspectives will not solve the problem of development of the branch, as such.

Proceeding from the above stated, for the increase of economic efficacy of the branch it is necessary to perfect scientific-research activity and especially, to improve radically selection activity, which at the terms of present day funding (at least on the first stage) is hardly realizable. Therefore, the state and international organizations, must direct the solid resources provided for the development of the branch via policy of protectionism- towards the improvement of selection activity, strengthening of fodder base, perfection of technologies of grain preparation and initial treatment of cocoon.

We consider it appropriate to ask organization BACSA to give recommendation to independent states of post-Soviet space and to assist them in a deed of import of grain and initial material. At the same time, taking into consideration the interests of the region, at least at the first stage, to render support in development of local grain production industry and to equip grainage factories by modern technology.

As to the Institute, it has developed many projects, a program for the problems of revival of sericulture, which were acknowledged and approved by the Ministry of Agriculture of Georgia.

The Institute actively cooperates with FAO in the project connected with the "Revival and Rehabilitation of Sericulture in Georgia".

The Institute is a founder member of the Black and Caspian Seas Countries Sericulture Association (BACSA), and staring of its programs will contribute to the revival of the branch.

The Institute has signed contracts with many countries about coordinated scientific research activity.

For realization of the second stage, alongside with the favorable natural conditions of the state there is high scientific potential, qualified personnel and necessary projects, materialization of which in the nearest perspectives will guarantee production of 2-3 thousand ton cocoon, and later it will reach 4-5 thousand tone.

Analysis of the situation in sericulture of the state of the last decade shows that for rescuing the branch it is necessary to carry out radical measures and to extirpate the causes conditioning its degradation, and namely:

- Necessary measures must be implemented for strengthening fodder base, for restoration of the lost traditional consumers market and provision of its protection and preservation;
- The integrity must be established between the manufacturer of raw material (cocoon) and the branch, marketing service must be regulated and management system – perfected.
- Decrease of leakage of skilled personnel and preparation of the needed quantity of new highly skilled personnel and revival of a system of re-training must be achieved;
- Specific attention must be paid to production of local industrial grain and to the decrease of import of foreign origin grain,
- Local industry and s/s treatment objects must be equipped by modern machinery;

Regulation of the above stated problems will greatly contribute to the progress of sericulture and production of competitive products. Of course, the present day situation in sericulture is extremely heavy, but there are still the chances to rescue it.

Sericulture Development in Uganda. Strategies for the 21st Century

By

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ABSTRACT
Sericulture has been identified as one of promising enterprises for employment and income generation, poverty alleviation and rural development in Uganda. An analysis of the present situation of the sericulture industry has been presented. The salient futures of the policy and the national sericulture strategic plan to create the capacity for developing the sericulture industry to economic levels, harness the opportunities of the 21st century and steer the industry through the anticipated and unanticipated challenges are highlighted in this paper.

INTRODUCTION
Although sericulture is new to Uganda, it started as a research activity as early as 1920. During this period, indigenous wild anaphe silk was being exported to Europe. There was minimal growth of the industry due to a number of constraints, which included lack of technical know-how. Attempts to revive the industry during the early 1970s did not succeed because of lack of trained manpower and the prevailing political and economic situation then. Sericulture production picked up again in 1986 and by 1992 commercial cocoon production had started.

Since then, sericulture development has been led by the private sector that initiated commercial cocoon production for export. Factories for mulberry silk cocoon processing and textile production have now been established by the private sector to add value and enhance competitiveness of Uganda's silk. High quality silk yarn for export has been produced and silk textiles, which have been produced, are marketed locally. Craft processing which involves hand reeling, re-reeling, spinning and weaving has also been started by rural people in the sericulture areas.

Since the start, the private sector has been facing problems in the development of the sericulture industry. Production facilities and systems have failed to achieve expected productivity levels and stabilization of the cocoon crops that are essential for the sustenance of the sub-sector. On farm production and productivity are currently at 50%. There are insufficient material inputs like quality silkworm eggs. There are also inadequate skilled and qualified personnel for training and supervising farmers. An analysis of the industry and the strategies to overcome current constraints and drive the industry through the 21st century are presented below.

Situation Analysis
Strengths
The Uganda sericulture industry has a high possibility of success to survive, grow and contribute substantially to the economy during the 21st century because

- Farmers have interest in the industry which can be demonstrated by the high rate of mulberry plantation which is now distributed in more than 50 districts
- Silkworm eggs which are a critical input in sericulture development are now produced locally
- Farmers are already rearing silkworms and producing silk cocoons which is an all year round activity, not seasonal

- Factories have already been put up, maintained and run by Ugandan technical personnel who have demonstrated that they can produce products which can be marketed
- Government is interested in supporting the industry

Weaknesses

The growth and development of the Uganda sericulture industry is currently constrained by a number of factors. These include, but not limited to the following:

- Inadequate supply of inputs, especially quality silkworm eggs and improved mulberry varieties
- Lack of specialized sericulture support infrastructure.
- Lack of a strong and well organized apex body to promote and drive the industry
- Inappropriate credit schemes for cocoon production, purchasing and processing
- Inadequate training opportunities
- Lack of an effective regulatory framework relating to sericulture production, health, marketing and research which may result in importation or exportation of poor quality products and damaging the industry

Opportunities

Some opportunities favor sericulture development in Uganda

- The favorable climatic conditions for mulberry cultivation and ideal weather for silkworm rearing throughout the year means that people will be productively working in their mulberry farms and silk processing enterprises, creating employment and wealth
- The high value-low volume property of silk makes it an ideal export commodity for land locked Uganda
- Uganda silk has demand in the traditional silk processing and consuming countries which is demonstrated by the requests for supplies from Uganda which are yet to be fulfilled

Threats

- Lack of appropriate equipment for artisan/craft silk processing and investment for modern cocoon and silk processing equipment
- Inadequate technical training opportunities for sericulture extension and silk factory workers

The National Sericulture Development Strategy for the 21st Century

Government has formulated a national policy and strategic plan for sericulture development. NGOs, the private sector including farmers, processors and traders are playing a vital role in sericulture development and their roles will be facilitated, guided and supported where necessary.

The vision of the national sericulture policy and strategic plan for the 21st century is "prosperous rural communities and a beautiful country through sericulture farming". The strategy involves long-term plans intended to address major constraints, overcome weaknesses and prepare the industry to exploit the opportunities and face challenges of the 21st century. The mission is "**to develop a sericulture industry that will contribute to improvement of livelihoods of the poor rural producers and national revenues".** To realize the vision and mission, the industry will have to constantly take care of the needs of the consumer of the century 21st century, who probably will continue to need reasonably priced but high quality silk. The ultimate goal of the Uganda sericulture sector for the 21st century is, therefore, to ***"increase sericulture farm productivity and produce silk products that are affordable in order to meet domestic, regional and international market demands".***

Strategic Objectives

Sericulture development will be based on long term strategic actions, which are intended to create a technical base and capacity for economic and sustainable silk production in Uganda. It is expected that annual fresh cocoon production will be increased to 13,920 tons and high grade raw silk to 1,740 tons by the year 2017.

The main objectives are:

- Provide an institutional framework and capacity to implement sericulture policies and strategies

- Increase silk production and revenues

Strategic areas and priorities

Manpower development
Recruit and retain personnel with relevant qualifications to improve on the capability of the sericulture services nation-wide in order to efficiently carry out professional and technical functions; both in technical and administrative positions. Annual training plans will be made and implemented to equip personnel with relevant skills.
Expansion of mulberry plantations
There is need to increase cocoon production to meet current factory requirements and future needs in order to make the industry competitive locally, regionally and internationally. Gradual rehabilitation and expansion of mulberry fields in Eastern, Northern, Central and Western regions will be undertaken. Modern practices in mulberry cultivation will be practiced to reduce costs and improve silk quality.
Silkworm egg breeding, parent line maintenance and multiplication, egg production and marketing
To increase cocoon production, correct organization of breeding works for egg production is a must. At the moment, only one Japanese and Chinese type pure breed is available. It is planned to produce more breeds within 4-5 years to reduce the risk of relying on two breeds only. The silkworm parent stocks are maintained and multiplied at National Sericulture Center, Kawanda. NSC will continue producing eggs until private sector capacity is built or attracted by volume/returns of the business.
Improvement and expansion of young silkworm rearing facilities and technology
Silkworm eggs are incubated at young silkworm rearing centers owned by farmers associations. It is a form of co-operative arrangement. The eggs are hatched, young silkworms reared up to second stage only (out of 5 stages) and distributed to the individual members of the association. Incubation facilities and young silkworm rearing houses will be improved, expanded and equipped according to farmers' needs, targeted cocoon and silk production.
Establish an effective extension delivery system for sericulture
Sericulture extension services have been private sector led and are currently provided by farmers' associations. The associations have been working with the local government entomology staff and National Sericulture Center for information, training and technical backstopping. The strategy aims at building on this experience by supporting the training and retention of local government entomology personnel and sericulture farmers' associations.
Exploitation of indigenous sericulture resources
Unique textiles have been produced from some of Uganda's indigenous silkworms such as *anaphe*. Another type of silkworm, the eri silkworm, which feeds on castor plant leaves, is also being reared at the NSC for commercial exploitation of the silk from the silkworms in combination with oil production from the castor seeds. The combined exploitation of castor oil, eri, mulberry and anaphe silks will offer an additional opportunity for gainful employment, industrialization and improve the livelihoods of rural communities and national revenues. The strategy aims at exploitation of these indigenous resources in the long-term.
Support farmers' groups to increase cocoon production
Financial institutions will be encouraged to avail credit to farmers for rearing houses and to procure equipment. Farmers' groups will also be strengthened and their members trained to help stabilize supply of silk cocoons.
Cocoon and silk processing
Small and medium scale cocoon and silk processing using improved craft and modern equipment and tools are being promoted. Silk technology training for reeling, twisting, refining raw silk yarn and dyes will be done at village and national level. Local and national silk processors organizations will be promoted.
Marketing of silk products

The strategy is to make products, which can be marketed locally and gradually expand to regional and then global markets. Craft cocoon processing is being done to produce artistic products for the internal market, tourist points and export. Such products include fabrics, scarves, shawls, embroidery, carpets, rugs, tapestry, bedcovers, souvenirs, interior decorations, sofa covers and others. Raw silk from multi-end and automatic reeling machines is being exported. The strategy is to produce high quality cocoons for processing using advanced reeling machines to produce high quality raw silk and to promote investment in high quality silk product manufacture, to compete in the international market for silk.

Research

The strategic objective is to develop technologies and technical skills for the efficient exploitation and utilization of sericulture resources and products. Key strategic activities will include adaptability and productivity studies, control of diseases and pests that impact on sericulture production, development of technologies for exploitation of indigenous sericulture resources, market research and development of appropriate silk cocoon post-harvest technologies and silk products to sustain the industry.

Quality assurance

A quality inspection system for silk and grading standards for raw materials and products will be established to ensure routine inspection and continuous quality improvement. Inspectors will be recruited, trained and retained. A silk testing center will be established and equipped for routine tests both locally produced and imported cocoons and silk products.

Institutional Framework for Implementing the Strategy

The National strategy for sericulture development will be implemented within the strategic framework of Plan for Modernization of Agriculture, National Agricultural Advisory Services, National Agricultural Research System, Rural Development Strategy, MAAIF Development Strategy and Investment Plan. The sericulture strategy is a guide providing an outline of activities and responsibilities of different stakeholders, inputs which may be required and the expected outputs over the proposed time frames.

Four ministries, as well as the private sector will be involved in strategy implementation covering manpower and skills development; agriculture, environmental and industrial activities.

Table1.Proposed roles of various stakeholders in the implementation of the Uganda National Sericulture Strategy

Strategy	Responsibility		
	Ministry	**Institutions and functions**	
Mulberry production	MAAIF	NSC/DLHE, NAADS, Private Sector Support establishment of plant propagation Nurseries	
Silk egg production and marketing	MAAIF	NSC Maintenance and multiplication of silkworm Parent stocks • Inspection of (public/private) production facilities Licensing of egg producers Private Sector Silkworm egg production and marketing	
Young silkworm	MAAIF,	• NAADS	

production	MLG	
Exploitation of indigenous sericulture resources	MAAIF	NSC • Technology development NAADS, Private Sector • Production and distribution of silkworm eggs
Extension services	MAAIF, MLG	DLHE • Establish a trainining unit at NSC • Train extension service providers • Monitor and supervise extension service delivery NAADS, Private sector • Support training of farmers
Strengthening of Sericulture Farmers' Organizations	MAAIF, MTTI, MLG	MAAIF, NAADS, UEPB, Private Sector • Support establishment of cocoon producers and Processors organizations
Support to value addition	MTTI, MAAIF	NSC • Establish a sericulture post-harvest training unit • Training and demos in silk reeling, spinning, Dyeing and weaving IRI, DLHE, Private Sector, NGOs • Provide technical support to processors • Support and promote craft silk processing • Promote modern silk processing mills for high Quality silk production • Support training in value addition
Marketing of raw materials and silk products	MAAIF, MTTI, MFPED	UEPB, NAADS, DC, DLHE, Private Sector • Support establishment of farmers Co-operatives for cocoon marketing • Promote silk products on local and export Markets • Provide information on markets

Research	MAAIF, MTTI	NARS, Public Universities, NSC, Private Sector • Biological sericulture research IRI • Industrial research UEPB, NAADS, Private Sector • Market research • Export market development
Regulation and Quality Assurance	MTTI, MAAIF	NBS • Establish silk standards and monitor quality of raw materials, products, tools, equipment, machinery and supplies • Collect and collate quality data and produce reports • Issue quality certificates DLHE • Issue licenses to sericulture/silk exporters and importers

Funding Mechanism for the strategy

The above strategic measures have been designed to alleviate current and anticipated future technical constraints for the long-term future of the silk industry. The sustenance and development of the industry in its entirety is beyond the capabilities of only the line ministry, Ministry of Agriculture, Animal Industry and Fisheries. A multi-sectoral approach is proposed where stakeholders for the mandated activities outlined in Table 1 will plan and provide funds from the core budgets and other sources. It has also been proposed that a sericulture technical steering committee with one person representing each stakeholder should be formed to harmonize work plans and activities to avoid duplication.

Evaluation of sericulture for augmenting agricultural income of marginal farmers in semi-arid region of India.

By

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In India, annual rise in agricultural income is only 1.5 % as against 4 % rise in expenditure. Productivity of rainfed agriculture therefore needs to be increased on sustainable basis through different means. Sericulture is one of the promising technologies that has proved effective in augmenting agricultural income in different parts of the country. Moreover, labour intensive nature of sericulture also helps in creating employment in rural economy. It is felt that semi arid conditions in central part of the country are not conducive to sericulture. However researchers and farmers have devised effective techniques and successfully raised sericulture crop. Successful adoption has also generated interest amongst farmers. Purpose of this study was to evaluate augmentation of income through sericulture and the quantum of employment created. The study was conducted in five different villages in Nagpur district, Maharashtra state, India with representation from small and medium land holding category of farmers. It was observed that small and medium farmers were underemployed except during the peak period of sowing and harvesting. The extent of unemployment was 227 and 193 mandays (MD) in a year respectively for small and medium farmer category. Adoption of sericulture resulted in gainful employment. The farmers used spare time in rearing the silkworm. The extent of employment increased by 180 MD and 173 MD in small and medium category respectively, with corresponding additional income of Rs. 23700 ($ 578), and 31320 ($ 764) per annum. Thus inclusion of sericulture in farming system provided an opportunity to earn an additional income with employment generation on sustainable basis in rural sector. We concluded that sericulture could be propagated even in the semi-arid region part of the country to increase agricultural productivity. It would also create an employment and slow down the migration of underemployed farmers to the urban areas.

Keywords: Sericulture, Agriculture income, Employment generation

Tapioca-An asset of Kerala with diversified economic utility

By

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ABSTRACT
In Kerala, though there was a shift from high volume, low value crops like tapioca and paddy to low volume, high value crops like pepper and rubber, still tapioca is being cultivated for tuber production, in large extent of over one lakh hectares, being an important food and industrial crop. Presently, the tapioca leaves are being used partly for cattle feed or composting, forms an important food material for eri silkworm (Samia cynthia ricini), which was mostly reared in Northeastern States and introduced in other South Indian states in recent times. Central Silk Board through its Cluster Development Centre, Agali in Palakkad district of Kerala conducted trial-cum-demonstration rearing of eri silkworms by utilizing tapioca leaves has been successful in realizing an additional income to the tapioca growers. Details of district-wise extent under tapioca in the State, recommended tapioca varieties, cultivation practices, plant protection measures etc. are discussed. Further, the details of trial-cum-demonstration eri silkworm rearing on otherwise discarded tapioca leaves with returns, cocoon characteristics are discussed. In addition to utility of tapioca leaves for generating additional income, value addition through nutrient rich pupae, which can combat malnutrition among tribal women and children or as food for poultry/ fisheries, is explained. SWOT analysis for large-scale introduction of Ericulture, available support services and future strategies to be adopted in the State are discussed.

Key words: Tapioca, eri silkworm, Cluster Development Centre, malnutrition

INTRODUCTİON

Kerala, the South-western State of India is abode of varied bio-diversity and terrain. Though the annual per capita income in the State has recorded an increase from Rs 5,065/- in 1992-1993 to Rs. 19,461/- in the year 1999-2000, over 12.7 % of population in the State is still below poverty line. The pressure on land in Kerala is the highest in India and the state's economy continues to be dominantly agrarian. Rice and tapioca are important food crops. Though there was, of course, a shift from high volume low value crops like tapioca and rice to low volume, high value crops like pepper and rubber, still tapioca is being cultivated in large extent. Tapioca cultivation suits well to the State's conditions as is it requires low manpower and can be managed by the family labour inputs. Out of total geographical area of 388.55 lakh hectares, about 28% is under forests (10.82 lakh hectares) and net area sown is 218.85 lakh hectares (56.3%). District-wise area under tapioca and tuber yield in the State is depicted at **Table-1**.

Table-1: District-wise data of Tapioca cultivation in Kerala (Area in hectares)

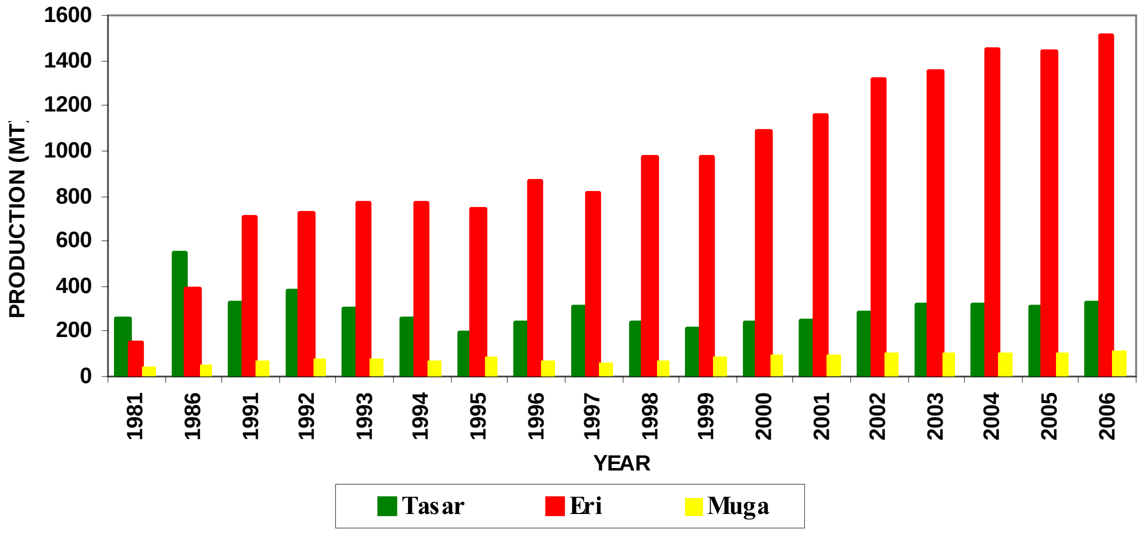
Sl. No.	District	1999-2000	2000-01	2001-02	2002-03
1	Thiruvananthapuram	25981	27084	25085	23922
2	Kollam	25678	26484	26114	24065
3	Pathanamthitta	6877	7681	8833	7614
4	Alappuzha	4524	4843	4367	4121
5	Kottayam	7745	8749	7780	7426
6	Idukki	7775	7794	8224	7806

7	Eranakulam	5131	5208	5777	5668
8	Thrissur	1527	1637	1405	1376
9	Palakkad	6373	6646	5649	4960
10	Malappuram	8491	7508	7206	6947
11	Kozhikode	4924	4037	4311	3964
12	Wayanad	1620	1620	1692	1915
13	Kannur	3996	3945	3420	3247
14	Kasaragod	1280	1373	1326	1148
	State Total	**111922**	**114609**	**111189**	**104179**

Source: Kerala Agricultural statistics 2002-2003

Among *Vanya* silks, ericulture and silk weaving remained, since time immemorial, an inseparable part of the socio-economic activities of the rural and tribal people of North-eastern States. The success of the UNDP assisted Project for eri development in Northeastern states has given much required impetus for its large scale introduction in mainland States, where the food plants like castor

Table- 1: PRODUCTION TRENDS OF *VANYA* SILKS IN INDIA



or tapioca are being grown for oil seed and tuber production (Teotia *et. al.,* 2003).

Eri silkworm, *Samia Cynthia ricini,* a domesticated multivoltine silkworm is polyphagous in nature feeding on leaves of Castor (*Ricinus communis*), Kesseru (*Heteropanax fragrans*), Tapioca (*Manihot utilessima*), Payam (*Evodia flaxinifolia)* etc. With development initiatives of the Central

Silk Board in association with State Departments of Sericulture and NGOs, it is finding its place in Southern States *viz.,* Andhra Pradesh, Karnataka, Tamilnadu and Kerala. Further, the States like Maharashtra, Gujarat, Orissa, Bihar etc., are evincing interest to take up Ericulture on large scale.

Though eri silk contributes about 7.26% of the total raw silk produced, it accounts for over 78% of the total production of *Vanya* silks produced in the country. Interest on Ericulture has been building up and Eri silk is fast becoming popular in recent years. Interventions of Central Silk Board on design development and product diversification targeting domestic and overseas consumers has created a demand-pull for eri spun yarn prompting increased production and quality. Due to concerted efforts of Central Silk Board, Govt. of India over the different Plan Periods, Eri silk production has enhanced by over 10 folds compared to that of two and half decades ago. Production trends in *Vanya* silk production in the country are depicted in the **Table-3**.

Why Ericulture in Kerala?

- Eri culture offers opportunity for additional income without affecting the tapioca tuber production with no significant additional investment.

- Ericulture generates additional employment avenues for tapioca growers and without disturbing the existing socio-cultural and ecological balance.

- Congenial agro climatic conditions in the State for cultivation of Tapioca and eri silkworm rearing.
- Presence of sericulture infrastructure and technical manpower and handloom weaving skills of local artisans.

The resource poor farmers raise tapioca for tuber production with readily available marketing facilities (which is used as staple food in the form of sago/ floor and also as raw material for many industrial products viz., industrial alcohol, starch, sago, flour, glucose, vitamins etc.) under rainfed conditions as a regular subsistence/ contingent crop, can use the foliage for Eri rearing so as to earn additional income.

As such, ericulture can provide a subsidiary economy for the poor, tapioca cultivators. It provides gainful employment to women, too. Further, it is established that partial utilization of about 30 per cent leaves does not affect tuber yield (Bhat *et. al.,* 1991). After three months of plantation of tapioca, some farmers defoliate leaves for cattle feeding or the leaves at bottom level get matured and wither off. Large scale studies on total leaf availability, percentage of leaf plucked for silkworm feeding and impact of leaf plucking on tuber yield in Andhra Pradesh through CSB assisted Ericulture Project revealed that around 25% of leaf is available for eri silkworm rearing, without affecting the tuber yield (Rama Rao *et. al.,* 2005). Further, it is estimated that 5 to 6 MT of leaf is available for harvest per hectare of tapioca plantation without affecting tuber yield, which otherwise go waste. This surplus leaves can be utilized for eri silkworm rearing. If cultivated judiciously, a tapioca farmer can add up his income by about Rs.10,000/- to Rs.12,500/- per hectare through rearing of about 500 eri dfls and producing 40 to 50 kg eri cocoon shells from the same cultivated area and sold at around Rs. 50/- per kg.

Many improved varieties for tuber yield and starch content have been evolved by the Tamilnadu Agricultural University (TNAU) and Central Tuber Crop Research Institute (CTCRI) is most suited to Kerala (**Table-3**).

MATERIALS & METHODS

The Central Silk Board is implementing a Cluster Development Project in Attappady Block of Palakkad district in Kerala State, in collaboration with Attappady Hill Area Development Society (AHADS) for the overall development through Cluster approach and project mode. Understanding the potential for Ericulture, Central Silk Board has assisted an R&D Project to study feasibility, technology development, refinement and transfer by S. Jayaraj Research Foundation (SJRF) through its Cluster Development Centre (CDC) at Agali. Attappady is a tribal abode with Irular, Mudugar and Kurumbar as the main tribal groups. They live in forest in closely built huts called 'Ooru' (hamlets). As these tribals cultivate tapioca for tuber production (for their consumption), introduction of Ericulture can be a viable source for additional income.

Table-3: Improved Tapioca Varieties

Institute	Tapioca Varieties
TNAU	CO1, CO2, CO3
CTCRI	M4, H-119, Sree Vishakam, Sree Kala, Sree Harsha, Sree Rekha, Sree Prabha

Source: S. Jayaraj, 2003

Mosaic tolerant variety Sree Vishakam was included in the present study at farmers' level. Before planting, the field was ploughed 2-3 times to a depth 25-30 cm to establish a deep porous field. Mature healthy stems free from diseases or pests are selected after discarding about 10 cm from the lower mature and about 30 cm from the upper immature end. Stems were cut into 15-20 cm length and harvested stems are stored vertically in shaded and well-aerated places. Dimethoate (0.05%) was sprayed on the stem to control scale insects. Plantation was taken up during April-May with the onset of southwest monsoon with pit method of planting, where cuttings are planted vertically after smoothening the lower cut end, at a depth not exceeding 4-6 cm. Square method of planting was adopted at a spacing of 90 x 90 cm @ one cutting per pit. Gap filling should be done within 15 days after planting. A basal dose of 50:100:50 kg N: P2O5: K2O per ha was given uniformly. Irrigation was given to provide sufficient moisture under conditions of prolonged dry periods after planting. Farmyard manure or compost may be applied at 10 MT/ha while filling up the pits so as to provide about 1 kg of organic manure per plant. Recommended fertilizer doses for various tapioca varieties are indicated at **Table-4**.

Fields were kept free of weeds by 2-3 shallow diggings or hoeing up to 90 days after planting followed by light earthing up. Two shoots were retained on each plant in opposite directions and excess shoots were removed about 30 days after planting. Tapioca tuber harvest was taken up during December-January months.

Eri silkworm rearing was conducted during three seasons (June-July, July-August and November-December) following recommended rearing practices for tray rearing.

Table-4: Chemical fertilizer dose recommended for Tapioca

Variety	N: P2O5:K2O (kg/ha.)
H-97 and H-226	75:75:75
H-165, Sree Visakham, Sree Sahya	100:100:100
M-4 and local	50:50:50

Source: I kisan website

RESULTS & DISCUSSION

Trial-cum-demonstration rearings conducted by the Central Silk Board in the Palakkad district through CDC, Central Silk Board, Agali, which are depicted in **Table-5,** proved beyond doubt that the eri silkworm rearing can be taken up successfully and can generate additional income without substantial investment**.**

Table-5: Trial-cum-Demonstration eri silkworm rearings in Palakkad District by Cluster Development Centre, Central Silk Board, Agali, Kerala

Trial Rearing: I (June-July)

Sl. No.	Name of the farmer	Village	No. of dfls	Hatching percentage	Actual yield of cocoons (kg.)	Yield/ 100 dfls (kg.)	Returns/ 100 dfls (Rs.)
1	Sasi Kumar	Agali	56	97%	44.70	79.82	3991.07
2	Sukumaran	Agali	5	97%	3.00	60.00	3000.00
3	N. J. Antony	Agali	5	97%	2.80	56.00	2800.00
4	T. Rajani	Agali	5	98%	3.60	72.00	3600.00
5	N.G. Manoj	Kottathara	5	98%	2.90	58.00	2900.00
	Total / Average		**76**	**97.4**	**57.00**	**65.16**	**3258.21**

Trial Rearing: II (July-August)

1	Selvi	Chavadiyar	15	97%	8.00	53.33	2666.67
2	Ammani George	Padur	10	96%	8.00	80.00	4000.00
3	Fr. Varheese	ASSO, Pakkalam	5	98%	2.80	56.00	2800.00
	Total / Average		**30**	**97**	**18.80**	**63.11**	**3155.56**

Trial Rearing: III (November-December)

Sl. No.	Name of the farmer	Village	No. of dfls	Hatching percentage	Actual yield of cocoons (kg.)	Yield/ 100 dfls (kg.)	Returns/ 100 dfls (Rs.)
1	John Augustin	Agali	20	95%	10.50	52.50	2625.00
2	Agali Co-p. Farming Society	Pattimalem	20	95%	13.10	65.50	3275.00
3	Sasi Kumar	Agali	10	95%	6.40	64.00	3200.00
	Total / Average		**50**	**95**	**30.00**	**60.67**	**3033.33**
	Grand Total / Average		***156***	***96.47***	***105.8***	***62.98***	***3149.03***

Even the cocoon characteristics of eri cocoons harvested from the above trial-cum-demonstration rearings by CDC, Agali **(Table-6)** are very encouraging so that eri culture development activities i.e., motivating tapioca growers to take up eri silkworm rearing in addition to the tuber production to enhance their income and also processing of eri cocoons can be planned in a bigger way in Kerala.

Table-6: Cocoon characteristics of Trial rearings by CDC, Agali

Trial rearing	Single Cocoon Weight (gm.)	Single Shell Weight (gm.)	Shell Ratio %
Rearing-I	2.53	0.35	13.77
Rearing-II	2.62	0.35	13.38
Rearing-III	2.52	0.35	13.99
Average	**2.56**	**0.35**	**13.71**

Though tapioca growers continue to grow tapioca for its tuber production, following assistance is available towards activities like training, infrastructure creation, equipment support, and establishment of processing facilities etc., for plantation of perennial food plants, rearing of eri silkworms and processing of eri cocoons.

1. Financial assistance is available under Swarna Jayanti Gram Swarozgar Yojana (SGSY), Scheme of Training and Employment Programme (STEP), National Afforestation Programme and various tribal development programmes may be tapped to provide additional income to the small and marginal tapioca growers.

2. Catalytic Development Programme (CDP) Schemes of Central Silk Board for eri development are available for :

    a. Augmentation of eri food plants with training and start-up tools.
    b. Support for construction of rearing house.
    c. Assistance for states for the maintenance of eri farm-cum-grainages.
    d. Support to agencies (Non-Governmental Organizations-NGOs/ Cooperative Societies) for upgradation and popularization of improved reeling/ spinning devices.
    e. Establishment of Common Facility Centres (CFC) especially for degumming and processing of cocoons.
    f. Establishment of eri spun silk mill.

Future Strategies & Conclusion

Scope for development of eri culture in the State of Kerala can be vibrant if the following areas are properly exploited so that the weaker sections of the society will get meaningful employment and additional income generating opportunities in addition to effective utilization and conservation of its biological asset, tapioca.

- Development of Intensive Integrated Farming System approach, integrating ericulture with other compatible farm enterprises viz, agriculture, horticulture, animal husbandry, aquaculture, agro-forestry, apiculture, mushroom culture etc., utilizing natural resources and/ or farm wastes, instead of the present mono crop system.

- Development of sound and systematic intercropping system for eri host plants, with a mixture or individual crops like pulses, oil seeds, millets, vegetables, medicinal plants, forages etc., along with comprehensive crop and soil management packages for both the host plants and intercrops.

- Conscious efforts by State Government to develop Ericulture as an additional income generating activity under 'Kutumbasree' in clusters where tapioca is abundantly grown, to integrate sericulture extension and agriculture extension, if required, to energize the extension system and maximize benefits to the farmers under the broad based extension.

- Identification of NGOs/ Voluntary Organizations with reputation and organizational ability for involving them with performance linked assistance in the areas of transfer of technology, seed production and popularization of post-cocoon activities.

- Introduction of region specific varieties of Tapioca suited for ericulture and development of systematic plantation of other eri food plants as bund crops.

- Technological support in post-cocoon areas viz., spinning, processing of cut cocoons, loom-upgradation and marketing.

- Research on potential market exploitation with more attention towards product mix & diversification and design development for commercial marketing of eri products based on the market intelligence to cater different market segments of domestic market as also to meet the changing needs and preferences of global market.

The NGOs and SHGs involved in development found Eri silk production as the most eco-friendly activity amongst all agri-businesses since all its bye products can be gainfully recycled. With the perspective for value addition and export of the products, Eri culture could well be propagated in Kerala by tapping its important biological asset – Tapioca, so that this avocation can become a potential supplementary source of income for the tapioca growers of the State, without substantial investment. In rural environs, the services of the women could profitably be roped into this enterprise with tremendous economic implications.

REFERENCES

Bhat G.G., Umesh, T. and Ramakrishna Naik (1991): Tapioca is an ideal root upon which to rear the eri silkworm, *Indian Silk*, April 1991: 19-20.

Jayaraj, S. (2003): Large scale development of Ericulture in India – Perspective for the future, *Indian Silk*, 42 (1): 29-30.

Rama Rao, M., Prasad, R.N. and Suryanarayana, N. (2005): Ericulture – an additional income for tapioca (Cassava) growers and good nourishment to the malnutritioned tribal populace. *Presented during the 20th Congress of the International Sericultural Commission, Bangalore, India*, Volume-II, 15-18th December 2005, p 94-98.

Teotia, R.S., Sathyanarayana, K., Rajashekar, K., Goel, R.K. and Krishna Rao, J.V. (2003): UNDP assistance in development of eri culture, *Indian Silk*, 41(12): 13-18.

Special SGSY Projects in Bihar and Jharkhand: A Model for successful NGO-GO Collaboration

By

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ABSTRACT

India has a rich tradition of voluntary concepts like Non-Governmental Organizations (NGOs), since time immemorial actively associated with welfare activities and livelihood creation. Few of them realize their goal through sericulture developmental activities in collaboration with Central Silk Board, Ministry of Textiles, Govt. of India and the State Sericulture Departments. A reputed NGO, Professional Assistance for Development Action (PRADAN) which is associated with such Projects on a pilot scale, is now implementing special Swarna Jayanti Gram Swarojgar Yojana (SGSY) Projects in Bihar and Jharkhand for development of tasar culture with the financial assistance from the Ministry of Rural Development, Govt. of India and Central Silk Board. The progress under the Projects has been very remarkable in spite of several constraints in the initial period. Collaboration between NGO, PRADAN and various Government Organizations (GO) under the Projects, modalities of execution, implementation, monitoring of the Projects is discussed. Role of PRADAN in various activities like formation of Self Help Groups, capacity building, linking various activity groups, extension support, marketing etc under the above Projects is also discussed. Various innovative ideas and entrepreneurial models were successfully implemented under the Projects are discussed. Keeping in view this successful NGO-GO collaboration, need and strategies for involvement of more such NGOs for sericulture development, their strengths and weaknesses, role clarity of different players in such association are discussed.

Key words: SGSY Projects, PRADAN, Collaboration, Innovative ideas, Entrepreneurial models

INTRODUCTION

Till recent times, Central Silk Board with the help of State Departments of sericulture was involved in development of sericulture in general and *vanya* in particular, in the country covering large area in remote locations, large population and diverse cropping pattern. However, their role was mostly confined to transfer and disseminate appropriate technologies/ practices, which alone is not sufficient for sericulture development. In view of the very skeleton staff available with many of the State Sericulture Departments under poor service conditions, there is a need to augment the involvement of Non-Governmental Organizations (NGOs) in sericulture development, in order to reduce the economic burden of government agencies and also to tap the strengths of NGOs in group formation and motivating the activity groups towards efficient use of resources, conservation of soil, water and bio-diversity, capacity building, linking various activity groups, extension support, establishing credit linkages, marketing, growth with equity and sustainable growth (Sathyanarayana *et. al.,* 2006).

NGOs have been contributing immensely towards various developmental programmes for livelihood creation in the rural and tribal areas of the country, due to their wider reach at grassroots level even in the remote areas. Their approach with target group is direct, emphatic, and closer to ground realities and as per the needs of the rural communities. NGOs enjoy certain functional advantages, being community based, more accountable and capable of providing services at a lesser cost. In a number of developmental activities, NGOs are either supplementing or complementing the efforts of the government Departments. Further, the process of social mobilization and development of people's initiatives can easily be achieved with the active support and involvement of NGOs. NGO promotes activity with a wholistic view such as group approach, technical tie-ups, marketing support, thrift and credit activities. Manoshi Mitra (1992) studied the association of NGOs with credit and technology transfer will reduce credit risk and increase the participation of the beneficiaries in accountability and performance. Further, in agriculture extension, NGOs have been playing significant role as indicated by FAO survey (**Table-1**).

It is further established that transfer of agricultural related technologies to farmers is more effective when the state (GO), non-governmental (NGO), and private (PO) sectors work in partnership Promoting partnerships and strengthening them through information obtained from in-depth periodical reviews greatly enhances small farmers' access to improved and relevant sustainable technologies, which is necessary to increase productivity and reduce poverty (Ojha and Morin, 2001).

Table-1: Distribution of Extension Organizations based on FAO Survey of 113 countries

No	Types of organisations	Percentage
1.	National and State governments	81.0
2.	Non-governmental organizations	7.0
3.	Parastatals	3.0
4.	Universities	2.0
5.	Private sector	5.0
6.	Others	2.0
	Total	**100.0**

(Source: Swanson et. al., 1990).

Role of NGOs in Sericulture Development:

Like in the case of any other livelihood creation activity, even in sericulture development, the NGOs can play a significant role through formation of Self Help Groups of the individuals, capacity building, building entrepreneurial abilities and establishing marketing linkages. Recognizing the contribution of NGOs in other developmental activities, though Central Silk Board (CSB) has roped in NGOs in sericulture developmental activities in implementation of National Sericulture Project, significant contribution was made by the NGOs in implementing UNDP assisted sub-programme for development of *Vanya* Silks in the States of Assam, Meghalaya, Nagaland, Bihar, Jharkhand, Orissa, West Bengal and Uttarakhand (Sathyanarayana *et. al.,* 2007). NGO-GO collaboration has become inevitable, mainly in the States / areas where the Department of Sericulture / Central Silk Board could not implement the schemes for want of extension network or manpower. Role of the facilitating NGOs is to elicit people's participation in Self Help Groups (SHGs) and federating them further. SHGs in turn will ensure regular savings, mobilizing credit, its repayment with role clarity and active participation of all the members (Mukul Prakash *et. al.,* 2004). Various authors emphasized role of NGOs and the need for NGO-GO collaboration for sericulture development in different states of the country (Somashekar, T.H. 2004, Babulal *et. al.,* 2006, Sharmila Ribeiro and Arunesh Singh 2004, Geetha Devi *et. al.,* 2006). One such collaborative initiative has been the Special Projects under special Swarnajayanti Gram Swarojgar Yojana (SGSY), with the financial assistance from the Ministry of Rural Development, Govt. of India in the States of Bihar and Jharkhand executed by the Central Silk Board and implemented by a Non-Governmental Organization, Professional Assistance for Development Action (PRADAN).

PRADAN – Creating Livelihoods:

Professional Assistance for Development Action (PRADAN) was established in 1983, under the Societies Registration Act governing charitable organizations, on the belief that individuals with knowledge resources and empathy towards the marginalized must work with poor people if mass poverty is to be removed proactively by expanding livelihood opportunities for poor people and getting caring and capable people on board to do so. PRADAN personnel promote livelihoods in diverse sectors, ranging from agriculture and natural resource management to rural enterprises. Internally, PRADAN has an elaborate human resource development programme that systematically recruits, trains and puts to work some three score university educated people as grassroots development workers every year to keep expanding its outreach.

About 30 Field teams, comprising of 6 to10 professional staff each, implement the livelihood promotion programmes. An experienced staff member designated as Team Leader heads each team. Eight senior staff members designated Programme Directors support several teams each and/or have organization-wide functional responsibilities, namely, Human Resource Development, Finance and spearheading various programme themes, and as members of an Executive Committee, assist the Executive Director in policy and institutional development. Presently there are 190 professional staff, about a third of them with over five years' grassroots experience, trained in reputed universities in India and abroad in technology, management, agriculture, social and life sciences and humanities. Another 60 staff provide office and logistical support.

Following an area saturation approach, PRADAN currently works with approximately 120,000 poor women (53% Scheduled Tribes, 14% Scheduled Castes, 29% Other Backward Castes, 4% other communities, including the minorities), about 90% of whom are organized into self help groups (SHGs) in 27 districts across seven States viz., Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Orissa, Rajasthan and West Bengal in the poorest regions of the country. Sectoral activities taken up to promote livelihoods include agriculture (cereal crops, cash crops, vegetables, horticulture), livestock (dairy, goat rearing, fisheries), forest/plantation-based activities (tasar silk worm rearing, shellac rearing and leaf plate making), integrated development of natural resources (livelihood-focused watershed development and small irrigation) and rural enterprises (modern commercial poultry, mushroom cultivation, tasar silk processing). Typically, PRADAN has to extend support for three to five years, albeit with declining intensity, before a poor family can carry forward the livelihood activity on its own. The extent and duration of support depends on the newness of the activity to the people and the place, the complexity of technology and linkages and the existential context of the household.

PRADAN leverages development finances from government agencies at the district, State and Central levels, banks and people's own resources, including savings by SHGs. Grants from donors constitute a miniscule proportion of development finances, and in conjunction with project-specific funds from government, are mainly used to meet costs of staff engaged in grassroots work, field operations, training of poor people, internal HRD, research and documentation and modest management costs and overheads.

It is PRADAN's endeavor to channelize programme investments from various public schemes and donors directly to village communities, their organizations and collaborating voluntary organizations, enhancing local capability to deal with resource agencies and reinforces PRADAN's identity as enablers rather than financiers of development. Initiatives of PRADAN are presently supported by Sir Ratan Tata Trust, Sir Dorabji Tata Trust, ICCO of the Netherlands, The Ford Foundation, Council for Advancement of People's Action and Rural Technology (CAPART) of the Ministry of Rural Development of GOI, UNDP, the Central Silk Board, the Government of Rajasthan, the Government of Madhya Pradesh, Government of Jharkhand, Government of

Chattisgarh, etc. It is the Founding member of Sa-Dhan, a network of organizations working on micro-finance (**source: *www.pradan.net***).
PRADAN works with socio-economically disadvantaged communities, such as adivasis, women, scheduled castes, the landless and marginal and small cultivators. Grassroots action to enhance livelihoods is PRADAN's primary focus. Improving the husbandry of natural resources and promoting or strengthening non-farm enterprises are the broad avenues PRADAN follows to enhance livelihoods. PRADAN's work includes:

- motivating and mobilising community members;
- identifying, adapting and promoting technology;
- mobilising resources;
- fostering functional mechanisms, including community organisation and external linkages;
- developing skills and capability of members of the community;
- experimentation and fostering mechanisms for sustained impact, growth and spread.

Special SGSY Projects in Bihar & Jharkhand – A Successful Collaborative Model:
The joint development initiative of the Central Silk Board and the Ministry of Rural Development, Govt. of India is being implemented by PRADAN, which is actively promoting tasar culture in the states of Bihar and Jharkhand for the past nearly two decades and also implemented UNDP assisted Project for tasar development. The NGO has adequate knowledge of the technologies involved, rural economics and the socio-cultural environment in the region. The Implementing Agency (IA) was assisted by CSB in identification of the Consultants/ Resource persons/ Trainers for the various training programmes.
The beneficiaries were from the below poverty line (BPL) families of rural poor mostly belonging to scheduled tribes, Schedule Castes and other weaker sections of the society who are traditionally involved in tasar culture. The selection of beneficiaries was done as per the norms listed under the SGSY. Special emphasis was laid on encouraging women to take active role in the project especially in the silk production activities like reeling, spinning etc. Efforts were made to establish backward and forward linkages from plantation to silk reeling with assistance from the project funds for development of tasar culture in all facets. Necessary support to produce quality Dfls by private graineurs was also provided and the required infrastructure to produce yarn was established in the form of Common Facility Centers (CFCs) under cooperative sector.
The activities of raising tasar plantations were taken up with inter cropping of Redgram (Tur dal) so as to generate additional revenue during the 3-year gestation period, wherever soil conditions were ideal. The implementing agency, PRADAN developed its overall operational and implementation strategy and organized the beneficiaries in to serviceable groups like SHGs, Women groups, rearers groups, reelers groups etc. and these groups are integrated to Cooperatives at different levels such as Block, District etc.
Project Execution & Management: Central Silk Board, being the Executing Agency (EA) closely monitoring the implementation of the project, extend all necessary technological support through the respective units of Central Tasar Research & Training Institute (CTR&TI), Ranchi on pre-cocoon aspects and Central Silk Technological Research Institute (CSTRI), Bangalore on post cocoon activities besides meeting the entire requirement of basic seed through the Basic Seed Multiplication & Training Centres (BSM&TC) located in the states. The Member Secretary of CSB was the Chairman of the Project Management Board (PMB). The funds received from the Ministry of MORD were maintained separately and released to the IA against the indent submitted through the Director, CTR&TI, Ranchi, and the Chairman of the Project Monitoring Committee (PMC). The PMB besides approving the yearly work plans as recommended by the PMC submitted periodical reports on the physical and financial progress to the MORD every quarter.
Project Implementation: The Project was implemented by PRADAN with its project office at Deoghar, Jharkhand. The IA through its field offices and units located in the project states implemented the projects as per the yearly work plans approved by PMB. Various committees such as Beneficiary selection committee, purchase committee etc. was constituted by IA. The strategy for implementation was drawn in association with the concerned Project Leaders in seed, pre-cocoon and post-cocoon sectors as well as Project Coordinator of CSB.

Project Monitoring: Project Officers in seed, Pre-cocoon and post-cocoon sectors assisted the Project Leaders with the help of Nodal Officers drawn from CSB field units in closely monitoring the activities besides providing requisite technological and technical support and assistance to the Implementing Agency in smooth implementation of the project and report the progress and provided feedback for reviewing and planning future strategies for implementation.

Achievements under the Special SGSY Projects: PRADAN has worked on various elements of the tasar value chain to reduce uncertainty, increase productivity and help poor people retain more of the added value, under these Projects. Key elements of its strategy are:

- Promoting scientific rearing practices to reduce diseases and mortality among silkworms
- Promoting hamlet level groups of rearers called Tasar Vikas Samitis to ensure their participation at every stage including raising of tasar host plants on privately owned wastelands.
- Promoting village-based tasar egg production centres called grainages, owned and operated by some enterprising tribal youth/ women in the village to earn a living.
- Promoting common facility centres in villages and a Producers' Company for women yarn producers.
- Demystifying technology and training cocoon and yarn producers to adopt improved technologies.
- Conducting motivational trainings to enable cocoon and yarn producers to attain entrepreneurial abilities and to set higher goals.
- Building linkages for material inputs, credit and marketing.

Many innovative ideas to bring in entrepreneurial approach among tribal rearers, youth and women are successfully implemented under the Special SGSY Projects in Bihar and Jharkhand. Achievements are depicted at **Tables 2-5**.

Table-2: Assets created under the Projects

Natural Forests with tasar food plants rejuvenated and maintained (Hectares)	10,000
Plantations of tasar food plants raised (Hectares)	1,630
Tasar Private graineurs promoted	360
Yarn Production Centres Created	56

Table-3: Impact of Tasar Silkworm Rearing

Particulars	Traditional method	Under the Projects
Cocoon Productivity (per dfl)	14	60
Crop duration (Days)	90	70
Individual earnings (Rs.)	3,000	16,000

Table-4: Income & Employment generation

Number of Sustainable Livelihoods	10,000
Annual Income Potential (Million Rs.)	100
Annual Income Earned (Million Rs.)	65
Wage Days Generated (Million days)	1.3

Table-5: Progress achieved by Private Graineurs

Particulars/ Year	2003	2004	2005	2006
Grainages in operation	243	317	360	360
Number of rearers supported	3,570	4,170	5,126	5,398
Cocoon production (million pieces)	29.6	20.4	30.5	32.5
Value of cocoons (Rs million)	23.8	30.0	26.0	45.5

In view of the recent collaboration of Government Organizations with NGOs, there is a need to augment the involvement of NGOs in sericulture development, in order to reduce the economic burden of government agencies, demands reviewing the strengths and weaknesses of NGOs.

Strengths of NGOs:

- They work much closer to the poor and disadvantaged sections of the society.
- Personnel of NGOs are normally highly motivated and altruistic in their behaviour.
- They can easily stimulate and mobilize community resources and have access to motivated manpower.
- They are more effective in bringing about people's participation.
- They are less rule-bound and are non-bureaucratic, non-formal and flexible in their structure and operations.
- They have a greater potential for innovation and prefer to work in a multi-sectoral framework.
- They act as catalysts for creating social cohesion (Kumar 1998).

Weaknesses of NGOs:

- Lack of experienced personnel on sericultural technologies and development with some of the NGOs.
- Lack of convergence and synergy in dealing with various Line Departments.
- Lack of appropriate standards of accountability and transparency in maintaining their integrity, in case of some NGOs.
- Inability of various NGOs involved in sericulture department to cooperate with each other in a way, which would allow for coherent policy making.
- Apprehensions about the motives and competence of NGOs may result in non- cooperation at field level and affect the sericulture development.

Strategy for NGO – GO collaboration for sericulture development:

1. Government Organizations, besides taking care of issues related to technology dissemination, markets, prices, demand and policies, needs to train their personnel in social science skills and recruit specialists or hire the services of professionals in these areas.
2. Capabilities of extension managers need to be improved to manage the process of change in public extension through well knit Human Resource Development Programmes.
3. A scheme for supporting NGO networks working for integrated sericulture development needs to be accommodated in the developmental schemes with role clarity in various activities of the NGOs vis-à-vis the State Departments with allocation for Administrative expenses to carryout their job effectively in the assigned areas (Randhawa, T.S., 2003).
4. Promotion of NGOs for implementing sericulture development Projects needs to be matched by corresponding shifts in the allocation towards their administrative expenses.
5. Mechanism needs to be derived to recover the costs of providing advice to the sericulturists out of profit margins by charging for extension services. However, the vulnerable groups need to be protected through targeted subsidies (Sathyanarayana et. al., 2006).
6. Predictably enough, it is the group-organizing and human resource development skills of NGOs, which have tended to complement the technical skills and facilities available with public extension. Hence there is a need to train NGO personnel in R&D institutions for technology awareness and vice-versa.
7. Most of the initiatives under many developmental Projects in spite of proper linkages do not sustain after the Project period (after withdrawal of assistance). To address this mechanism needs to be developed involving NGOs with minimal monitoring charges so that the activities will sustain even after withdrawal of project assistance.

In order to involve more number of NGOs for sericulture development, better NGO-GO collaboration strategies to simplify procedures/guidelines for funding NGO initiatives, capacity building of the voluntary sector, facilitate the inter-sectoral partnerships, promote the spirit of volunteerism and devise effective monitoring and evaluation of schemes implemented through voluntary sector need to be discussed and finalized at policy level.

REFERENCES

*1.*Babulal, Khatri R.K., Sharma A.K., and Jagdish Singh (2006): Sericulture Extension in Uttaranchal – Present challenges and prospects. *Proceedings of Regional Seminar on "Prospects & Problems of sericulture as an economic Enterprise in North-West India, Dehradun, India, 11 & 12th November 2006, p552-556.*

*2.*Gana Pati Ojha and Stephen R. Morin (2001): Partnership in agricultural extension- Lessons from Chitwan (Nepal). *Agriculture Research & Extension Network*, Network paper 21, pp 1-11.

*3.*Geethadevi, R.G., Dandin, S.B. and Kumaresan P. (2006): Effective Extension system for transfer of technologies in South India. *Proceedings of Regional Seminar on "Prospects & Problems of sericulture as an economic Enterprise in North-West India, Dehradun, India, 11 & 12th November 2006, p559-566.*

*4.*Manoshi Mitra (1992): Credit to poor women in the unorganized sector. *Proceedings of the National Workshop on credit to sericulture, Bangalore, 22&23nd May 1992, p128-143.*

5.Mukul Prakash, Bhagat Singh Negi and Bipin Chandra Pandey (2004): Extension methodologies and by-product utilization. *Proceedings of National Workshop on Potential and Strategies for Sustainable Development of Vanya Silks in the Himalayan States*, November 8-9, pp 48-60.

6.Randhawa, T.S. (2003): Final Report of Impact Assessment study of Fibre and Handicrafts Programme of United Nations Development Programme for Development of Non-Mulberry Silks, A Study by National Institute of Design, Ahmedabad, 2002-2003, pp 17.

*7.*Sathyanarayana, K., Mukund. V. Kirsur and Amarnath, S. (2006): Sericulture Extension: Status and need for private participation. *Presented during the Seminar on "Prospects & Problems of sericulture as an economic Enterprise in North-West India, Dehradun, India, 11 & 12th November 2006.*

*8.*Sathyanarayana, K., Mukund. V. Kirsur, Mohan Rao, K., Teotia, R.S. and Amarnath, S. (2007): Role of voluntary organizations in sericulture development. *Presented during the State Level Workshop on sericulture management, Bhubaneswar, Orissa, India, 15 & 16th March 2007, p 132-139.*

9.Sharmila Ribeiro and Arunesh Singh (2004): Product development and diversification of *vanya* silks in connection with market avenues. *Proceedings of National Workshop on Potential and Strategies for Sustainable Development of Vanya Silks in the Himalayan States*, November 8-9, pp 32-47.

10. Somashekar T.H. (2004): The possibilities and prospects for the development of the post-cocoon sector of *vanya* silks in Uttaranchal. *Proceedings of National Workshop on Potential and Strategies for Sustainable Development of Vanya Silks in the Himalayan States*, November 8-9, pp 29-31.

11. Swanson, B.E, Farmer, B.J and Behal. R (1990): The current status of Agricultural extension worldwide in FAO Report of the Global Consultation on Agricultural Extension, 4-8 December, 1989, Rome.

Cluster Approach for Sericulture Development in Kerala – A Success Story

By

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ABSTRACT

There is increasing evidence in all the developing and developed countries that small enterprises can boost their competitiveness through networking, and that this process is easier and more sustainable if the firms are situated and work very closely with one another in clusters. The Government of India has been promoting the Cluster Approach for integrated development in rural areas. It is found to be true even with the sericulture development in India. The need for integrating the efforts of Central Silk Board, State Govt., NGOs, SHGs and other agencies through synergic effect for development of the cluster has been emphasized. Keeping in view the various on-farm and non-farm activities carried out by various agencies in isolation and required backward and forward linkages, common facilities and integrated approach for sustained development, need for creating a sericulture cluster is discussed. Ideal cluster map indicating the possible approach for the development of sericulture and its long term sustenance has been drawn. Modalities of identification of potential clusters, feasibility study of various activities based on the status, defining the role clarity of various agencies involved in sericulture development, monitoring and evaluation system are discussed which would be pooled together in the form of a systematic project for the integrated development of sericulture. Involvement of NGOs and their role as cluster development agent in organizing and developing network among different SHGs for effective coordination is also discussed. Details of the Cluster Development Projects implemented through the Central Silk Board Field units involving local NGOs in Agali, Chenganur and Nilambur clusters of Kerala and their progress are discussed. Based on the experience, future strategies for such initiatives are suggested.

Key words: Cluster approach, Sericulture development, NGOs, Future strategies

INTRODUCTION

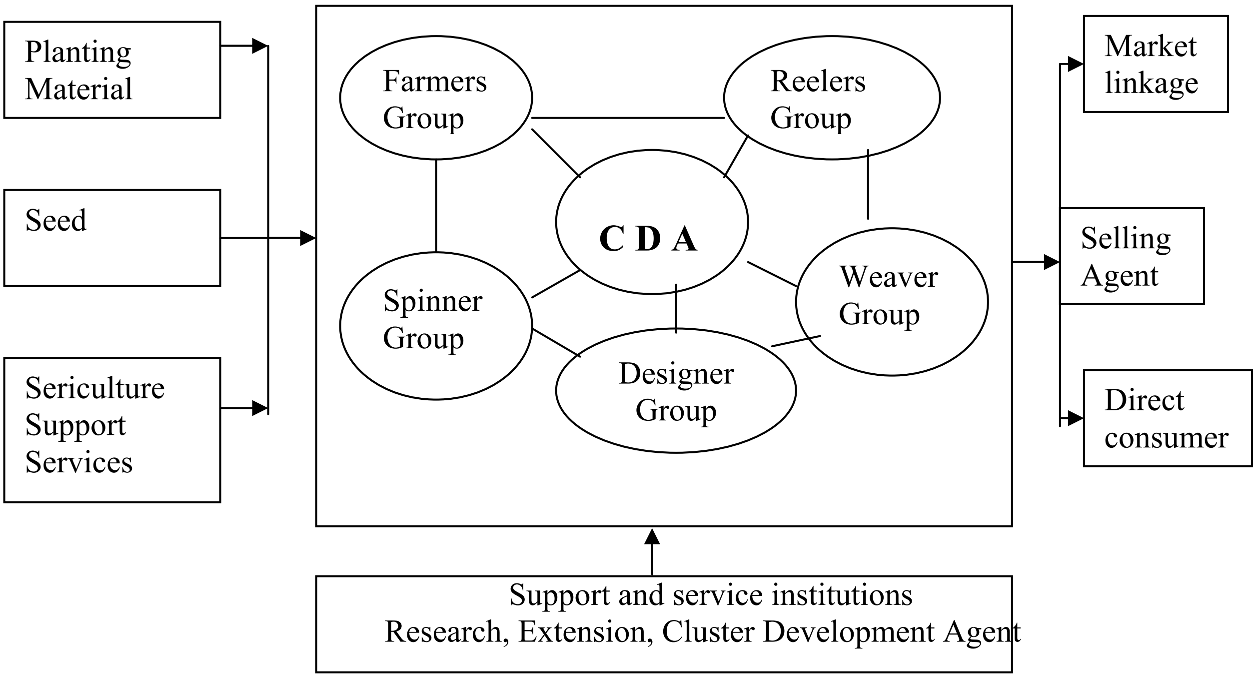
Kerala, a small State in the south-west corner of India is popular as 'God's Own Country' with diversified terrain. The highlands sloping down from the Western Ghats have major plantations like tea, coffee, rubber, cardamom and other spices. The midland, lying between the mountains and the low land, is made up of undulating hills and valleys, with intensive cultivation of cashew, rubber, coconut, areca-nut, cassava (Tapioca), banana, rice, ginger, pepper, cocoa, sugarcane and vegetables. The lowland or the coastal area is made up of the river deltas, backwaters and the shore of the Arabian Sea is essentially a land of coconuts and rice with fisheries and coir industry constituting the major industries.

Mulberry can be cultivated in all the above three regions and mulberry sericulture plays an important role in improving the living standard of the marginal farmers, landless labourers and women folk from rural areas besides stopping urban migration of rural unemployed youth. Central Silk Board introduced Sericulture during 1989 under World Bank and SDC (Swiss Agency for Development and Cooperation) assisted National Sericulture Project as a part of Western Ghat Development Project in Palakkad and Idukki districts, which was extended to other districts under Kerala Khadi & Village Industries Board. Sericulture remained only as a subsidiary occupation and is practiced as a sort of mixed or inter crop with other traditional cash crops. Uncertain availability and high cost of labour, high rainfall and high humidity affecting cocoon quality thereby reeling parameters have been major constraints for sericulture growth. In spite of all the constraints and setbacks due to lack of marketing and extension facilities, cocoon production reached 101.29 MT of bivoltine (CSR) hybrids. Cluster approach followed for the development of sericulture in the State of Kerala, is one of the major factor for this achievement.

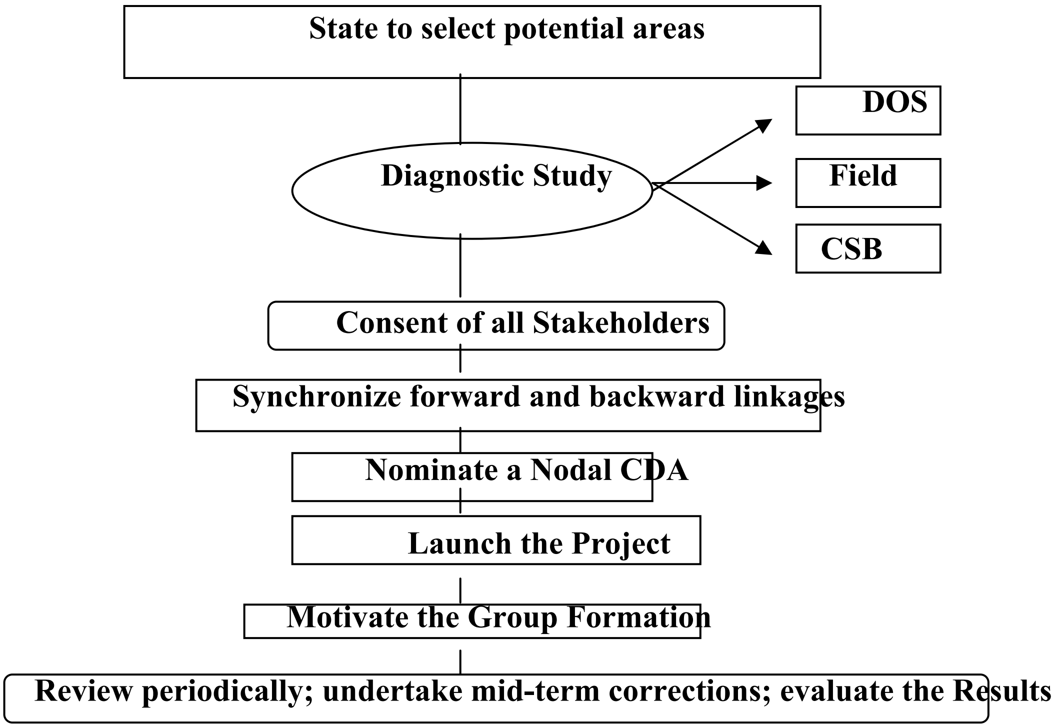
Cluster Approach for Rural Development: Cluster is a group of geographically bounded concentration of related activities functioning together in-order to derive enhanced competitive advantage (or collective efficiency) through the development of closed relations and linkages (activities) by way of sharing, collaborating to meet a particular market demand. There is increasing evidence in all the developing and developed countries that Small and Micro Enterprises (SMEs) can boost their competitiveness through networking, and that this process is easier and more sustainable if the firms are situated and work very closely with one another in clusters. Government of India had announced the launch of a National Programme for Rural Industrialization to give a boost to integrated rural development and rural industrialization, including sericulture. The objective of the programme is to reduce urban rural disparities and to provide benefit to rural artisans and unemployed youths to check urban migration. Rural industrialization calls for integrating efforts of various governmental agencies to achieve necessary co-ordination of governmental efforts at the field level.

Need for Cluster approach for Sericulture Development: Sericulture is a group of many on-farm and non-farm activities carried out by various agencies in isolation. The sericulture industry needs many backward and forward linkages, common facilities and integrated approach for sustained development. There are many developmental agencies supporting sericulture and there is no satisfactory coordination among these agencies. The Cluster Development in sericulture would ensure that all schemes of Government of India and State Government for sericulture and silk industry development reach beneficiaries in the identified clusters. With this kind of cluster approach, the technical innovations can be disseminated systematically to improve the production and productivity. This is an ideal approach for development of sericulture in a planned way. The cluster development also creates interest among other farmers to take up sericulture, mainly due to the reason that from the start of development of mulberry plantation till post-cocoon activity, support and constant guidance is given by the implementing agency to the farmers. The cluster development programme brings awareness among the beneficiaries about the latest technologies developed by Central Silk Board / State Departments. The project plays a major role in sustained development of sericulture as it develops networking among the farmers and helps them to work collectively with increased efficiency. Sericulture cluster development centers are meeting all the requirements of the cluster farmers viz., Dfls supply, technical supervision, supply of proper critical items for sericulture, linking all governmental programmes especially of local self governments for sericulture development and are acting as reliable office for all their sericulture needs. While starting cluster activities the condition of farmers can be compared to an infant who needs regular care, consideration and training to develop into a fully grown up self sufficient individual. Ideal cluster map for sustainable sericulture development is indicated below:

Commercial service providers
CRC, Disinfectants, Equipment supply,
Drying chambers, Institutional finance etc.



A brief methodology of cluster approach in sericulture is detailed below.



MATERIALS AND METHODS

Keeping the above objectives in view, available activity groups in sericulture and directions given by the Ministry of Textiles, Central Silk Board (CSB) with the help of SERIFED, Kerala identified clusters in Nilambur (Malappuram district) and Chengannur (Alleppey district) for development of sericulture, during X Plan. During the year 2004-05, one more Cluster Development Centre (CDC)

was initiated at Agali (Palakkad district) through Attappady Hill Area Development Society (AHADS), an NGO, as implementing agency.
The Project is implemented in Kerala state by Central Silk Board through Cluster Development Centres established in three agro climatic zones viz., low land (Chenganur), middle land (Nilambur) and in high land (Agali). The critical areas for development of mulberry sericulture includes propagation of high yielding mulberry verities, providing drip irrigation, construction of separate rearing houses, supply of modern rearing equipments, assured supply of quality disinfectants and cocoon quality testing and grading equipments, recycling of sericulture byproducts etc.. Besides the above, training of the implementing staff and the stake holders for effective implementation and transfer of technologies to the farmers are also taken up under the Project.

The entire activity was focused to small geographical areas of 30-35 Km radius covering 3-6 gram panchayaths in each cluster. The target groups were nursery entrepreneurs, mulberry cultivators and silkworm rearers. The beneficiaries were organized into small homogeneous groups (SHGs) of manageable size from each pocket for easy implementation. This has been a successfully coordinated activity of different agencies like Research units of CSB, Seed Production units of National Silkworm Seed Organization (NSSO) of CSB, State Government agencies, NGOs, local self-government, through a single window to give synergic effect, with well knit backward and forward linkages. Some of the issues considered and included in the clusters are as detailed below.
Mulberry Varieties: Introduction of improved mulberry variety Victory-1 (V1) through Kisan nursery in place of K2.
Plantation System: Paired raw system (90+150) cm x 60cm facilitating the mechanization of intercultural operation was introduced in place of existing spacing of 90cm x 90cm.
Construction of separate rearing house: Rearing shed to create a micro-climate ideal for silkworm rearing, with sufficient space for leaf preservation, chawki rearing, late age rearing, mounting and convenient to carry out effective disinfection were provided to the beneficiaries under the Project.
Supply of Rearing Equipments for shoot rearing: Shoot rearing with use of modern rearing equipments such as shoot rearing, rack, improved mountages etc. was introduced in place of conventional tray rearing to enhance the rearing capacity, cocoon quality and productivity of the crop besides reducing labour cost by 40%, used for leaf plucking, feeding and mounting.
Supply of quality disinfectants: Quality disinfectants along with other critical inputs were made available and supplied from the cluster centers to the farmers at cost price.

Market support: In order to tackle the cocoon marketing problem, cocoon quality testing and grading equipments were supplied and quality linked cocoon procurement centers were established in each clusters under the Project.

Human Resource Development: Project personnel were trained in the Project issues, technical, managerial and extension methods besides motivational aspects. These frontline workers from different agencies in turn trained the beneficiaries in their respective activities.

Monitoring and Evaluation: To guide the sericulture farmers in the cluster, Joint Action Plan was prepared well in advance, by the Cluster Level Committee involving CSB experts, Department of Sericulture, extension staff of Non-Governmental Organizations (NGOs) and SHGs connected with project. Regular field visits were conducted for crop inspection. Observation books were supplied to farmers for recording and follow the observations made by the technical staff during their field visits. A well laid out monitoring and evaluation system, with fortnightly meetings of cluster staff in the cluster centers for evaluating the field observations/ experiences of the technical personnel is followed. State Level Cluster Committee meetings are also conducted on a regular basis for evaluating the progress and to remold the Action Plans. The Cluster Development Agent (CDA) is the main coordinating agent and the cluster development center (CSB unit) is the nucleus for all the development activities required for the sustained development of cluster, closely monitored from CSB Head Quarters.

Books, pamphlets and guidelines on bivoltine sericulture technologies in local languages were made and distributed to the Project beneficiaries for better understanding. Modern gadgets like TV, DVD, Digital camera and personal computers were provided to the clusters for effective monitoring and extension work. A number of Enlightenment Programmes, Field days, Study tours, Group discussions, workshop, Seminars were also organized in the clusters.

RESULTS AND DISCUSSION

This initiative of Cluster approach for systematic and sustainable sericulture development has received encouraging response besides economic development of the farmers. The high literacy level of the farmers of Kerala helped to easily absorb and adopt the high end sericulture technology packages required for producing good quality cocoons with higher levels of productivity. The Project achieved development in terms of new plantation, Dfls supply and cocoon production and productivity, thereby enabling the poor and weaker section of society to attain regular income and employment opportunities. The implementation was based on a participatory approach involving SHGs and Kutumbashri (Kutumbashri is successful Community Building concept adopted in the entire State of Kerala through Panchayat Raj Associations). Proper adoption of sericulture technologies by the farmers of the cluster is an important factor for achieving high yield and income generation. This was achieved by the combined and synergetic effort of different agencies. The role and responsibilities of each agency was clearly entrusted and monitored in the Project. High rate of adoption was noticed in most of the technologies, such as improved mulberry, planting system, construction of separate rearing houses, modern rearing equipments, CSR hybrid rearing, shoot rearing system, disinfections and hygiene besides converting sericulture farm residues for composting and vermicomposting.

The Dfls supply and cocoon production increased from 12,080 to 67,420 and 4.697 MT to 31.146 MT, respectively over a period of five years. The share of CSR bivoltine hybrid cocoon production in the clusters rose from 14.13% at the start of the Project to whopping 30.75% at the end of the X Plan Period (2006-07).

Graphical representation of cluster-wise farmers covered, mulberry acreage covered under V1, number of dfls reared and cocoon produced is furnished at Tables 1 to 4 below.

Table-1: Farmers covered under Cluster Development Programme in Kerala

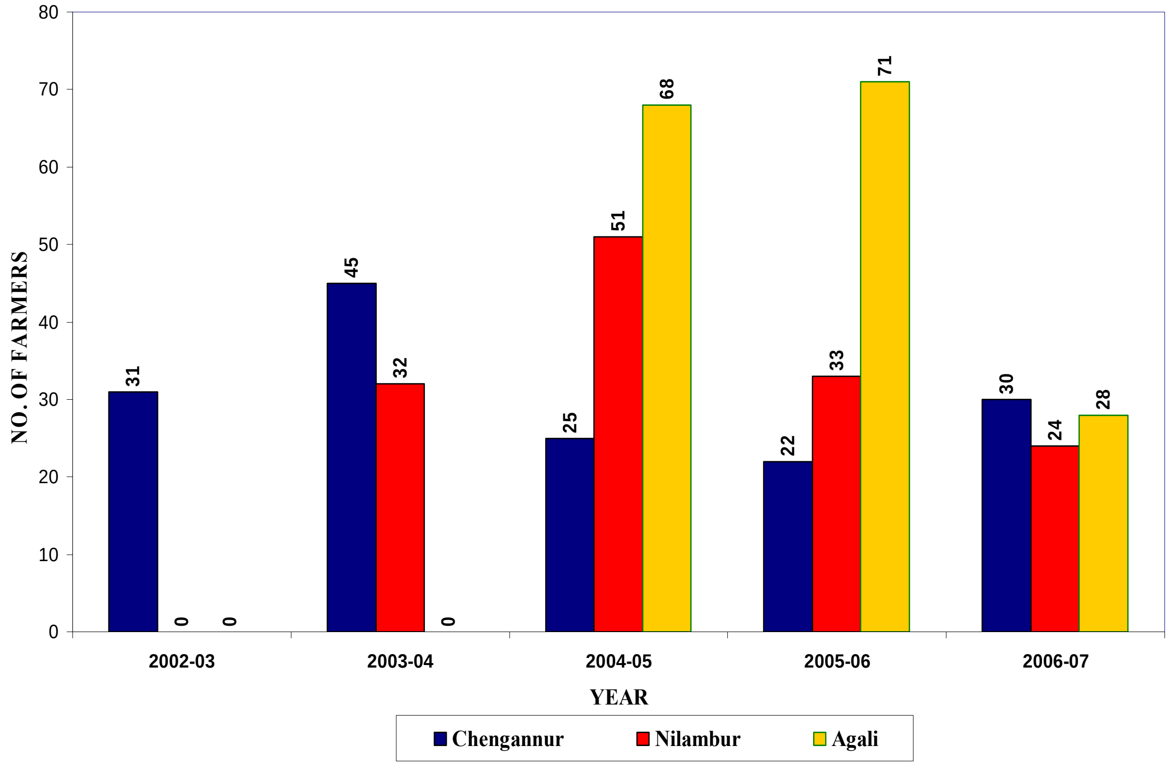


Table-2: Mulberry Acreage raised under Cluster Development Programme in Kerala

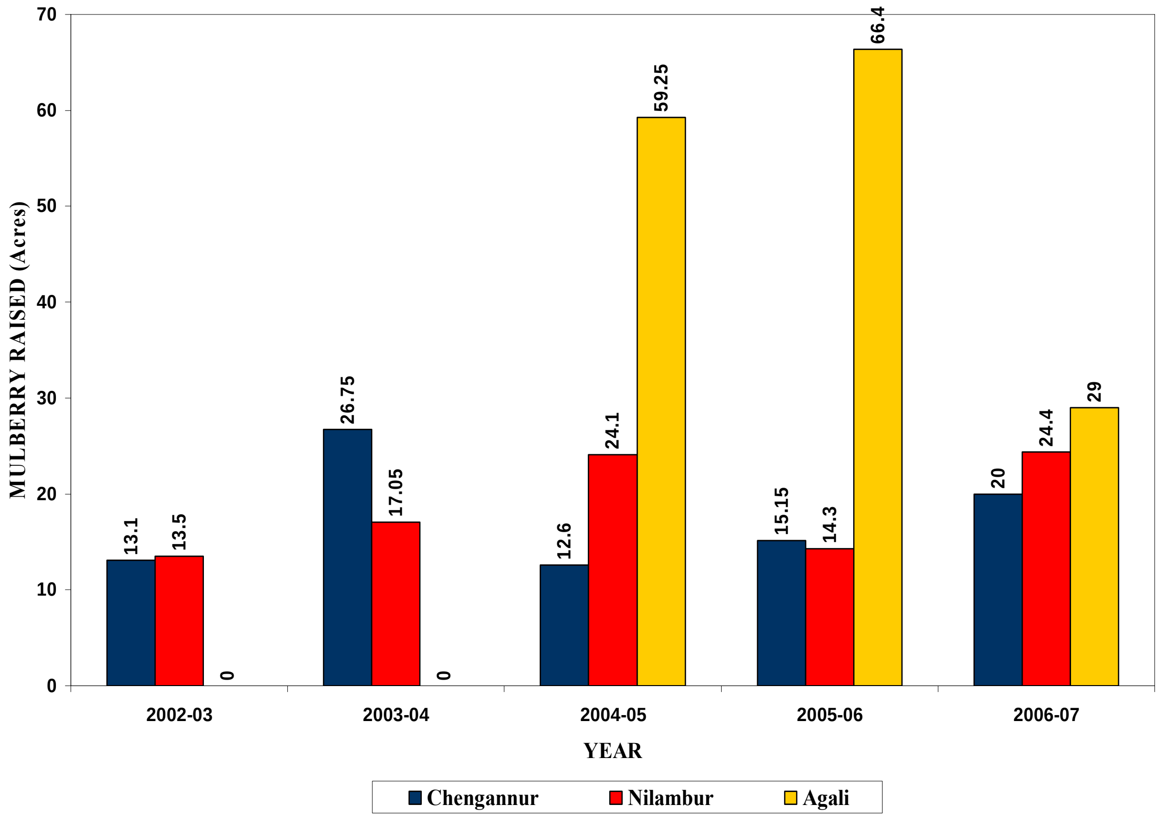


Table-3: No. of Silkworm Dfls reared under the Cluster Development Programme in Kerala

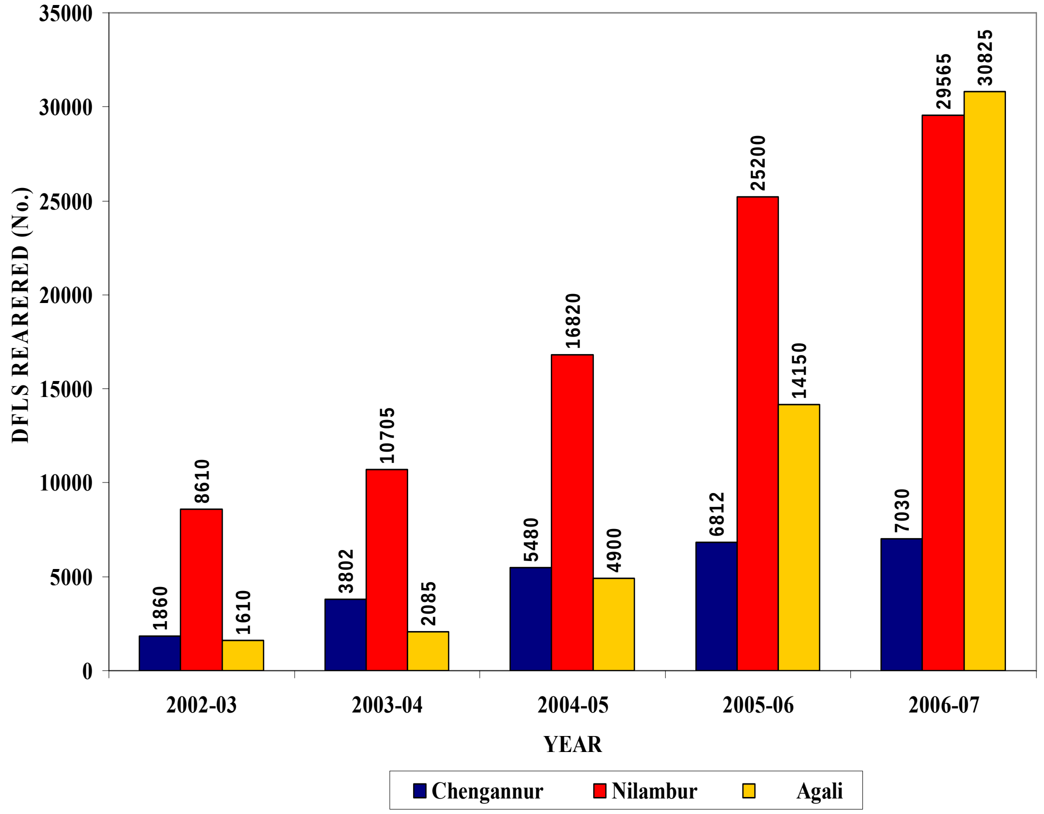
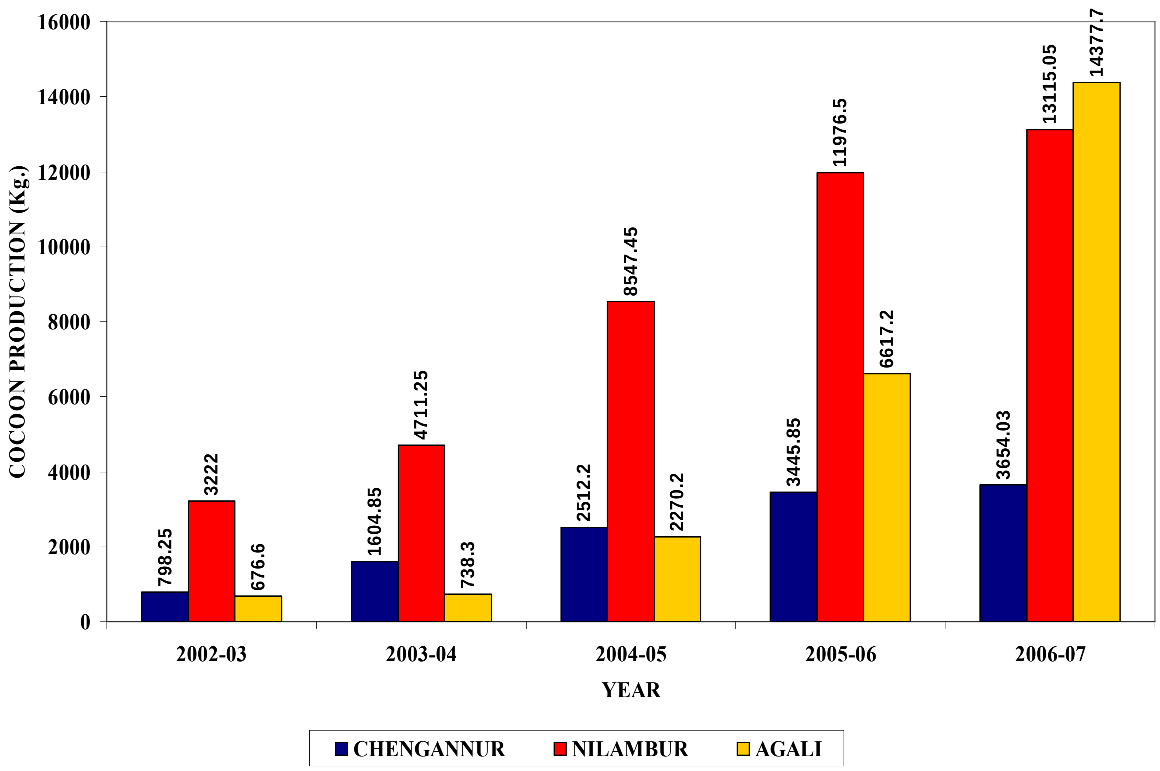


Table-4: Cocoon Production under Cluster Development Programme in Kerala



Impact of Cluster Development Project in Kerala:

- Acreage under V1 plantation has increased and the farmers have accepted the concept of V1 nursery and plantation to replace the old K2 gardens.
- Separate rearing houses were constructed for better yields with the new CSR bivoltine hybrids.
- Complete switch over from tray rearing to shoot rearing method to save the labour by following thorough disinfection and other technologies.
- A single window approach from cluster development centers for quality Dfls, critical inputs, proper technologies and marketing of produce have boosted the morale and confidence of stake holders.
- The cluster approach and the regular contacts between the farmers facilitated interactions among them which lead to sharing of experiences, rearing patterns and other facilities leading to a healthy competition.
- The modern demonstration equipments like pruning saws, cuttings preparation machines, power sprayers, flame guns, deflossing machines etc., which were available in the clusters (for demonstration purpose) were used by the farmers and slowly they started using them regularly by procuring such equipments themselves.

Success stories from clusters:

1. *Name of farmer*: Sri._K.M. Raveendran, Venmony, **Chengnanur**
Year of Planting: January 2003 *Area*: 0. 50 acres *Variety*: V1

Year	***Dfls*** **reared**	**Dfls/ Acre/ Year**	***Actual cocoon*** **Yield (Kg.)**	**Actual return (Rs.)**	**Yield/100 dfls (Kg.)**	**Cocoon Yield/acre per year (Kg.)**
2003-04	150	300	75.550	11268	50.36	472
2004-05	515	1030	345.750	52583	67.13	628
2005-06	540	1080	55429	55429	66.77	655
2006-07	610	1220	408.720	63760	67.00	743

2. *Name of farmer*: Sri. C.C. Johnson, Chungathara, Nilambur
Year of Planting: 2003 October *Area*: 0.50 *Variety*- V1

Year	***Dfls*** **reared**	**Dfls/ Acre/ Year**	***Actual cocoon*** **Yield (Kg.)**	**Actual return (Rs.)**	**Yield/ 100 dfls (Kg.)**	**Cocoon Yield/ acre per year (Kg.)**
2004-05	**415**	**830**	**261.600**	**39641/-**	**63.036**	**523**
2005-06	**575**	**1150**	**393.400**	**70411/-**	**68.417**	**787**
2006-07	**875**	**1750**	**692.400**	**114039/-**	**79.130**	**1385**

. ***3.*** *Name of farmer*: Sri.K.EASWARAN, Cheerakadavu, Agali**.**

Year of Planting: 2004 October *Area:* 1.00 Acre *Variety*: V1

Year	*Dfls* reared	Dfls/ Acre/ Year	*Actual cocoon* Yield (Kg.)	Actual return (Rs.)	Yield/100 dfls (Kg.)	Cocoon Yield/acre per year (Kg.)
2004-05	135	270	77.750	10782/-	57.60	77.75
2005-06	1025	2050	605.500	101587/-	59.07	605.50
2006-07	1050	2100	622.400	102472/-	59.30	622.40

Future Strategies: Scope for development of sericulture in the State through cluster approach in project mode can be very promising and vibrant, if the following areas are properly addressed.

- Increase in Dfls intake from existing level of 400 to 800 per acre/year
- Increase in the productivity from existing 50 kg/100 dfls to 60 kg/100 dfls.
- Extension of mulberry plantation to an additional area of 150-250 acres in each cluster.
- Strengthening of extension and technical support.
- Strengthening of the marketing system by open cocoon markets whenever each cluster achieves self sufficiency in marketing.
- Better co-operation among Central, State staff and concerted effort to achieve the goal of sustainable and profitable sericulture.
- Identification of more NGOs, formation of more SHGs and their involvement in the scheme.
- Introduction of chawki rearing concept through SHGs/ co-operatives under technical guidance of CSB.
- Skill up gradation of beneficiaries and project personnel through regular trainings.
- Federation of Sericulture - Self Help Group (SHG) in a Cluster into to a Sericulture Cluster Group (SCG) and facilitate the SCG to access credit from formal Banking channels to take up various Sericultural activities. SCG – Bank linkage programme have proved to be the major supplementary credit delivery system with wide acceptance by Financial Institutions, NGOs and various Government Departments. These efforts would help to make the Sericulture Cluster self sustainable in the longer run.

Women in Sericulture – Hopes Galore

By

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ABSTRACT

The contribution of women in sericulture in India since ages, particularly in some of the critical areas is more of result of her innate attachment with the process of producing the best - the Queen of Textiles- and had been unarguably more than a cliché. Studies figured her involvement at 53 to 70% in different sectors of industry and sincere efforts were made under the first ever ambitious sericulture project – the National Sericulture Project, the Indo-Swiss Project, SERI-2000, Catalytic Development Programmes of Central Silk Board under different Plan Periods and Swarna jayanthi Grameena Swarozagar Yojana (SGSY) Projects financed by the Ministry of Rural Development, Govt. of India. As a result of such efforts the number of women stake holders is on a steady increase in the recent years, which perhaps is an indicator of the gradual acceptance of their contribution towards family income and decision making - by the society. That is why sericulture is fast becoming an important WID (Women in Development) and is attracting the attention of the developmental agencies.

Yet, with all this said and done what remained far from realization is the sustainable development of her persona with more of realistic, holistic and consistent approach- her involvement in marketing, decision making, utilization and investment i.e., management of funds, adoption of integrated technologies among others. To facilitate her achieve, an increased and assured involvement now, the need to quantify the achievements vis-à-vis the targets envisaged has become a matter of concern and utmost consideration. We ought to learn from the past experiences that suggest devising a frame work of equitable and sustainable development of her participation on a consistent basis; institutionalizing the mechanism of monitoring the implementation of various schemes and Projects placing her dues appropriately.

Keeping in view the involvement of women in sericulture and silk industry, their present status in society and need for their empowerment, strategies to be incorporated in the various developmental initiatives are suggested..

Key words: Women in Development, *Vanya* silks, Sustainable development Women exclusive programmes,

INTRODUCTION

India has a rich heritage of silk .In fact, it has been intermingled with the very culture and traditions of the country. Ever since *Hsi-ling shi* discovered silk (2640 B.C.), women have assumed a significant role in the development of silk and silk industry. In India out of about six million people involved in sericulture and silk related activities, women constitute about 53% of those employed in downstream activities of sericulture. Their participation is about 57% in case of silk reeling, spinning and weaving. Besides, they are full time house wives also - attending to all the domestic works!

Sericulture has been fully recognized as an important rural industry in India and also else where and is mainly practiced as a household industry. It is a labour intensive, export oriented industry, generating high employment and income per unit area of land. One hectare of mulberry plantation under irrigation generates about 13 persons, annually in mulberry cultivation, silkworm rearing, silk reeling, twisting, and weaving. Nearly 60 percent of people employed in this industry are women. (Prabha Sekhar and Ravi Kumar 1988). Sericulture has several advantages that encourage women to go for it. Some of them are:

- Needs minimum investment, education, technical know how and physical energy
- Involves more of indoor activities. In fact it provides *in situ* employment
- Work is spread through out the day with enough leisure time in between
- Rearing of silkworms is a delicate job that needs motherly care and patience which are inherent qualities of women
- Provides continues employment with frequent and reasonable profit margins
- Even landless women can take up activities like silkworm rearing, reeling, twisting, dyeing, printing, weaving etc.
- There is a big scope for utilization of byproducts wherein women can involve

Opportunities for women in sericulture

In case of mulberry sector, about six million people have been engaged in various activities of the industry of which involvement of women is more than 53-57 %. But with all such impressive statistics, ironically women are always neglected and their hard work is not given due recognisation. Their participation is not even appreciated."Women in India have been generally considered as 'Home makers' but not as those who also work for a livelihood to support their families. Women also form more than half of all agricultural labour in India. Although, most Indian rural women spend 16 to 18 hours a day working at home and outside, their importance in the development of the family has not been fully recognized and appreciated.(Prabha Sekhar and Ravi Kumar 1988). But, different Women studies have proved beyond doubt that women's contribution towords sericulture is quite significant. Women contribute to the family income through sericulture to a great deal" (*Mrudula Reddy and Kamalamma 1999*). " If the rural households are to be made economically viable self-sustaining units the employment and income generation by rural women need to be given utmost priority". (Prabha Sekhar and Ravi Kumar 1988). Studies conducted at Institute of Social &Economic Change(ISEC) Bangalore, by *Acharya et al.* under the Beneficiary Assessment Programme of National Sericulture Project (1989-96) have also addressed the issues and come out with meangful remedial measures.

Even in case of *Vanya* Silk sector, (*Tasar, Oak tasar, Eri* and *Muga*) which is forest based and being practiced in forest belts of North Eastern States, parts of Chhattisgarh, Madhya Pradesh, Bihar, Jharkhand, Orissa and Central Himalayan belt, the people involved are mostly tribal and socially backward communities.Here, women play a major role in various activities of sericulture right from egg production to weaving. Their work mainly involves collection of cocoons, rearing of worms, reeling and weaving. In case of *eri* and *muga,* spinning/weaving is entirely done by women. In states like Assam, weaving is a prerequisite for brides. The problems faced by women in *vanya* sector are no way different than in the mulberry sector and need more or less similar approaches.

Table-1: Income generating employment opportunities in sericulture where women are actively participating

I	Mulberry Cultivation	1. Nursery / Sapling raising 2. Planting 3.Cultural operations like weeding 4. Leaf plucking
II	Silkworm Rearing	1. Egg production. 2. Chawki (young age) rearing. 3. Late age rearing. 4. Cocoon harvesting, cleaning & sorting.
III	Silk Reeling	1. Cocoon cooking 2. Reeling : a. Charkha b. Cottage basin

		c. Multiend 3. Re-reeling 4. Twisting
IV	Weaving	1. Warp making & Pirn winding 2. Weaving : a. Hand looms b. Power looms 3. Dyeing 4. Printing
V	By-product utilization	1. Silk spinning 2. Dupion reeling 3. Cut cocoon handicrafts
VI	Sericulture dependent activities	1. Silk and milk production 2. Sericulture and Pisciculture 3. Bamboo craft.

Gender bias –the root cause

But Why women in sericulture are neglected?, Why their contribution is not duely recognized? Why women are less paid than men? why this bias? The root cause for all these problems appears to be gender bias. The term "gender" is used to describe a set of qualities and behaviour expected from men and women by their societies. Gender relations in India (as almost everywhere else) are patriarchal - that is, they reflect and perpetuate a hierarchy where women are subordinate to men. Women's subordination is reflected in inequality and differences between women and men within the family and community, as well as in all social, economic, cultural and political interactions and relationships between people. Patriarchy makes women powerless in many ways - by convincing them of their own inferiority to men; by demanding that they conform to certain stereotyped `appropriate' roles and behaviour; by denying them control over their own lives and labour; by limiting their access to resources and by restricting their opportunities to participate in decisions which affect their own lives.

It is apparent that developmental efforts especially in sericulture and silk sector, in all these years, by and large have not particularly addressed this subordination and gender bias. Most of the main stream approaches towards women development have not been based on analysis of the over all reality of women's life but have focused on their roles as mother, house wife and the like.

The earlier approach "let them participate" did not let them involve in decision making in vital areas. Besides, here the terms were decided by others. The emphasis later shifted to targeting women through separate *women only* projects though many of such projects were quite innovative and catalytic, they were small, isolated and under funded. Naturally their impact was not long lasting. Though in cases where women's components have been included in large mainstream projects, the objectives and priorities were seldom influenced and responded to women's needs and concerns. Now it is come to an understanding and acceptance that the gender inequality is not the result of women integrity or lack of integration in development or their lack of skills, credit and resources. The root cause of the problem lies in the social structure, institutions, values and beliefs, which create and perpetuate women's subordination.

Efforts done so far in the important areas

During 1989-96, Central Silk Board and major silk producing states of the country addressed several issues of women in sericulture. With major projects like World Bank and Swiss Development Co-operation assisted National Sericulture Projects focused mainly on overall development of women through sericulture. Several science and technology organizations were engaged to study the gross root level problems being the bottle necks in the techno- economic empowerment of women under the plethora of social constraints. Some of the main issues addressed were;

a. Access to land, credit and other family assets through formation of women groups

Formation of women groups to derive mutual benefits was found very successful. Two clusters (*Pandipathri* and *Elikatta* in Andhra Pradesh) involving 39 to 60 women sericulturists, respectively were selected for the study. These groups were given access to government *patta* land; provided with community rearing house; irrigation facility; credit was organized through banks; training programmes conducted and access to marketing was also provided. Studies in these two clusters provided useful information and these clusters became the repetitive models. In fact, it was proved that for better self employment on the on-farm activities formation of women group was found to be highly successful.

b. Technical awareness and skill development

After identifying the crucial aspects of technical requirement of various Sericultural activities and enlisting women oriented technologies and work requirements, organizations like Central Sericultural Research and Training Institute, Mysore, Central Silk Technological Research Institute, Bangalore, Karnataka State Sericulture Research and Development Institute, Bangalore were asked to develop ways and means towards reduction of drudgeries and fatigue. Special training programmes for the women entrepreneurs, camp training and demonstrations were organized. Para extension workers were employed and made to work with women groups at grass root levels. Such programmes proved quite successful in the technical empowerment of women entrepreneurs

c. Access to credit

As success of most of the entrepreneurs depends on the initial capital investment which is directly linked to guarantee and security, for most of the women sericulturists' access to capital investment was almost impossible task. To overcome this constraint, group guarantee on mutual trust basis was assured; a joint ownership of the required land / house was suggested. Input supply arrangements were created for the women through bank guarantee.

d. Access to marketing and marketing awareness

Realization of their hard efforts in the form of cash returns appears to be the biggest incentive and attraction to make women more self reliant. Special sections were opened in the major cocoon markets of Karnataka; they were given sufficient awareness about the market activities / transactions, about cocoon quality *verses* prices; women supervisors were employed to help women rearers in marketing.

e. Malady Remedy approach to address occupational hazards

Except in reeling and grainages all other sectors in sericulture have more or less no health problems. In reeling, the major problems complained are *Asthama,* blisters, burning of eyes etc. As expert committee comprising of a doctor was constituted to study the situation and give remedial measures; smokeless *chulas*, multi fuel oven, soft and clean water; proper drainage; good aeration; using foot wear etc., were suggested as remedies. Periodical health checkups were arranged. These measures have brought down the risk to a significant extent.

According to the XI plan Sub group report on sericulture, the important areas to be tackled are:

- Change of perception while planning, researching, implementing or evaluating programmes
- Providing exclusive marketing services for the women, both in on-farm and non- farm sectors
- More women to be brought into extension services
- Methodologies, time duration, locations and other factors of training programme design have to be designed to the needs of the women.
- The micro finance for the women in silk industry needs serious revamping with new set of terms and conditions and the role of the intermediaries and subsidized interest rate.
- Create a mechanism to access land, decision making opportunities, and entrepreneurship
- Sensitization of policy planners, grassroots level workers, scientists on women empowerment
- Special care for physically challenged women, SC/STs and Widows

- Improvement in machineries suited to women workers and greater incentive for women beneficiaries
- Introduce alternate energy resource wherever possible
- Long term measures to tackle health hazard problems
- Single window system for women beneficiaries

Table3.Under the Catalytic Development Programmes(X plan,) the following schemes were taken up for covering women entrepreneurs

Sector	No. of schemes	Coverage of women (%)
Mulberry	1. Supply of Rearing appliances/farm equipment 2. Assistance to drip irrigation 3. Supply of quality disinfectants 4. Construction of rearing houses 5. Construction of CRC buildings and procurements of Chawki rearing equipments	30
Tasar	1. Augmentation and maintenance of Tasar/oak tasar plantation 2. Support to private graineurs	30
Eri	1. Augmentation of eri food plants with training and startup tools	60
Muga	1. Augmentation of Muga food plants 2. Support to Muga private graineurs	30
Post Cocoon	1. Supply of multiend silk reeling machines 2. Quality service clubs 3. Providing Mater reelers, weavers and Dyers to States 4. Installation of Common Facility Centers for Mulberry 5. Installation of Common Facility Centers for Non-Mulberry 6. Support to agencies for upgradation and popularization of improved reeling and spinning devices	30 30 30 30 70 70

Subsequently, the following women oriented schemes were taken up under the Additional inputs to the Catalytic Development Programme during the X Plan.

1. Scheme to dissuade Child labour with use of Improved Technologies
2. Common Facility Centre for Yarn Processing
3. Promotion of improved Handloom developed by CENTRAL SILK BOARD
4. Setting up of Common Facility Centre for Vanya Silk yarn processing linked to mechanized spun silk system
5. Assistance to NGOs/ Cooperative Societies/ Self Help Group towards administrative expenses

Frame work for sustainable development

Although the NSP period witnessed commendable initiatives in the form of implementing exclusive programmes for women and intermittent interventions during the subsequent Plan period, the programmes it appeared were not aimed for a sustainable development on a consistent basis; though, most of the schemes aimed for certain percentage of women participation, there is no target

set nor any physical progress available as such. In the absence of a mechanism available to monitor the welfare of women in the industry, the women development in sericulture, it appears could not attain to devise a framework of equitable and sustainable development on a consistent basis.
The need therefore is to move from integrating women into existing development approaches, providing them with a frame work of equitable and sustainable development. The issue here is not merely 'adding on' women to various processes but of reshaping these processes to create the space for women's involvement not only in implementing the developmental agenda but also in agenda setting it self. This involves the reshaping of developmental targets to reflect the visions, interest and needs of the women. As women and poor together form the majority of the India's population, the perspectives and experiences of poor women can be a major source of transformation of the way in which we understand development. In fact, in countries like India, the economic status of rural women may be accepted as an index of the social development and the progress of the country Thus, gender mainstreaming becomes the main strategy for addressing development in silk sector

Table-2 : Extent of women involvement in various aspects of sericulture.(Study conducted in Karnataka)

Sl. No.	Activity	No. of Dist. Covered	No. of villages	No. of families involved	% of women
1.	Mulberry cultivation	07	14	422	49.55
2.	Silkworm rearing	07	14	422	49.67
3.	Egg production	10	14	082	20.46
4.	Silk reeling	06	13	392	48.81
5.	Silk throwing	04	06	096	56.34
6.	Silk weaving	06	12	267	49.02
7.	Dyeing - printing	04	06	071	41.00
8.	Bye-products	01	08	050	65.00
9.	Silk & Milk production	04	15	300	75.00
10.	Silk spinning (Only in West Bengal)	02	20	200	80.00
	Total / Avg.	**51**	**122**	**2302**	**53.45**

Source: Surveys conducted by Karnataka State Sericulture Research and Development Institute, Bangalore; ISEC, Bangalore; and Avinash Lingam Institute for Home Science.

Future Strategies

Based on the experience gained from the past experienses, Central Silk Board has chalked out certain strategic approaches. The proposed strategies have been grouped into a three pronged approach, so that the sectoral requirements are taken care of at appropriate levels. They are (1) General guidelines (2) Exclusive women oriented programmes/schemes and (3) Integrated approaches for taking up women exclusive projects

General Approach
Some of the important general approaches are:

- ❖ Creation of women development cells in Central Silk Board and DOSs to coordinate and monitor the participation of women to ensure that they get their due share
- ❖ Increased subsidy to women participants under different schemes can be considered
- ❖ Empowering women in decision making areas ensuring their participation
- ❖ Making available the industrial sheds of the industry departments to the women entrepreneurs

- ❖ One or two other suitable avocations can be identified which can compliment sericulture and *vice versa* like silk and milk in mulberry sericulture, forest development project and tasar culture, waste land development with sericulture etc.
- ❖ Imparting gender sensitization programmes for policy makers, scientific and technical personnel
- ❖ Establishment of sericulture equipments and supply centers through women groups

Women Exclusive Programmes

Some of the important Women Exclusive approaches are:

Sericulture technology parks for women can be opened for providing information creating awareness, training and providing forward and backward linkages through single window approach

- ❖ Establishment of women technical service centers (WTSC) introducing
- ❖ strengthening health insurance schemes for women workers
- ❖ Conducting training programmes like trainers training programme, peripatetic training at gross root levels, entrepreneurship training etc., for women sericulturists
- ❖ Facilitating access to land to women sericulturists by changing the land titles in favour of women
- ❖ Subsidised credit facility for women
- ❖ Establishment of women *chawki* centres (WCC)
- ❖ Providing special marketing facilities to women in cocoon markets, Sunday bazaars etc.
- ❖ Create special market *niche* for the products made by exclusive women groups/women entrepreneurs
- ❖ Setting up of sericulture stores, start up expenditure
- ❖ Providing and improving the basic amenities for women like rest rooms, toilets, crèches etc., in cocoon markets, reeling, twisting, weaving units etc.
- ❖ Giving vide publicity to women programmes / projects and their achievements through print and electronic media
- ❖ Instituting best women sericulture award at *taluka*, district, state and national level
- ❖ Women Year in Sericulture 2008-09

III. Integrated approaches for taking up women exclusive projects

There must be recognition of the fact that working with poor women requires much more time and investment than is possible under a time bound limited budget scheme, but projects that are long term and programmes that are consistent for longer periods have to be taken up. And also projects that can integrate two or three avocations popular among the women would be more effective. interventions

interventions

Such recommendations backed by the special emphasis being laid by the union and state governments on gender issues, once find their place in the developmental schemes, are sure to bring in the much awaited change for the women in sericulture, and empower them to enjoy their economic and social independence, a reward rather over due for her untiring efforts and sacrifices in making and managing her home and the country as well.

REFERENCES

1. Approach paper on Women Empowernment in Sericulture for inclusion in the XI Plan (2007) Central Silk Board
2. Ravi Kumar and Prabha Shekhar(1988) *Role of Rural Women in India Sericulture,* Proceedings of the International Congress on Tropical Sericulture Practices, (February 18-23, 1988 Central Silk Board p. 65)
3. Geethadevi, R.G., (2007) 'National Seminar on Technology Awareness for Women Sericulturist' Indian Silk May 2007 p. 24 – 25.
4. Special Issue on Women in Sericulture Indian Silk 1994

Vanya silks of India – Exploring New Horizons

By

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ABSTRACT

In India, while the mulberry sericulture is practiced as a commercial venture, non-mulberry silks or wild silks or vanya silks are adopted by tribals as a subsidiary occupation. This is due to the thought process of tribals who rear vanya silks, treating vanya culture just as livelihood opportunity and not as a commercial venture. In spite of possessing ideal biosphere to produce all five varieties of commercially exploitable silks i.e., Mulberry, Tasar, Oak Tasar, Muga and Eri in India, their true potential still remains unexploited. Vanya silks remained obscure for a long time as an exclusive craft of tribal and hill folks inhabiting the Central and North Eastern India, which neither assumed importance nor attracted attention till recent times. The rich production potentialities within the country, abundant availability of host plantation, steady demand of the products outside, eco-friendly nature of the production and processing activities of vanya silk industry, natural colour of vanay silks, participation of rural populace in different stages of vanya culture, promoted commercial exploitation of this craft, which culminated in the transformation of this age old tribal tradition to an industry of immense potentiality. Brief history of vanya silks and their distribution in India is discussed along with the progress through various Developmental Plan periods, support provided by Central Silk Board, Government of India for the development of vanya sector. Production trends, area under food plants of vanya silkworms, status of vanya seed sector, marketing of vanya products, R&D strategy in vanya sector and constraints, export of vanya silk products are also discussed. Various initiatives by Central Silk Board, Government of India with its own and external funding towards exploring the true potential of vanya silks for empowering the tribal populace of the country are discussed. Strategy for future development of vanya silk sector in various areas of technology transfer, seed sector, human resources development, product development and design, market promotion etc., are suggested.

Key words: *Vanya* silks, Tribals, Plan Periods, Initiatives, Strategy

INTRODUCTION

Natural silks are broadly classified as Mulberry and Non-Mulberry silks. While the mulberry sericulture is practiced as a commercial venture, Non-mulberry sericulture, popularly known as wild or vanya sericulture are practiced by the Tribals and other backward communities as their livelihood option. Table-1 indicates the vanya silks exploited commercially, in India.

Table-1: *Vanya* silks of India – An Overview

Silkworm Variety	Entomological name	Primary Food Plants		Distribution
		Local	Botanical Name	
Tropical tasar	*Antheraea mylitta* D.	Arjun Asan Sal	*Terminalia arjuna* *T.tomentosa* *Shorea robusta*	Central India and Southern Plateau Region
Oak tasar	*Antheraea proylei* J. *A.roylei* Mr.	Uyung	*Quercus serrata* *Q.incana* *Q.semicarpifolia*	Sub Himalayan region and North Eastern India

Eri	*Cynthia samia ricini* Bsd	Kesseru Castor	*Heteropanax fragrans* *Ricinus communis*	North Eastern Region, Bihar, Andhra Pradesh, Orissa, Madhya Pradesh
Muga	*Antheraea assamensis* Ww.	Som Sualu	*Machilus bombycina* *Litsaea polyantha*	North Eastern Region

Vanya sericulture remained obscure for a long time as an exclusive craft of tribal and hill folks inhabiting the Central and North Eastern India. It is in the recent past that this tribal tradition assumed importance and attracted attention at National level. The rich production potentialities within the country, steady demand for vanya silk products outside, eco-friendly nature of the production and processing activities, women participation, promoted commercial exploitation of this craft, which culminated in the transformation of this age old tradition to an industry of immense potentiality.

History of *Vanya* Silks in India: *Vanya* silks have been commercially exploited way back in 17th Century. The Western World gained an appetite for these alien shaded silks in mid 1800 when a rampant silkworm disease destroyed the European sericulture industry. Asia could not supply enough mulberry silk to cater to the needs of Europe and Noth America, thus creating a market for *vanya* silks.

Tasar: Though there is no recorded document available regarding the origin of tasar in India, one can find the mention of tasar silk in ancient epic Ramayana "Rama's nuptial gift to Sita includes tasar silk". Temperate tasar is of recent origin and was introduced during mid 1960's.

Muga: The silk of Assam (Muga) was made known to the World during 1662 through a famous European traveller Jean Joseph Tavenier. Sericulture was exempted from payment of land revenue as the Kings of Assam patronised the development sericulture. Around 1950, there was a great earth quake in Upper Assam and the large number of muga plantations was destroyed, which hampered the growth of muga industry.

Eri: The word eri means castor plant, is derived from the word "eranda" of Sanskrit origin. The advent of ericulture is lost into the antiquity but, the fact remains that Assam was the original home of eri silk from time immemorial, with the earliest reference documented in 1779. The Britishers called it as "Palma Christi" silk. The eri silk was woven into heavy clothes known as "Bar Kapoor". Captain Jenkins (1771) remarked that eri silk was of incredible durability.

Distribution of the *Vanya* Silk Industry in India:

Tasar: Tropical Tasar growing area forms a distinct belt of humid and dense forest sprawling over the Central and Southern plateau, covering the traditional states of Bihar, Jharkhand, Madhya Pradesh, Chhattisgarh, Orissa and touching the fringes of West Bengal, Andhra Pradesh, Uttar Pradesh and Maharashtra. Temperate tasar (oak tasar) extends from the sub-himalayan region of Jammu and Kashmir in the West to Manipur in the East covering Himachal Pradesh, Uttarakhand, Assam, Mizoram, Arunachal Pradesh and Nagaland.

Muga: Assam accounts for more than 95% of the muga silk production. The culture is also spread in different districts neighbouring Assam in Meghalaya, Nagaland, Manipur, Mizoram, Arunachal Pradesh and West Bengal.

Eri: Eri culture was mostly confined to the Brahmaputra valley of Assam in the tribal inhabited districts, followed by Meghalaya, Nagaland, Mizoram, Manipur and Arunachal Pradesh. Ericulture is introduced on a pilot scale in States like Andhra Pradesh, West Bengal, Bihar, Madhya Pradesh, Orissa etc.

Progress of *Vanya* sector through Plan Periods:

I Plan (1951-52 to 1955-56): Sericulture did not find a separate place in the First Plan which was included in the "Other Village Industries". Central Assistance was made available to the states through the Central Silk Board as grants/loans for the implementation of specific approved schemes. There was no commendable progress achieved under the *vanya* silk sector as this sector did not find a distinctive place in the plan programmes of the Government.

II Plan (1956-57 to 1960-61): During the Second Plan period, 339 developmental schemes were implemented which included few schemes exclusively for the development of *vanya* silk sector in the Central India and North Eastern Region.

III Plan (1961-62 to 1965-66): Emphasis was given to vanya research and basic seed production. Board has established Central Tasar Research Station at Ranchi (Bihar) and Central Tasar Seed Station at Lakha (Madhya Pradesh). Improved reeling and spinning equipments were introduced for reeling and spinning of tasar and muga cocoons. Spun silk mill was set-up in Jagi road (Assam) under public sector for the economic utilisation of muga and eri silk waste. Central Silk Board (CSB) has initiated necessary action to provide price support for tasar cocoons.

IV Plan (1969-70 to 1973-74): Research and seed organisations were further strengthened. Emphasis was given for the development of oak tasar. Regional Tasar Research Stations were established at Batote (Jammu & Kashmir), Bhimtal (Uttar Pradesh) and Imphal (Manipur). Eri and muga research unit at Titabar (Assam) was taken over by the CSB and the same was re-organised into a full fledged a Research Station. Raw Material Bank was established at Chaibasa (Bihar).

V Plan (1974-75 to 1977-78): Four tier tasar seed multiplication system was launched for the production of quality tasar silkworm seed, with a net work of Central Tasar Research and Training Institute (Elite seed), Central Tasar Silkworm Seed Station (nucleus seed), Basic Seed Multiplication and Training Centres (BSM&TC –basic seed) under CSB and Pilot Production Centres (PPC – commercial seed) under the State sector. One more spun silk mill was set up at Bhagalpur in Bihar under State sector.

VI Plan (1980-81 to 1984-85): Inter State Tasar Project (ISTP) was implemented under Indo-Swiss Technical Co-operation Programme in 8 tasar producing States, under which 7850 ha. of tasar block plantation and other infrastructure facilites for seed production, storage and reeling were developed. A Muga Seed Development Project (MSDP) was launched in North Eastern region to produce quality muga seed. Muga Raw Material Bank was established at Sibsagar, Assam to provide necessary price support to muga producers. The Central Silk Technological Research Institute (CSTRI) was set up at Bangalore to tackle the research problems of post cocoon technologies. The Central Eri and Muga Research Station, Titabar was reorganised with separate Regional Stations for Muga and Eri Research at Boko (Assam) and Mendipathar (Meghalaya), respectively. Two sub-depots of Raw Material Bank (RMB) for tasar were established at Raigarh (M.P.) and Bhagalpur (Bihar). Seven oak tasar BSM&TCs were set up in North Eastern Region besides establishing a Regional Extension Centre at Bir in Himachal Pradesh.

VII Plan (1985-86 to 1989-90): The follow-up phase of ISTP was implemented in the states of Orissa and Maharashtra to provide necessary infrastructural facilities such as Seed Production Centres, Reeling Units, Nurseries, Seed Rearers Co-operatives, Weavers Co-operatives etc, besides developing systematic tasar crop plantation. Eight Demonstration Cum Training Service Centres (DCTSC) in *vanya* sector were established in 7 tasar producing states and Assam to provide necessary training and demonstration in *vanya* sector. PPCs were strengthened with necessary equipments to produce quality tasar silkworm seed.

VIII Plan (1992-93 to 1996-97): Other Developmental Plan (ODP) schemes addressing seed production, marketing of tasar and eri cocoons, base line survey of tasar host plants, development of nature grown tasar cocoons (Raily) in Madhya Pradesh, survey, augmentation of tasar, muga and eri food and product development & diversification, DBT (Department of Biotechnology) collaborative research projects on muga, exchange of Scientific manpower and germ plasm material with the Chinese non-Mulberry Research Institutes and organising Basic Tasar Silkworm Seed Organisation (BTSSO) at Bilaspur were the major initiatives.

IX Plan (1997-98 to 2001-02): "Third International Conference on Wild Silk moths" was organised at Bhubaneshwar, Orissa during 1998. Catalytic Developmental schemes (CDP) for augmentation and maintenance of Vany Silk host plants, up gradation of seed multiplication infrastructure, training and supply of start-up tools, support to graineurs for quality seed production under private sector and for popularisation of improved reeling/spinning devices were implemented with the joint participation of the State Governments besides implementing special projects for Oak tasar seed multiplication in North Eastern and North Western Region, development of modal eco race in Similipal biosphere of

Orissa, UNDP assisted sub programme, sericulture Development Project in Manipur and Chhattisgarh with financial assistance from Overseas Economic Co-operation Fund (OECF), Japan.

X Plan (2002-03 to 2006-07): In addition to continuing the Catalytic Developmental schemes (CDP) during IX Plan Period, new schemes like setting up of Eri Raw Material Bank (ERMB), Eri Silkworm Seed Organization (ESSO), scheme to dissuade child labour with use of improved technologies, support for byproduct utilization were implemented besides establishing Vanya Silk Market Promotion Cell (VSMPC). Even the Mininstry of Rural Development has funded two projects under Special Swarnajayanti Gram Swarozgar Yojana (SGSY) in the States of Bihar and Jharkhand for development of tasar and eri silks.

Status of *Vanya* Seed Sector in India

The major bottlenecks for the tardy performance of *vanya* sector are poor performance of seed multiplication facilities and non-availability of adequate disease free commercial seed.

Tropical Tasar: There is a four tier seed multiplication system with CTR&TI supplying the elite seed to Central Tasar Silkworm Seed Station (CTSSS), Lakha which multiplies for one generation and supply to BSM&TCs for further multiplication. The BSM&TCs further multiply and supply the basic seed to Pilot Production Centres (PPC) of the State Government. To bridge the existing gap between demand and supply, private graineurs have been roped in for production of commercial seed. Under special SGSY Projects in Bihar and Jharkhand, even rearing of nucleus seed by Adopted Seed Rearers and basic seed production by grainer groups were successfully taken up.

Oak Tasar: Paucity of quality silkworm seed and lack of adequate extension support system have been the main constraint for oak tasar development, though it has potential in North-Eastern and North-Western States where abundant oak flora is available. Regional Tasar Research Station (RTRS) and one oak tasar grainage in Manipur and three Research Extension Centre (REC)/BSM&TCs in the States of Assam, Nagaland and Manipur were established to fulfil the seed and extension requirement. In the North-Western region, RTRS at Bhimtal (Uttarakhand) and REC at Palampur (Himachal Pradesh) were established.

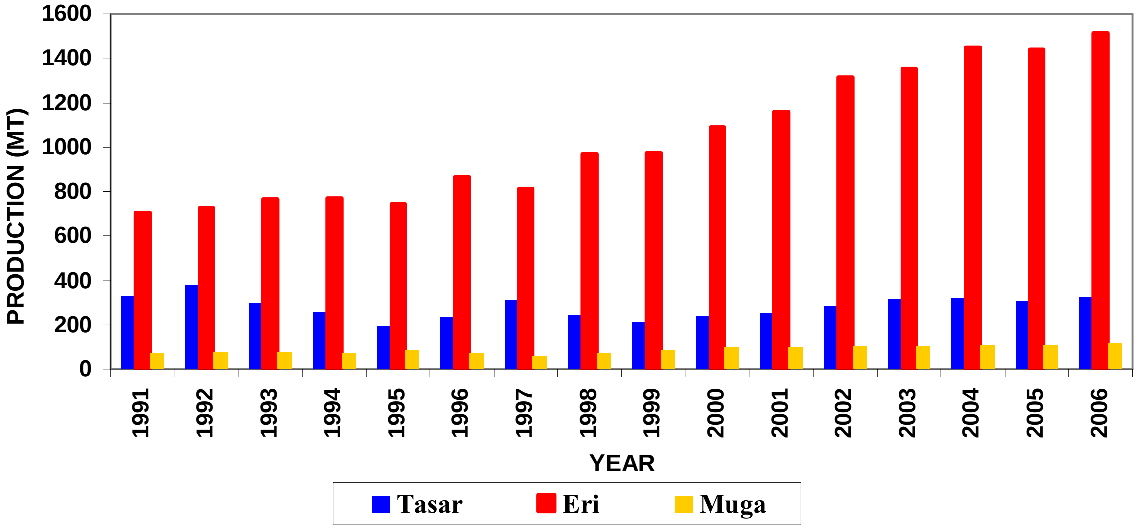
Muga: The P4 and P3 basic seeds are managed by the CSB while, P2 layings are prepared by the State Government and P1 layings by private rearers. Under MSDP, 2 P4 and 7 P3 muga basic seed stations were established under Central Sector which are now reorganised into 2 P4 units, 5 P3 units and 2 commercial seed production units to augment muga seed production in addition to 10 P2 seed centres under State sector.

Eri: By and large eri silkworm rearers usually prepare their own layings. The CSB has established one Silkworm Seed Production Centre (SSPC) for Eri in Assam. State Governments have established grainages and seed production centres to supplement the requirements. There are around 154 Government Eri seed production centres in the NE States. Eri Silkworm Seed Organization (ESSO) was established supported by Eri SSPCs to cater needs in seed sector.

***Vanya* Silks – Status Review**

1. Production trends: Of the total raw silk production during 2006-07 (18775 MT) vanya silk constitutes 10.4% (1955 MT). Of the total *vanya* production, Eri, Tasar and Muga silks are 77.5%, 16.6% and 5.9% respectively. Production trends of *vanya* silks for the last fifteen years are detailed below at **Table-2**.

Table- 2: Production Trends of *Vanya* Silks in India



Vanya silkworms are exposed to vagaries of nature and the yield also fluctuates depending on the environmental conditions. In addition, lack of systematic seed multiplication, marketing, socio-economic factors like migration of tribals and other weaker sections from their natural habitats to towns and cities, introduction of more attractive schemes and avocations based on horticulture, forestry etc., are also causes for fluctuation in the production despite large quantities of available natural resources, in the form of food plants. *Vanya* silk production which was around 254 MT during 1950 gradually increased to 1955 MT during 2006-07 registering about 8 fold increase over 5 decades.

2. Area under Food Plants: There is practically no systematic plantation of food plants for conducting *vanya* silkworm rearing, till recent times. While tasar silkworms are reared on food plants available in the forest, muga silkworm rearings are conducted on food plants in forests/ village grazing reserves etc., and eri silkworm rearing is largely conducted indoors with the leaves collected from trees growing in wild or from backyard plants in North-east. In other States, castor and tapioca raised for the oil seed and tuber production respectively are being utilised for eri silkworm rearing. CSB's research institutes have introduced the concept of raising and maintenance of systematic plantations of food plants of vanya silkworms to enhance the quality production and productivity, which is being included while implementing the developmental Projects/ Schemes. As on 2006-07, tasar, muga and eri food plants were reproted to be cultivated to the extent of 144073, 60979 and 9600 hectares, respectively.

3. Marketing of cocoons and silk: Though the marketing of *vanya* cocoons in general and tasar cocoons in particulars is monoploised by the cocoon traders, in the last two decades establishment of Raw Mateial Banks (RMB) in vanya sector by CSB and State government marketing agencies viz., Development Corporation of Vidharbha Limited (DCVL), Sericulture Federation (SERIFED), Khadi Village Industries Commission (KVIC), Tribal Federation (TRIFED) etc., have helped in marketing. Establishment of these agencies has resulted in improvement in the bargaining power of cocoon producers. Particularly in tasar and muga sectors organisation of bidding markets for cocoons and rolling credit support small reelers / weavers will be helpful as lack of differentiation between the reeler and the weaver in non mulberry sector is a viability factor which can be strengthened.

4. Export of *vanya* silk products: The share of export earnings by *vanya* silk products was to the tune of Rs. 174.65 crores (5.4%) at the end of the X Plan period .

5. R&D Achievements in *vanya* sector: Following achievements are made in R&D area of *vanya* sector (Dayakar Yadav, 2007).

Tasar: CSB's Central Tasar and Research Institute at Ranchi with its network of 8 Regional Tasar Research Stations and 10 Research Extension Centres is catering to the research needs of temperate and tropical tasar. Research highlights of Tasar sector during X Plan are given below -

- A package by combining various micro-nutrients mixture was developed for increasing leaf yield of tasar food plants.

- Biological control of stink bug (*Canthacona furcellata*) through egg parasitoids like *Psix striaticeps* and *Trissolcus spp*., combined use of nitrogen fixing bacteria and phosphor-bacterin and control of gall insect (*Trioza fletcheri*) by a plant based pesticide Azadiractin were tested successfully.
- Twenty two colours and shares were developed using lac dyes with various mordnats.

Muga and Eri: Central Muga & Eri Research and Training Institute at Ladoigarh, with its Regional Research Stations at Boko (muga) and Mendipathar (eri) and four Research Extension Centres is undertaking research in various aspects of muga sector. Important achievements made by these units are -

- *Polu Rog Nivarak*, a larval disinfectant to control muga silkworm diseases, 'Muga Guard', a chemical formulation against bacterial diseases of muga silkworm and 'Bani', a muga reeling machine were developed.
- Som and mulberry intercropping method, integrated cropping system of castor and kesseru plantation, four tetraploids of som host plant were evolved.
- Exploration studies were conducted for collection of various ecotypes of vanya silkworm from different parts of the country.
- Integrated eri silkworm package was developed with all the tested technologies.

R&D Constraints: *Vanya* sericulture has some serious disadvantages viz., slow growing food plants which do not easily multiply through vegetative propagation, out door silkworm rearing hazards, non-availability of productive and true breeding silkworm races, apart from an efficient silk reeling mechanism. A high degree of heterogeneity in the ecotypes is coming in the way successful silkworm breeding programme over last thirty years. Interspecific hybridisation to evolve productive breeds with different voltinisms to incorporate economically important genes viz, egg diapause, fertility restoration etc. found distributed in different species of *Antheraea* into a commercial breeds is of immediate need.

Strategy for development of *Vanya* silks

Approach for XI Plan (2007-08 to 2011-12): It is proposed to produce 420 MT of tasar silk, 190 MT of muga silk and 2390 MT of eri silk by the end of the XI Plan period i.e., 2011-12. Following is the approach suggested for development of vanya silks in India.

- Mapping and selection of potential areas in association with the State Departments.
- Implementation of developmental Projects/ schemes by adopting a Project mode and cluster approach for organizing various inter-linked groups with well developed forward and backward linkages with region specific practices, clear goals, measurable targets, resources and time schedule.
- The beneficiaries will be organized to homongenous Self Help Groups (SHGs) of manageable size taking help from the reputed Voluntary Service Organizations for availing credit from financial institutions and other institutional support.
- Various Committees will take up the responsibility of planning, monitoring and executing Project components at Field Level, District Level, and State Level for effective implementation of the Schemes.

Bench Marks for Vanya sector during XI Plan: Keeping in view the technological interventions in the Vanya sector and their successful transfer in the field, certain productivity and quality parameters have been set as bench marks during XI Plan period as indicated at **Table-3**.

Table-3: Bench Marks for Vanya sector during XI Plan Period.

Parameters/ Plan Period	Unit	TASAR		MUGA		ERI	
		X	XI	X	XI	X	XI
Dfl to Dfl ratio		1:4	1:8	1:3	1:7	1:40	1:45
Dfls/ Ha.	No.	225	400	1500	2000	550	1000
Cocoon yield/ Dfl	No.	35	55	50	60	0.07 kg	0.09 kg
Standard norms to produce 1 kg silk							
No. of cocoons	No.	1800	1800	5500	5500	1.4 kg	1.4 kg
Raw Silk	Kg.	1	1	1	1	--	--

Ghicha/ spun	Kg.	0.4	0.4	0.8	0.7	1	1
Fabric/kg	Mtrs.	11	11	11	11	6	6

Food Plants

There is a need to develop systematic food plantation in vanya sector for improving the quality and productivity. Propagation of tasar food plants under social forestry schemes of the Ministry of Forestry and Environment, allotment of usufruct right of plantation to tribals and implementation of schemes to augment vanya food plant availability (block plantations and chawki gardens), through propagation of seedlings with the help of the Local Gram Panchayats, Forest Protection Committees, Forest Departments, SHGs, NGOs, rearers group etc.

Seed sector

Required support would be provided for nucleus seed production in tasar, strengthening of Eri Silkworm Seed Organizationn with required number of Silkworm Seed Production Centres in eri sector, strengthening of existing P4, P3 and SSPCs of Muga Silkworm Seed Organization is planned besides supporting State Farm cum Grainages, private graineurs and Seed rearers to meet the increased seed demand in vanya sector.

Marketing

Besides continuing support for quality linked price support system for dfls, cocoon and yarn in Vanya sector, Vanya Silk Marketing and Promotion Cell (VSMPC) has been established with collaborative projects with National Institute of Fashion Technology (NIFT), National Institute of Design (NID), Army Institute of Fashion Technology (AIFD), Tirpur Exporters Association (TEA) to under take market survey, develop new products based on market demand and changing fashion trends. Vanya silk shops at New Delhi and Bangalolre provide network and market support to the NGOs producing vanya silk from interior parts of the country besides organizing workshops in different parts of the country as a part of 'Brand promoting exercise' for the vanya silks.To facilitate ensured availability and supply of vanya cocoons through out the year to the reeelers and weavers, cocoon banks will be established under cooperative sector.

Research

The *vanya* research requires concentrating on prioritisation in the development of resources between several research needs. Evaluation of suitable technology packages for various stress conditions, farmer input constraints, quality up-gradation, and product development and transfer of technology needs to be prioritised. The research efforts need to focus on the following areas.

- Develop and standardize commercially viable clonal propagation techniques for important perennial primary food plants of *vanya* silkworms.
- Develop *in situ* soil health and *in situ* conservation systems.
- Standardizing rain water harvest and *in situ* conservation systems.
- Develop improved protected rearing techniques for young instars of tasar and muga silkworms.
- Survey, collection and characterization of genetic variants if any, especially among muga and eri silkworms which can be utilized in breeding programme.
- Conserving endanged or dwindling eco-races which are not amenable to human handling but the cocoons of which were collected for silk production through public partnership.
- Improvement of reeling techniques to increase productivity per unit human power.
- Improvement in the texture of filament to provide a soft texture to it.

To meet the human resources requirements, various initiatives like Farmers' Field Schools and Skill and knowledge enhancement of scientific personnel through regular training, participation in National and International Seminars, Workshops etc., are planned. Further, gender sensitization for encouraging women's participation, support to backward groups, sericulture poly clinics, product development and diversification, by-product development, development of special utility products, providing brand equity to ethnic designs by protecting under geographical indicators, public-private partnerships, establishment of soil science & agro-chemistry facilities, establishment of Regional Silk Technological Research Station in the North-eastern region, creation of sericulture research and development fund etc., are some of other strategies for overall development of vanya silk sector in India during the XI Plan Period.

REFERENCES

Dayakar Yadav, B.R. (2007): X Five Year Plan – Major research achievements of CSB institutes (Part-II), Indian Silk, 46 (4), p 24-25.

Report of the Sub-group on sericulture for XI Plan (2007-12), September 2006, Ministry of Textiles, Govt. of India, New Delhi-110001.

Eri Silkworm Pupae - A tool to combat malnutrition in rural poor

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ABSTRACT

Despite the increase in agricultural production, attaining self- sufficiency in food and food security, poverty alleviation efforts have left much to be desired particularly in the rural and tribal areas of the country. While, nutritional security remains a mirage, which demands immediate attention, leaps beyond food security. Though, per capita availability of food grains has increased, about 204.4 million people still suffer from malnutrition. While fruits and vegetables are rich source of nutrients, animal-based foods provide quality proteins as well, certain amino acids should essentially come from animal sources. While some of the farm and livestock products viz., fruits, vegetables, milk, meat, fish etc., becoming dearer, and their sufficient usage are thus confined to middle/ upper middle class in rural and urban areas. To ensure nutritional security, diversification of agri-food of both plant and animal origin is equally essential. This includes diversification towards value-added products, based on by-product and waste utilization, which were traditionally supplementary in nature. One such under utilized by-product of eri silkworm rearing is eri silkworm pupae that can be explored to combat rural malnutrition in addition to economically exploiting unutilized wastelands for income and employment opportunities for the rural poor. Greater involvement of women in most of the activities related to cultivation of food plants and eri silkworm rearing further contributes to their empowerment. Existing potential for eri silkworm rearing and production of eri silkworm pupae, assistance available through various developmental schemes for its popularization, nutritional status of silkworm pupae, its acceptance as food by rural/ tribal people etc. are discussed. Progress under exploratory studies conducted to find out chemical composition, protein analysis of eri pupae and pre-pupae as well as oil extracted from them along with scope for further studies on human consumption of eri silkworm pupae to combat rural malnutrition and challenges are analyzed for its large-scale popularization.

Keywords: Food security, malnutrition, nutritional security, by-product, eri silkworm pupae

INTRODUCTION

In spite of increase in agricultural production, per capita availability of food grains and attaining self-sufficiency in food and food security, distribution of food is highly unequal and the rural poor, who constitute nearly one-third of Indian population, continue to be food-deprived. Though many Welfare Programmes have been taken up to address this, issue need to be pursued more vigorously, as about 204.4 million people are suffering from malnutrition in India, out of approximately 800 million people in the developing world, as per the most recent estimates. Malnutrition in developing countries is as much or more, a problem of calorie deficiency as of protein deficiency.

Nutritional security means ensuring adequate availability of food grains to provide calorie and, may be, protein needs of the people, the former implies adequate supply of micronutrients such as vitamins and minerals as well. As per the survey conducted by the National Nutrition Monitoring Bureau, 1996, the consumption unit per head for protein, carbohydrates, fats, iron and iodine sources are lesser than the recommended doses and except cereals, millets the remaining food items especially pulses and vegetable consumption is far less than the requirement. It is also reported that about 48% of families are consuming food having less calories and in case of proteins it is 20% of families only. Further, about 60% of the children of age group of 0-5 years are under nourished and over 90% of pregnant women are anemic and are mal-nutritioned.

Diversification of agriculture & Nutritional security: Cropping patterns have traditionally been dominated by food needs. Commercial crops were confined to some regions and on relatively larger farms. zTowards achieving the nutritional security, measures are being taken in the agriculture, horticulture and livestock sectors, which varied over time starting from the onset of green revolution, irrigation played most important role, and predominance of small holdings discouraged it. This was further supported by abundant supply of electricity, credit availability and crop diversification with livestock enterprises. At the end of the millennium, there was consensus that diversification to higher value enterprises like vegetables, fruits, other specialty crops, livestock products, fisheries, value added agricultural products etc, was the new pathway for income growth in agricultural and rural sector. This would also help in bridging the quality gaps in terms of nutrition. Most of these enterprises were traditionally supplementary in nature (Policy Paper-7, 2001). Further, agricultural interventions are more sustainable in addressing malnutrition among the rural poor than the direct nutritional intervention programs, which may not be cost-effective in the long run.

Fruits, vegetables, milk, meat, fish became luxury foods, whose demand was confined to the very small rich class in rural and urban areas. A food insecure nation, despite devoting bulk of its agricultural resources to food production, became chronic importer of food. Even extension of cultivation to marginal and sub-marginal lands did not help. To ensure nutritional security, increased availability of diverse types of food such as millets, pulses, fruits and vegetables, foods of animal origin (milk, eggs, meat, fish), besides cereals, is essential (Policy Paper-17, 2003). While fruits and vegetables are rich sources of micronutrients, animal-based foods abound in quality proteins as well. In a country like India where the population rises by a whopping 10 million every year, the importance of diversification of agricultural crops to meet, food processing and food preservation is self- evident.

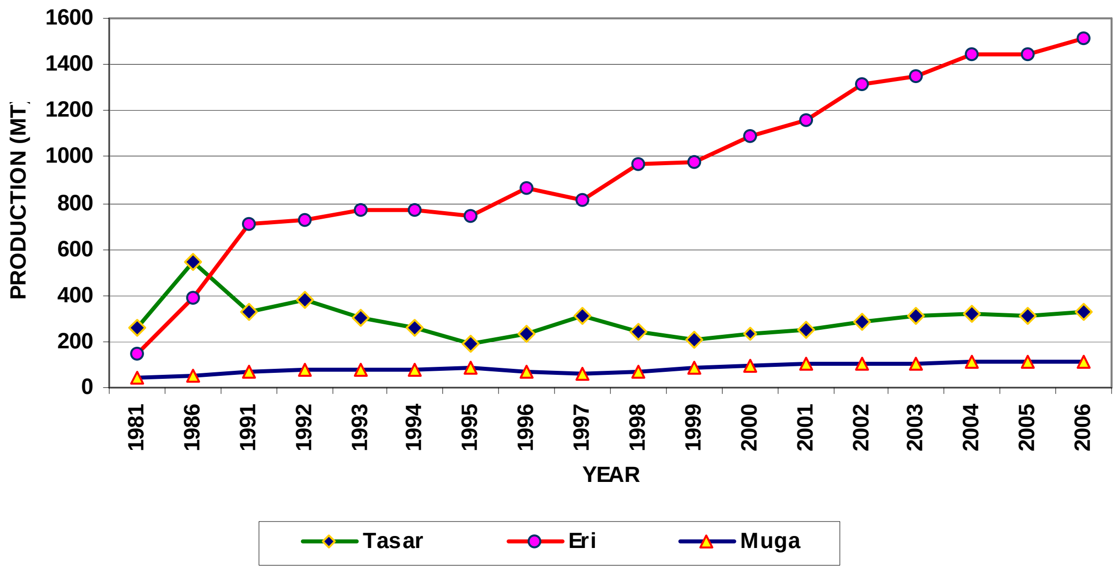
There is some apprehension that increasing diversification of land to non-food crops may affect basic food security, adversely. However, this can be addressed by exploiting the yield gap through research to increase the productivity levels of crops and animals and ease the pressure on land resources, substantially. Animal production systems in India are based on by-product and waste utilization. Increased efficiency of this system would moderate demand for food grains for animal consumption. Animals and insects play an important role in the history of human nutrition especially in developing countries (Bodonheimer, 1951). Insect proteins have been reported to be superior or equivalent to soya protein (Friske *et, al.,* 1989) and comparable to casein (Ozimek *et. al.,* 1985).

Among the diversified agricultural products of animal origin, potential of eri silkworm pupae, which is the by-product of eri silkworm rearing in India, is yet to be explored. The consumption of eri pupae can significantly supplement many of the protective nutrients and much needed energy.

Potential for Ericulture in India: Eri accounts for over 78% of the total production of '*Vanya*' silks produced in India. Eri silk production has been enhanced by over 10 folds from 147 MT during 1981-82 to 1515 MT during 2006-07 **(Table-1)**, due to interest evinced in it for quite some time. Eri silkworm and its host plant, castor offers an excellent example of multiple product crops and of sustainable agricultural practice (Gene R. Defoliart, 1999). A major portion of spend silkworm pupae is either thrown away as sericulture waste or used as a fertilizer and as a constituent of chick and fish feeds (Ichhponani & Malik, 1971). Though women work force is crucial in sericultural activities, it goes unaccounted as their contribution is considered as an extended part of their domestic duties (Gautam & Sharma, 2003). Women contribute over 70% in most of the activities of eri silkworm rearing (Jaya Prakash *et. al.,* 2005). Hence, any attempt to exploit nutritive potential of eri silkworm pupae will help in combating the malnutrition in rural and tribal women in the country.

Deoiled mulberry silkworm pupae contain high amounts of phenols, which inhibits protein digestion, and uric acid which is gut irritant. They can be reduced effectively by soaking in boiling water for 15 minutes. The detanned silkworm pupae meal can be safely and effectively incorporated in poultry feed, which reduce the pollution around reeling units and the poultry feed cost besides helping sericulturists/ reelers getting additional income (Thangamani, 1995).

Table- 1: PRODUCTION TRENDS OF *VANYA* SILKS IN INDIA



At present, utilization of by-products of eri silkworm rearing are reported in various ways, like, the oil extracted from the pupa is used in paints, soaps, and varnishes while the pupa protein cake is used as poultry, piggery, fish or cattle feed (Goel and Rupachandra Singh, 2004). One of the recent trends in R&D programmes is to find out the alternative sources of protein supply for human food or animal feeds. Studies of Central Food Technology & Research Institute (CFTRI) have shown that silkworm pupae is a good source of animal protein in place of fish meal in animal feeds (poultry and fish). Conversion of this proteinaceous waste in to a value added product helps to meet the increasing demand for proteins in animal production programmes and also saves the cost of waste treatment and disposal. A pollution free fermentation based process with a view to preserve/ recovers the nutrients in pupae as feed ingredient was developed by CFTRI to prepare a microbiologically stable and pathogen free silage which can be stored for a month in air tight plastic containers. The silage can be fed to pigs along with kitchen refuse or it can be mixed with other ingredients of feed formulations, extruded/ dried for poultry or aquaculture feed. The silage as a source of animal proteins (and other nutrients) can replace the conventionally used expensive fishmeal in animal feeds (Narasimha Rao & Mahendrakar, 2003).

Though spread of eri culture from the North-eastern Region to other states of the country was slow, factors like large scale cultivation of eri host plants by utilized wastelands i.e., castor and tapioca for their oil seed and tuber production, respectively, multivoltine nature of eri silkworm, easy cultivation practices, low cost rearing, ensured crops and the recent advances in various technologies in ericulture and their dissemination have encouraged farmers in non-traditional niches within the country like Andhra Pradesh, Bihar, Jharkhand, Orissa, Tamil Nadu, Kerala, Karnataka, Punjab, Uttar Pradesh and Chattisgharh to take up this culture as a commercial proposition.

Support systems for promotion of Ericulture: Central Silk Board thorugh its Catalytic Development Programme (CDP) Schemes is promoting ericulture beyond North-eastern States with assistance provided towards activities like augmentation of eri food plants with training and start-up tools, construction of rearing house, assistance for states for the maintenance of eri farm-cum-grainages, support to agencies (Non-Governmental Organizations-NGOs/ Cooperative Societies) for upgradation and popularization of improved reeling/ spinning devices, establishment of Common Facility Centres (CFC) especially for degumming and processing of cocoons, establishment of eri spun silk mill etc. Financial assistance is also available under *Swarna Jayanti Gram Swarozgar Yojana* (SGSY), Scheme of Training and Employment Programme (STEP), National Afforestation Programme and various tribal development programmes of Government of India. Organization like United Nations Development Programme (UNDP) has recognized the importance of Ericulture in enhancing income and employment generation in the rural India (Teotia *et. al.,* 2003).

Nutritional Status of Eri silkworm Pupae: Eri pupa is a delicacy and dietary staple for many tribes in North-eastern region, who eat eri silkworm in its pre-pupal or pupal stage after formation of cocoons. Eri pupae are naked and are suitable for human and animal consumption directly as raw staple food or after processing, which includes basically, frying, deep frying, baking and boiling with spices. The pupae in these cases are used fresh and the food prepared is highly perishable.

An Egyptian group of researchers studied different biochemical changes during metamorphosis of eri pupae at different temperature (El-Shaaraway *et. al.,* 1982). Biochemical analysis **(Table-2)** of eri pupae reveals high calorific value of 460 kcals/100gm on dry basis (33 kcals/100gm on fresh weight basis), which is quite high as compared with other foods such as cow milk (69 kcals/100ml), eggs (163 kcals/100ml), chicken (120 kcals/100ml), white sugar (385 kcals/100ml), raw carrots (42 kcals/100ml)etc. It is also established that refined protein of eri pupae is superior to the other animal foods due to presence of essential amino acids like leucine, which are important for human nutrition. Further, it has high contents of free unsaturated fatty acids, vitamins and sufficient quantity of calcium, iron and other minerals required for human growth and development. It is proposed to produce about 2400 MT of eri spun silk by the end of the XI Plan Period (2011-12), which results in production of an estimated quantity of 20,000 MT eri pupae per annum. If this quantity of pupae is properly collected, processed and preserved, it can serve as a nutritious food for many tribals and rural women.

For many ethnic tribes like *Rabhas, Bodos, Abor, Miri, Kachari, Garos, Khasi, Naga, Adis, Mizo* and the *Syntengs* in North-East India, it is a great delicacy and dietary staple. Live prepupae are sold in small plastic bags, by weight in local markets or by tin container at rural bus stops at Rs.50 to Rs.120/- per kg. They can be eaten dry as crisp or hydrated again and served as stew or fried. From a pilot project it is established that the source of income from eri spinning at 48%, from eri pre-pupa/ pupa at 37% and from eri waste at 15%. The different items of cuisine that can be prepared out of eri pre-pupae and pupae include fry, pakori/chop, cake etc. (Chaoba Singh K. & Suryanarayana N., 2003). Nutritive value of non-mulberry and mulberry silkworm pupae and consumption pattern in Assam was studied by Mishra *et. al.,* (2003) and Rao, P.U. (1994).

Eri Pupae are also rich in vitamins such as vitamin B12, nicotinic acid and vitamin D, thus provide a good source of human food. 100 gm of dried Eri pupae can supplement 75% of the average individual's daily protein requirement and 100% daily requirement of many vitamins (pyridoxal, riboflavin, thiamine, ascorbic acid and folic acid) and minerals (calcium, iron and phosphorous) (B.K. Singh *et. al.,* 2004). Since the eri pupa is rich in protein and minerals, consumption of pupae can substantially supplement the protein starved tribal populace in addition to the income generation through silk production. Tribals of I. Polavaram village of the East Godavari district have consumed pupae by making local traditional recipes viz., tikkas, deep fry, curry etc (Rama Rao *et.al.,* 2005). Similarly, consumption of eri silkworm pupae was effectively demonstrated in the States of Tamilnadu and Andhra Pradesh under the R&D Project implemented by S. Jayaraj Research Foundation (SJRF), Chennai with financial assistance from Central Silk Board.

Table-2: Biochemical composition of Eri pupae

Parameter	Quantity on dry weight basis	Quantity on wet weight basis
Moisture (%)	**9.10**	**71.80**
Total ash (%)	**4.20**	**1.30**
Protein (%)	**53.30**	**16.54**
Fat (%)	**25.60**	**7.94**
Crude Fibre (%)	**3.40**	**1.05**
Carbohydrates (%)	**4.40**	**1.37**
Calorific Value (kcals/100	**460**	**133**
Calcium (mg/100 g)	**76.10**	**23.60**
Iron (mg/100 g)	**2.60**	**0.81**
Phosphorus (mg/100 g)	**586**	**182**
Vitamin A (IU/g)	**4.0**	**1.23**

Source:** **Central Food Technological Research Institute, Council for Scientific and Industrial Research, Government of India, Mysore

Other than the North-East region, till the human consumption of eri silkworm pupae or processing of eri silkworm pupae is achieved, additional income of about Rs. 2800/- per hectare of castor/ tapioca garden can be earned by converting the eri pupae as poultry or fish feed (Jayaprakash *et. al.,* 2003).

Exploratory studies on nutritional potential of eri silkworm pupae: Kobayashi *et. al.,* (1952) reported a molecular distillation process of pupal oil for the elimination of disagreeable odour and free fatty acids and also for improved colour of the oil. α-linolenic acid (ALA) is a natural precursor of dietary long chain n-3 polyunsaturated fatty acids like eicosapentaenoic acid and docosahexanoic acid, which are known to have positive effects on several risk factors associated with coronary heart disease (Hu *et. al.,* 1999). Keeping in view the nutritional value of the eri silkworm pre-pupae and pupae, Central Silk Board with the help of reputed institutions *viz.,* National Institute of Nutrition and Indian Institute of Chemical Technology, Hyderabad, Andhra Pradesh has taken up the exploratory studies to evaluate the nutritional potential of eri silkworm pupae, eri pupae oil and surface lipids besides studies on effective utilization of silkworm pupae as protein supplement in poultry.

Proximate composition has shown that the eri silkworm prepupae and pupae from rearing conducted on tapioca and castor are both good sources of protein and fat with exceptionally high zinc content. Unsaturated fatty acids comprised of approximately 67-69% of the total fat with alpha linolenic acid being the major fatty acid which could be used for its nutritional advantage. Protein quality evaluation confirmed that the eri pupe and pre-pupae are good sources of essential amino acids particularly rich in phenylalanine, valine and isoleucine. Food intake was comparable between casein and eri silkworm prepuape/ pupae groups, however the protein quality of eri silkworm prepupae/ pupae was significantly lower than that of casein as judged by feed efficiency ratio, protein digestability and net protein utilization **(Table-3)**.

Table-3: *In-vivo* protein quality evaluation (Values are mean+ Std. deviation, n=6)

Parameters	**Casein**	**Eri Pre-pupae**	**Eri Pupae**
Food intake (gm/2 weeks)	121± 10.03	117± 10.08	117± 9.14
Gain in body weight (gm/2 weeks)	40± 7.21	26± 4.16	24± 4.8
Feed efficiency ratio (%)	33± 4.11	22± 2.05	21± 3.63

Protein digestability (%)	92± 1.63	87± 1.99	87± 3.92
Dry matter digestability (%)	96± 0.44	96± 0.52	96± 1.43
Net Protein Utilization (%)	61± 4.64	41± 1.62	38± 4.44

Source: National Institute of Nutrition, Indian Council of Medical Research, Hyderabad, A.P.

Xuefeng *et. al.,* (2002) conducted a feeding experiment of pupal oil in wistar rats. A reduction in serum lipid levels and cholesterol (TC and LDL-C) along with an increase in HDL-C and an inhibition of platelet aggregation was observed on consumption of pupal oil rich in ALA strongly indicating the protective role of the studied oil against coronary heart disease (CHD). Oil content in pupae was estimated to be in the range of 18-20% (dry basis), which was found to be enriched with α-linolenic acid (ALA) with palmitic acid as the second major fatty acid. Presence of large amount of ALA and their predominance at the *sn*-2 position make the eri pupal oil highly nutritious, if oxidative stability is ensured. (Shiva Shanker *et.al.,* 2006). Lipid profile of pupa oil and surface waxes present in eri pupae and pre-pupae fed on Castor and Tapioca plants was also studied besides standardizing the technology for extraction of pupa oil. The oil portion of eri pupae can be extracted from dry pupae powder by solvent extraction method. By using petroleum ether as solvent, it is found that extractable oil in dry eri pupae is 19.45% whereas the use of n-hexane shows the amount to be 21.47%. Refractive index of eri pupae oil is comparable to other common lipids of both vegetable and animal origins. This indicates the presence of long chain unsaturated fatty acids. The acid value indicates the presence of high amount of free fatty acids in eri pupae oil. The iodine value of eri pupae oil is quite high in comparison to common animal lipids. Thus eri pupae oil contains higher amount of unsaturated fatty acids than the common animal lipids. The lower saponification value signifies that its ransidification is lower than that of common animal fats. The cholesterol in eri pupae oil is comparable to any other common animal fat. The results suggest that eri pupae oil has great prospect for its utility in food industry as well as the source material for oleo chemical industries **(Table-4).**

Table-4: Important characteristics of Eri Pupae Oil

Parameter	Value
Refractive Index (at 30^0c)	**1.47**
Acid Value	**67.37**
Saponification Value	**150.88**
Iodine Value	**174.91**
Cholesterol (%)	**0.36**

Source: Satyendra Kr. Choudhury, 2003

Future Strategies:

Considering the huge nutritional potential and large quantities of eri silkworm pupae that are now going waste, it is considered important to evaluate its importance as a food product. The fact that eri pupae have been consumed by the population in North-east India for decades without any adverse effects shows that it is safe for human consumption. However, it is necessary to evaluate the nutritional potentials of eri pupae and confirm the safety of eri pupae consumption before exploiting the possible beneficial effects on population for mass consumption.

Following issues need to be addressed for effective utilization of this valuable by-product of eri silkworm rearing.

- Nutritional and short term toxicological evaluation of eri silkworm pre-pupae and pupae through biochemical and pathological parameters.

- Development of recipes using eri silkworm pre-pupae and pupae through organoleptic evaluation.

- Sources of oil rich in (n-6) PUFA (Poly Unsaturated Fatty Acids) are abundant in nature, but such is not the case with (n-3) PUFA. The eri pupae oil containing 42-58% of Alpha Linolenic Acid (ALA) could be an easily accessible alternate source of (n-3) PUFA, which has increasing demand as an alternate source of (PUFA) due to several positive health benefits.

- Development of bench scale process for the drying of pupae followed by extraction, refining and characterization of pupal oil.
- Assessment of shelf life of the oil by the storage studies of both the crude and refined pupal oil either separately or in combination with other silkworm pupal oils.
- Toxicological and sensory evaluation studies of the refined silkworm pupal oils.
- Evaluation of different physico-chemical parameters of the refined pupae oil.
- Research on the value-addition by utilizing fibroin.
- Use of moulted skin in pharmaceutical industry and extraction of the natural gum (sericin) for its diversified uses.

The consumption of eri pupae is gradualy gaining popularity among the protein deficient children and women of tribal communities. Value addition to silkworm pupae can be enhanced by finding suitable preservation methods and by conversion of silkworm pupae in to convenient processed products for wider market acceptability in different regions. Given the potential for expansion of ericulture, increasing production of eri silk, availability of large quantity of eri pupae and the millions of rural and tribal populace of the country suffering from malnutrition, there exists a vast potential for commercializing the concept of utilization of eri silkworm pupae for human consumption. Moreover, this would ensure additional income for the eri rearer and render ericulture more attractive.

REFERENCES

Bodonheimer, F.S. (1951): Insects as human food, W. Junk, *The Haque*, pp352.

Chaoba Singh K. and N. Suryanarayana (2003): Eri pupae – A popular cusisine too, *Indian Silk*, 41(12): 57-58.

El-Shaaraway, M.F., Gomaa, A.A. and Honsy, A.A. (1982): Biochemical changes during the development of eri silkworm pupae exposed to different constant temperature. *Mededlingen van de Faculteit Landbouwwetenschappen, Univeriteit Gen*, 47(2), 563-571.

Friske, M.D., Defoliart, G.R. and Benevenga, N.J. (1989): Use of a four parameter logistic model to evaluate the quality of the protein from three insect species when fed to rats, *J. Nutri.,* 119, 864-871.

Gautam, S. and Sharma. A. (2003): Women empowerment through sericulture in Himachal Pradesh, *Indian Silk*, 41(9): 18-20

Gene R. Defoliart (1999): Ecology and management of food industry. *Pesb. FDA. Tech. Bull. 4*, AOAC Arlington V.A. pp 595

Goel, R.K. and Rupachandra Singh (2004): Silkworm pupae as an edible by-product in *Vanya*, *Proceedings of National Workshop on 'Potential and Strategies for sustainable development of Vanya silks in the Himalayan States' Dehradun, India, 8 - 9th November 2004, pp 433-438.*

Hu., F.B., Stamfer, M.J. and Manson, J.E. (1999): Dietary intake of α-linolenic acid and risk of fatal ischemic heart disease among women, *Am. J. Clin. Nutr.*, Vol. 69, pp 890-897.

Ichhponani, J.S and Malik, N.S. (1971): Evaluation of deoiled silkworm pupae meal and corn steep liquor as proteins sources in chick rations, *Br. Poult. Sci.,* Vol. 12, pp 231-234.

Jayaprakash, P., Rao, B.V.S., Venkateswar Rao, K., Krishna Rao, J.V. and Sinha B.R.R.P. (2003): UNDP assistance in development of eri culture, *Indian Silk*, Vol.41 (12) 19-20.

Jaya Prakash, P., Sasikala, A. and Suryanarayana, N. (2005): Ericulture – A Tool for rural women development in Andhra Pradesh, India. *Conference papers of the 20th Congress of the International Sericultural Commission, December 15-18, Bangalore, India, Vol.II, Section-3: Non-mulberry silkworms,* Abstract no. 3.18, pp 106-113.

Kobayashi, T. and Kobayashi, S. (1952): The nutritive value of silkworm pupae. X. Molecular distillation of pua oil. *Nippon Nogei Kagaku Kaishi*, 26, 109-112.

Mishra, N., Hazarika, N.C., Narain, K. and Mahanta, J. (2003): Nutritive value of non-mulberry and mulberry silkworm pupae and consumption pattern in Assam. *J. Nutrition Research*, 23 (10), 1303-1311.

Narasimha Rao, D. and Mahendrakar, N.S.(2003): Value addition to silkworm pupae, *Indian Silk*, Vol.42 (1) :36.
Ozimek. L., Saver, W.C., Kozikowski. V., Ryan, J.K., Jorgension, H. and Helen.P. (1985): Nutritive value of protein extracted from honeybees. *J. Food Sci.,* 50, 1327-1329 & 1332.
Policy Paper-7 (2001): Diversification of agriculture for human nutrition, National Academy of Agricultural Sciences, India, 2001.
Policy Paper-17 (2003): Agricultural-based Interventions for Sustainable Nutritional Security, National Centre for Agricultural Economics and Policy Research, India, 2003.
Raghavaiah, C.V. (2003): Strategy for promotion of eri silk through utilization of castor for foraging, *Indian Silk*, Vol.42 (1) : 33-35.
Rama Rao, M., Prasad, R.N. and Suryanarayana, N. (2005): Ericulture – An additional income for tapioca (cassava) growers and a good nourishment to the mal-nutritioned tribal populace *Conference papers of the 20th Congress of the International Sericultural Commission, December 15-18, Bangalore, India, Vol.II, Section-3: Non-mulberry silkworms,* Abstract no. 3.16, pp 94-98.
Rao, P.U. (1994): Chemical composition and nutritional evaluation spent silkworm pupae. *J. Agric. Food Chem.,* 42 (10), 2201-2203.
Satyendra Kr. Choudhury (2003): Eri pupae oil, *Indian Silk*, 41(12): 55-56.
Shiva Shanker, K., Shireesha, K., Kanjilal, S., Kumar, S.V.L.N., Srinivas, C., Rao, J.V.K. and Prasad, R.B.N. (2006): Isolation and characterization of neutral lipids of desilked eri silkworm pupae grown on castor and tapioca leaves, *J. Agric Food Chem.*,54(9), 3305-3309.
Singh, B.K., Sahu J., Rao, J.V.K. and Das, P.K.(2004): Utilization of by-products of eri silkworm, *Samia ricini* (Donovan), *Proceedings of National Workshop on 'Potential and Strategies for sustainable development of Vanya silks in the Himalayan States' Dehradun, India, 8 - 9th November 2004, pp 462-467.*
Teotia, R.S., Sathyanarayana, K., Rajshekar, K., Goel, R.K. and Krishna Rao J.V. (2003): UNDP assistance in development of eri culture, *Indian Silk*, Vol.41 (12) 13-18.
Thangamani R.(1995): Final Technical Report of National Sericulture Project '*Effective utilization of sericulture by-product: Silkworm pupae as protein supplement in poultry ration*', p 2.
Xuefeng. Y., Huang. L., Hu, J., Li.T. and Gao. W. (2002): Effects of silkworm pupa oil on serum lipid levels and platelet functions in rats. *Weisheng Yanjiu*, 31(4), 249-251.

Interactive Voice Response System [IVRS]

- A NEW APPROACH IN SERICULTURE COMMUNICATION

By

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ABSTRACT

In Sericulture, extension communication plays a vital role. In the direction to ease the process of effective information transfer, central Silk Board(CSB) has developed an Interactive Voice Response System (IVRS) to support the stakeholders i.e. sericulturists, reelers, weavers, entrepreneurs and others on-line at Central Sericultural Research & Training Institute (CSR&TI), Mysore since 2006. The system has a capacity to entertain 4 calls at a given time. This system not only helps avoid the extensive travel of Extension personnel, but also transfers the information instantaneously and effectively. It facilitates the senior officers/scientists to interact with the stake holders to understand their problems and to solve them instantly. In addition to this, the caller incurs no expenditure since the IVRS are connected to Toll free number. IVRS enables Research & Development (R&D) Institutes to be more accessible and interactive with the stake holders of the Industry through the telephone. In turn, the R & D Institutes can also get the information on the prevailing problems in the field for needful action. At present, IVRS is installed at CSR&TI, Mysore on trial basis. The response is quite encouraging. During the coming days, CSB is planning to install the IVRS at its units located in different parts of the country. The present paper deals with the working mechanism and its utility in the field of sericulture.

Keywords: Sericulturists, Reelers, IVRS

INTRODUCTION

THIS IS HOW IVRS WORKS

In order to facilitate all segments of the callers in general and the rural folk in particular, a slight change as per the requirement i.e, Human interference - Information Officer (IO) is introduced for easy facilitating. Attempts are made to ensure 24x7 service.

At the event of receipt of a call response would be:

A. During working hours of office

- The call will pass through playing of automated recorded script like welcome greeting, selection of language. Later call is diverted to the Information Officer (IO) and the relevant information like name of the caller, contact phone / address, problem will be noted and answer the queries instantaneously, by referring to the FAQs / other information available with him/her.
- In case the caller wants to go through IVR, caller can proceed by dialing 99.
- If the reply is not convincing to the caller/if the caller wants to discuss with the experts, the call will be diverted to the experts available in the sections for direct interaction [Time being this facility is snubbed]
- In case, the query needs some more clarification/information, it would be kept pending and the caller would be intimated that, he/she will be contacted again. The information will be passed on to them with in the specified time depending on the gravity of the problem through phone/post/person.
- The relevant reply for the pending quires will also be posted in the system, which can be accessed by the caller in due course using the information number.

- In case the problem needs the immediate attention for addressing the problem, near-by extension centre can be informed to visit the spot for needful action or institute person can visit the spot.

B. During the time other than office hours:

- The calls received will be passing through welcome greetings and a series of automated guidance and response for obtaining the relevant information like name of the caller, contact phone / address, etc.
- Then the caller will be facilitated to hear to the readily recorded question and answers saved in the system. These questions with solutions are enlisted by the experts of the institute based on the prevailing on the past experience and present field/environmental conditions.
- In case the provided information does not suffice the caller, he will be offered for recording the query.
- All these recorded information will be saved in the form of wav files in the system, which can be opened later when the Information Officer resumes the duty.
- After opening the quires, it will be answered by referring to the Frequently Asked Questions (FAQs) and other information available with him/her or connect to the concerned page of the information kiosk.
- The callers will be contacted over phone, based on the information recorded. If need be, information will be given to nearby units to give personal attention.
- The relevant reply for the pending quires will also be posted in the system, which can be accessed by the caller in due course using the information number.

Important features of our IVR systems

- Used as a help line for Sericulture farmers - Routine information, capturing and storing voice requests sought by farmers, other information, complaints etc.,
- The system will have the toll free connection of Bharatiya Sanchar Nigama Limited, a government enterprise and can entertain 4 calls at a given time
- Able to access and relay information using self-driven, easy to handle menus
- Software supports five languages - Kannada, Tamil, Telugu, Hindi and English. Provision is made for 5 languages, but, presently only two, Kannada and English languages are under use.
- Have good quality Voice Script Recording.
- Voice data received from the farmers is stored as Wav files
- Able to alert in case of fresh calls, when the system under use
- Able to store call logs for specified periods
- Able to incorporate cut off time for production
- Able to Import and Export Call flows
- Able to integrate with existing database system like Information Kiosk, FAQ bank etc,
- Able to take the place of origin of call and contact phone no. from the caller ID and ask for confirmation or alternate phone number.
- A common number of menu option is provided under every section.
- Same digit is assigned for contacting the IO [snubbed during closed hours of office] and repetition of the menu.
- Generate the report in customized formats for easy monitoring by the Director concerned.

At present the farmers are developing interest in the system and the call frequency is increasing. However, it takes some time for stabilizing. The diagrammatic chart of the call flow is given below. Services of a software company are being utilised for developing & installing this system.

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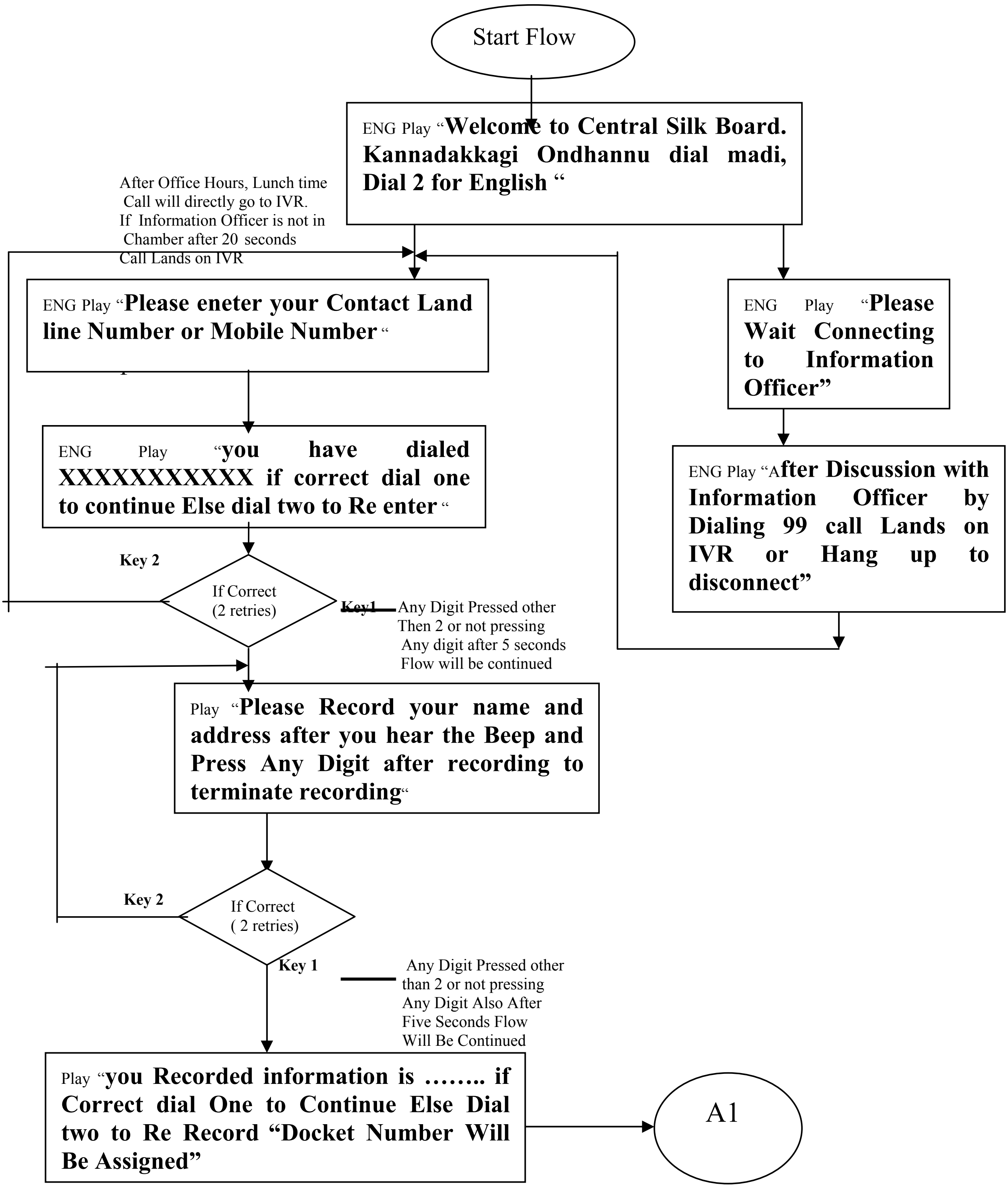
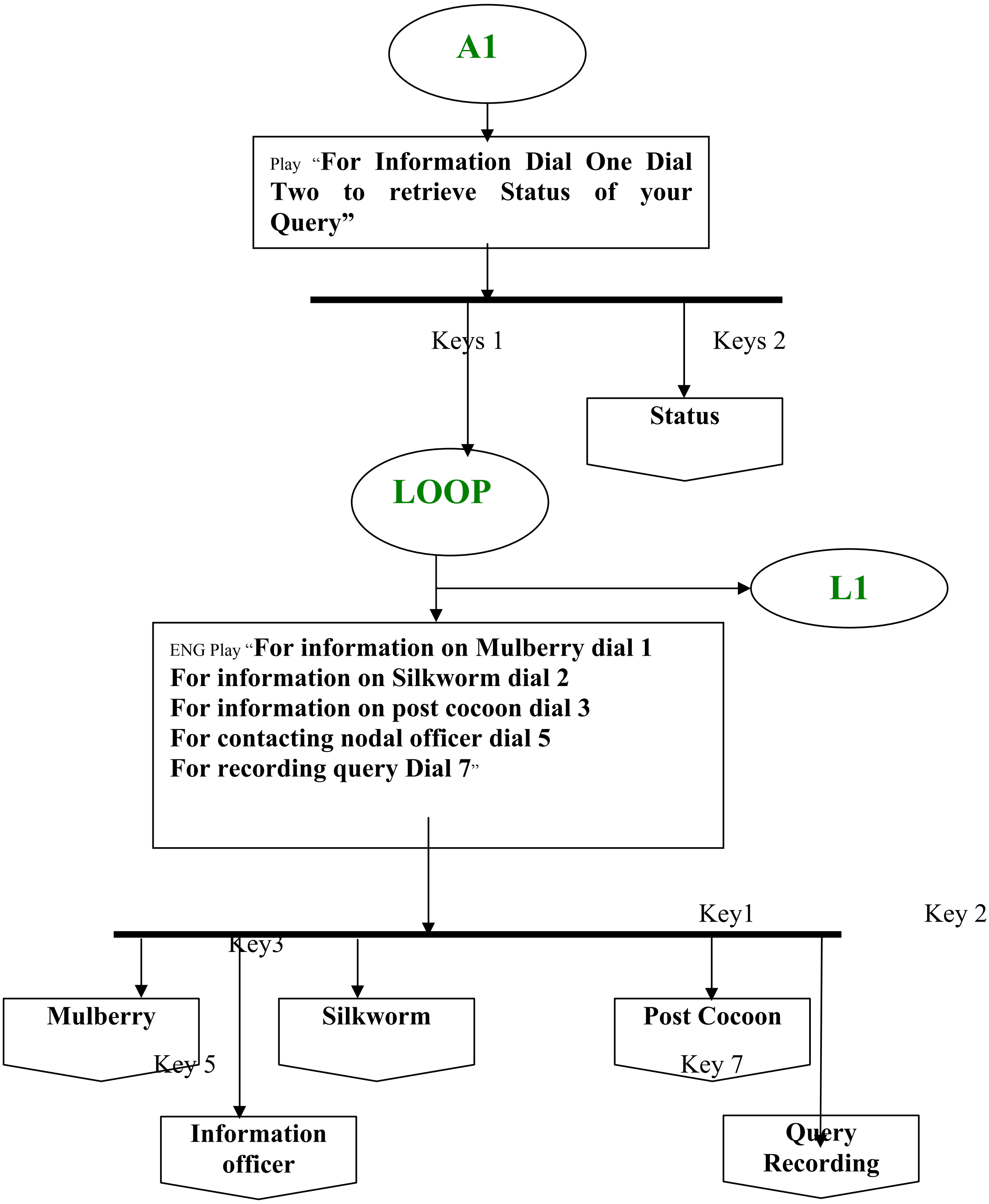
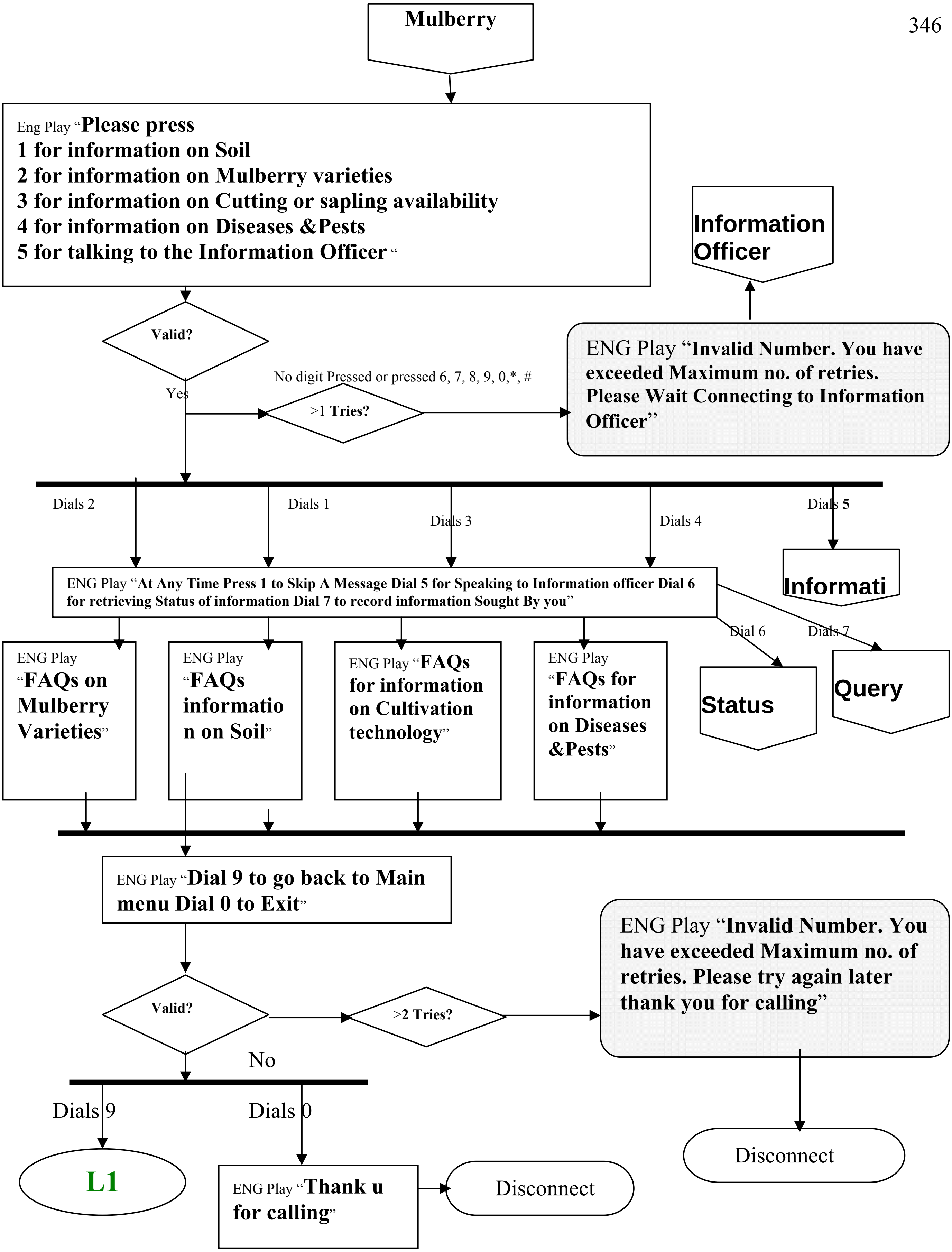
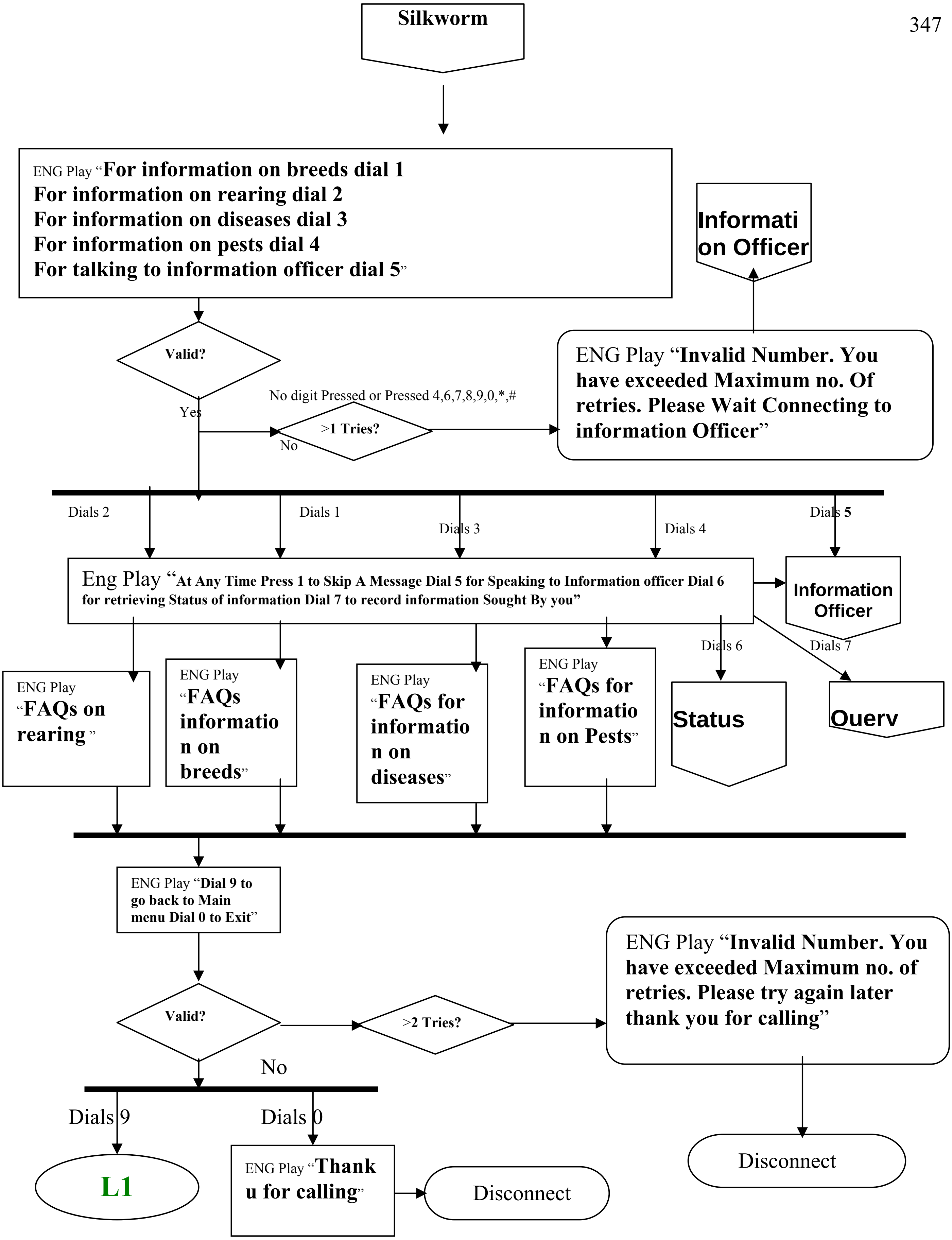
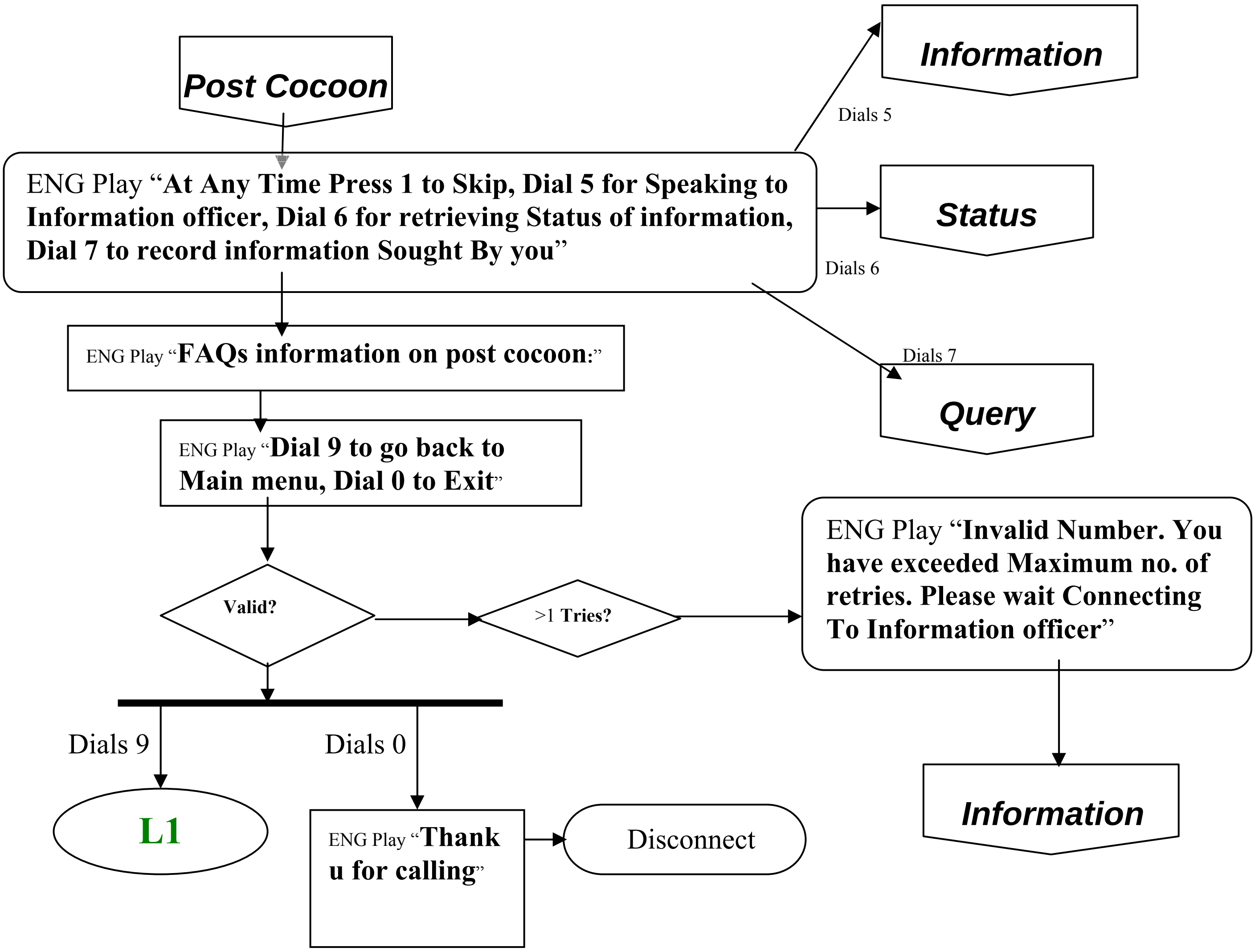
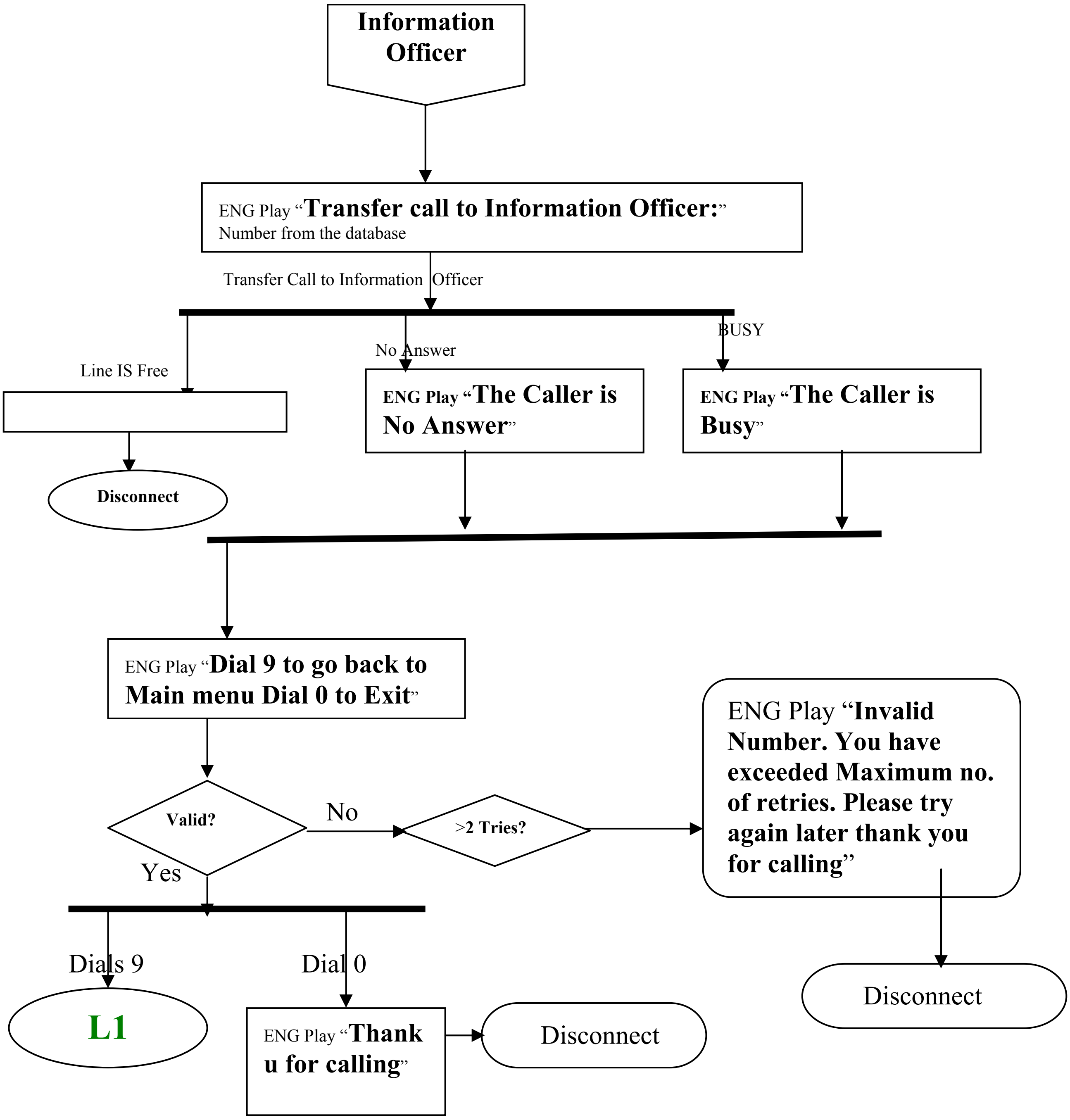

Start Flow
ENG Play "Welcome to Central Silk Board. Kannadakkagi Ondhannu dial madi, Dial 2 for English "
After Office Hours, Lunch time Call will directly go to IVR. If Information Officer is not in Chamber after 20 seconds Call Lands on IVR
ENG Play "Please eneter your Contact Land line Number or Mobile Number "
ENG Play "Please Wait Connecting to Information Officer"
ENG Play "you have dialed XXXXXXXXXXX if correct dial one to continue Else dial two to Re enter "
ENG Play "After Discussion with Information Officer by Dialing 99 call Lands on IVR or Hang up to disconnect"
Key 2
If Correct (2 retries)
Key1
Any Digit Pressed other Then 2 or not pressing Any digit after 5 seconds Flow will be continued
Play "Please Record your name and address after you hear the Beep and Press Any Digit after recording to terminate recording"
Key 2
If Correct (2 retries)
Key 1
Any Digit Pressed other than 2 or not pressing Any Digit Also After Five Seconds Flow Will Be Continued
Play "you Recorded information is …….. if Correct dial One to Continue Else Dial two to Re Record "Docket Number Will Be Assigned"
A1

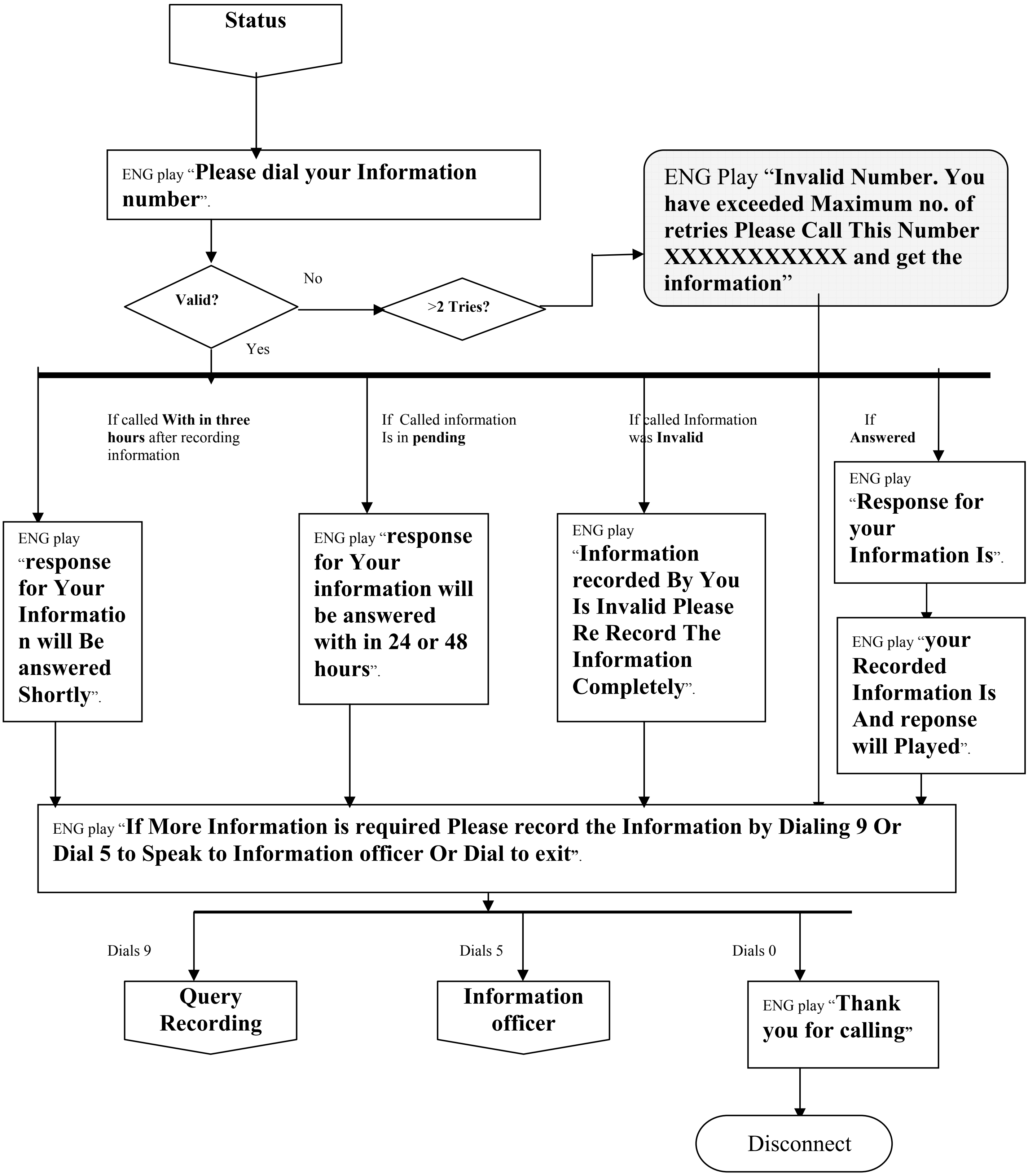

A1
Play "For Information Dial One Dial Two to retrieve Status of your Query"
Keys 1
Keys 2
Status
LOOP
L1
ENG Play "For information on Mulberry dial 1
For information on Silkworm dial 2
For information on post cocoon dial 3
For contacting nodal officer dial 5
For recording query Dial 7"
Key1
Key 2
Key3
Mulberry
Key 5
Silkworm
Post Cocoon
Key 7
Information officer
Query Recording

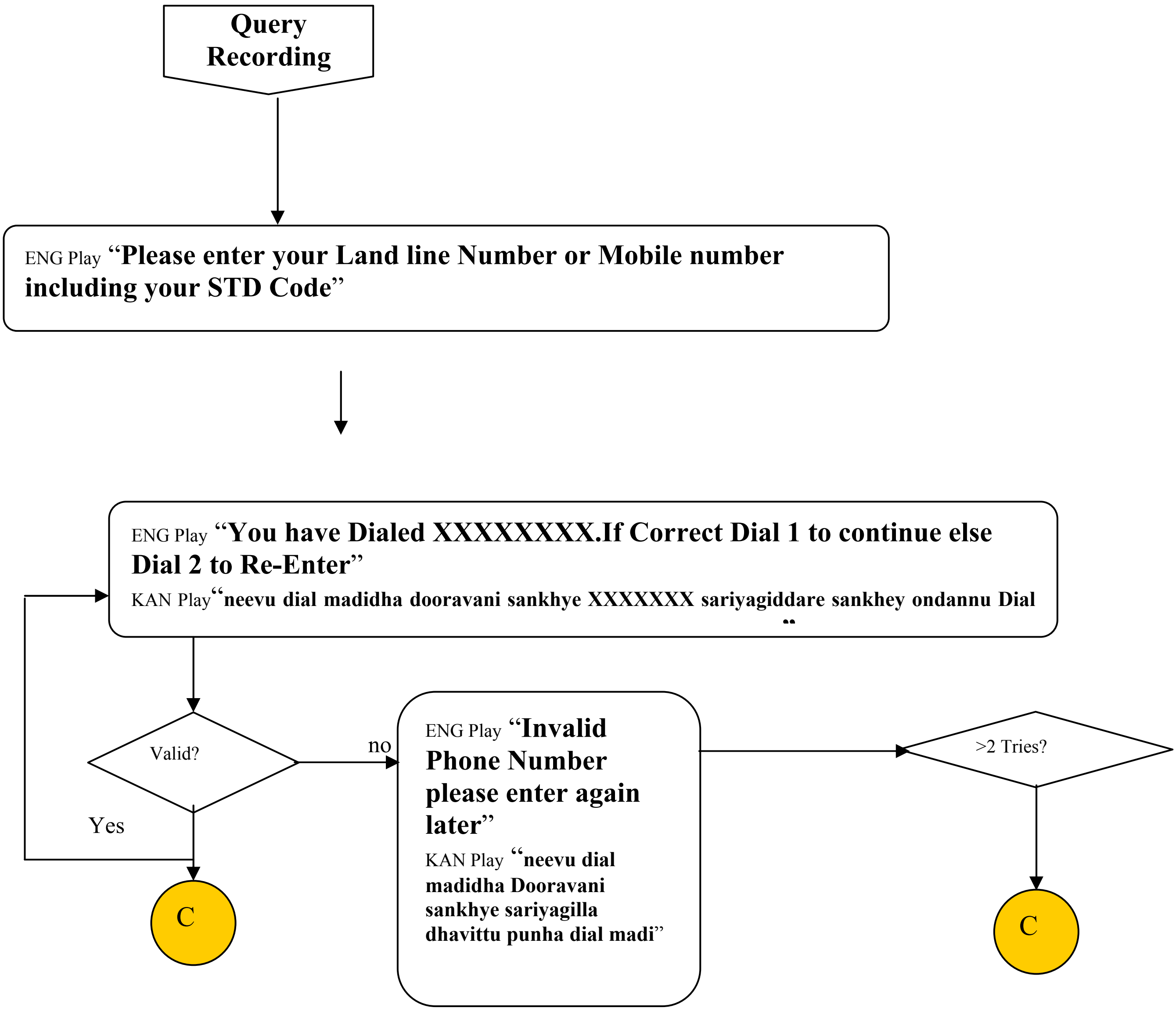

Mulberry
Eng Play "Please press
1 for information on Soil
2 for information on Mulberry varieties
3 for information on Cutting or sapling availability
4 for information on Diseases &Pests
5 for talking to the Information Officer "
Information Officer
Valid?
Yes
No digit Pressed or pressed 6, 7, 8, 9, 0,*, #
>1 Tries?
ENG Play "Invalid Number. You have exceeded Maximum no. of retries. Please Wait Connecting to Information Officer"
Dials 2
Dials 1
Dials 3
Dials 4
Dials 5
Informati
ENG Play "At Any Time Press 1 to Skip A Message Dial 5 for Speaking to Information officer Dial 6 for retrieving Status of information Dial 7 to record information Sought By you"
Dial 6
Dials 7
ENG Play "FAQs on Mulberry Varieties"
ENG Play "FAQs informatio n on Soil"
ENG Play "FAQs for information on Cultivation technology"
ENG Play "FAQs for information on Diseases &Pests"
Status
Query
ENG Play "Dial 9 to go back to Main menu Dial 0 to Exit"
ENG Play "Invalid Number. You have exceeded Maximum no. of retries. Please try again later thank you for calling"
Valid?
>2 Tries?
No
Dials 9
Dials 0
L1
ENG Play "Thank u for calling"
Disconnect
Disconnect

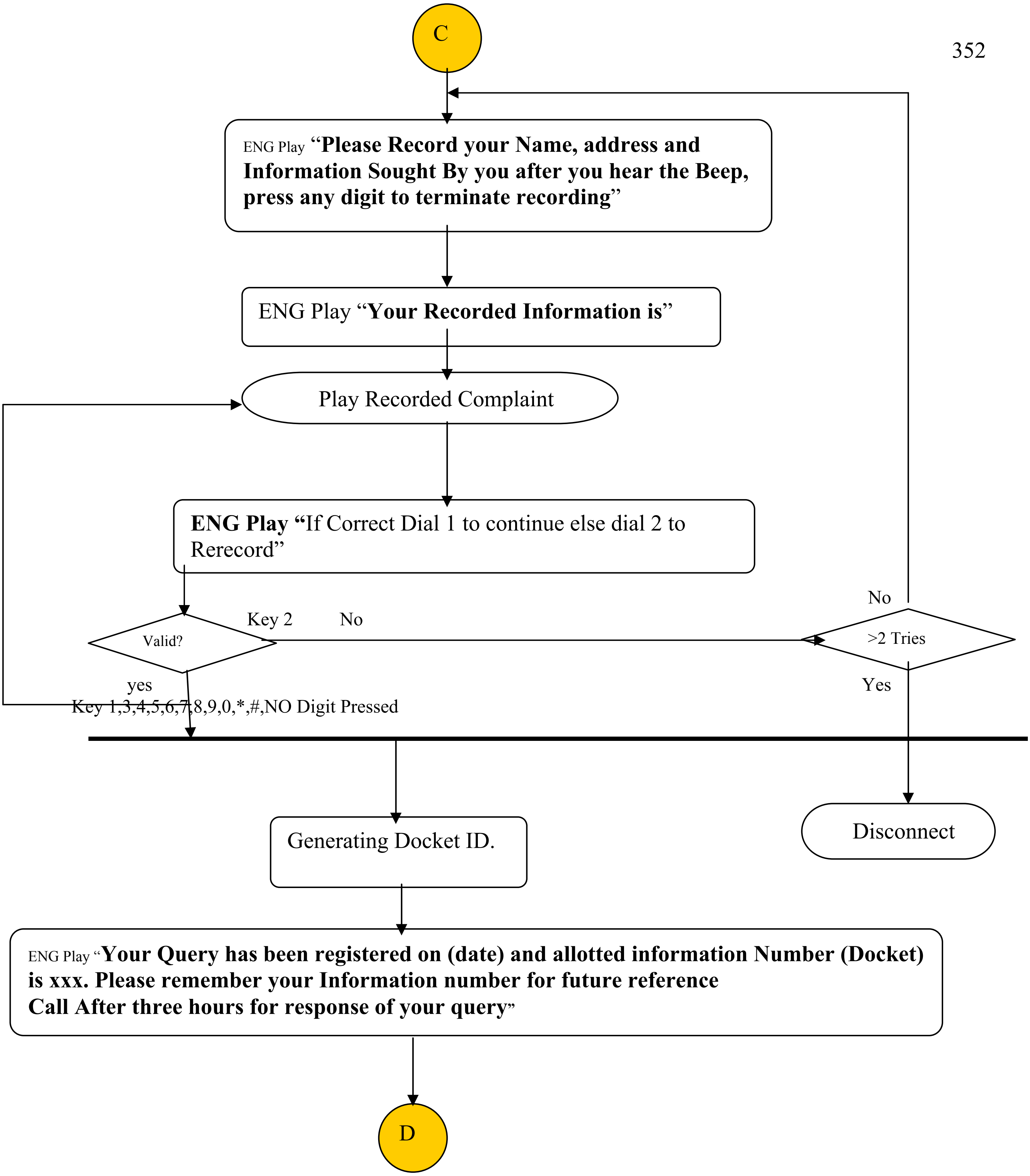

Silkworm
ENG Play "For information on breeds dial 1
For information on rearing dial 2
For information on diseases dial 3
For information on pests dial 4
For talking to information officer dial 5"
Informati on Officer
Valid?
Yes
No digit Pressed or Pressed 4,6,7,8,9,0,*,#
>1 Tries?
No
ENG Play "Invalid Number. You have exceeded Maximum no. Of retries. Please Wait Connecting to information Officer"
Dials 2
Dials 1
Dials 3
Dials 4
Dials 5
Eng Play "At Any Time Press 1 to Skip A Message Dial 5 for Speaking to Information officer Dial 6 for retrieving Status of information Dial 7 to record information Sought By you"
Information Officer
Dials 6
Dials 7
ENG Play "FAQs on rearing"
ENG Play "FAQs information on breeds"
ENG Play "FAQs for information on diseases"
ENG Play "FAQs for information on Pests"
Status
Query
ENG Play "Dial 9 to go back to Main menu Dial 0 to Exit"
Valid?
>2 Tries?
ENG Play "Invalid Number. You have exceeded Maximum no. of retries. Please try again later thank you for calling"
No
Dials 9
Dials 0
L1
ENG Play "Thank u for calling"
Disconnect
Disconnect

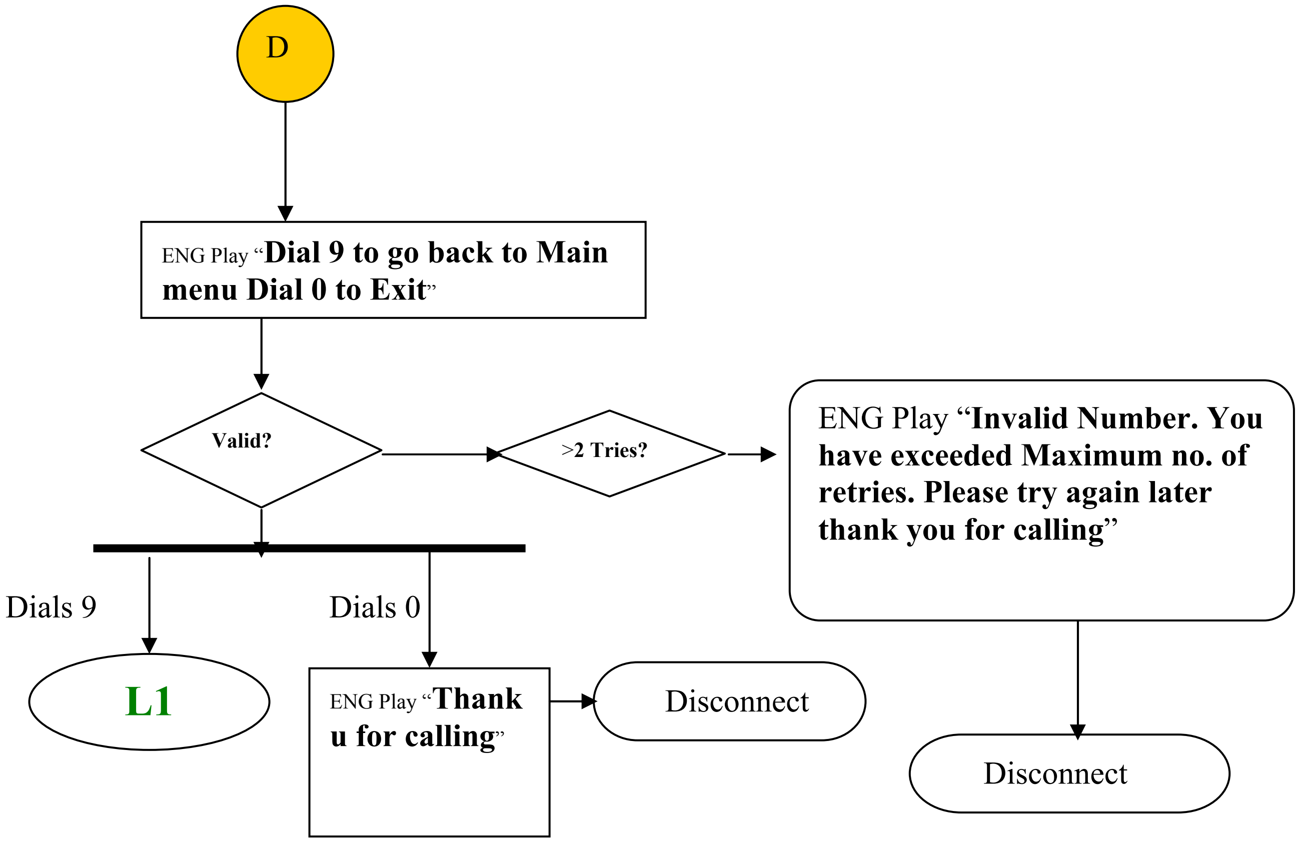

Post Cocoon
ENG Play "At Any Time Press 1 to Skip, Dial 5 for Speaking to Information officer, Dial 6 for retrieving Status of information, Dial 7 to record information Sought By you"
Dials 5
Information
Status
Dials 6
Dials 7
Query
ENG Play "FAQs information on post cocoon:"
ENG Play "Dial 9 to go back to Main menu, Dial 0 to Exit"
Valid?
>1 Tries?
ENG Play "Invalid Number. You have exceeded Maximum no. of retries. Please wait Connecting To Information officer"
Dials 9
Dials 0
L1
ENG Play "Thank u for calling"
Disconnect
Information


Information Officer
ENG Play "Transfer call to Information Officer:" Number from the database
Transfer Call to Information Officer
Line IS Free
No Answer
BUSY
ENG Play "The Caller is No Answer"
ENG Play "The Caller is Busy"
Disconnect
ENG Play "Dial 9 to go back to Main menu Dial 0 to Exit"
Valid?
No
>2 Tries?
ENG Play "Invalid Number. You have exceeded Maximum no. of retries. Please try again later thank you for calling"
Yes
Dials 9
Dial 0
L1
ENG Play "Thank u for calling"
Disconnect
Disconnect


Status
ENG play "Please dial your Information number".
Valid?
No
>2 Tries?
ENG Play "Invalid Number. You have exceeded Maximum no. of retries Please Call This Number XXXXXXXXXXX and get the information"
Yes
If called With in three hours after recording information
If Called information Is in pending
If called Information was Invalid
If Answered
ENG play "response for Your Information will Be answered Shortly".
ENG play "response for Your information will be answered with in 24 or 48 hours".
ENG play "Information recorded By You Is Invalid Please Re Record The Information Completely".
ENG play "Response for your Information Is".
ENG play "your Recorded Information Is And reponse will Played".
ENG play "If More Information is required Please record the Information by Dialing 9 Or Dial 5 to Speak to Information officer Or Dial to exit".
Dials 9
Dials 5
Dials 0
Query Recording
Information officer
ENG play "Thank you for calling"
Disconnect


Query Recording
ENG Play "Please enter your Land line Number or Mobile number including your STD Code"
ENG Play "You have Dialed XXXXXXXX.If Correct Dial 1 to continue else Dial 2 to Re-Enter"
KAN Play"neevu dial madidha dooravani sankhye XXXXXXX sariyagiddare sankhey ondannu Dial
Valid?
no
Yes
ENG Play "Invalid Phone Number please enter again later"
KAN Play "neevu dial madidha Dooravani sankhye sariyagilla dhavittu punha dial madi"
>2 Tries?
C
C


C
ENG Play "Please Record your Name, address and Information Sought By you after you hear the Beep, press any digit to terminate recording"
ENG Play "Your Recorded Information is"
Play Recorded Complaint
ENG Play "If Correct Dial 1 to continue else dial 2 to Rerecord"
Valid?
Key 2
No
>2 Tries
No
Yes
yes
Key 1,3,4,5,6,7,8,9,0,*,#,NO Digit Pressed
Generating Docket ID.
Disconnect
ENG Play "Your Query has been registered on (date) and allotted information Number (Docket) is xxx. Please remember your Information number for future reference
Call After three hours for response of your query"
D


D
ENG Play "Dial 9 to go back to Main menu Dial 0 to Exit"
Valid?
>2 Tries?
ENG Play "Invalid Number. You have exceeded Maximum no. of retries. Please try again later thank you for calling"
Dials 9
Dials 0
L1
ENG Play "Thank u for calling"
Disconnect
Disconnect

Competencies, Communication skills and the extension worker

By

Mukund V. Kirsur, K. Sathyanarayana, Phaniraj H S, Mohan Rao K and S. Amarnath

NASSI, Mysore, India

In the context of changing global Sericultural scenario the needs and demands of the sericulturists have also been changing drastically. That is why, unlike earlier days the extension communication has become much more challenging. To reach out effectively and holistically, the farmers needs are to be ascertained and understood in the present context of open market, demand for eco-friendly / organic products and the like. Advances in communication over the last decade have exposed Indian sericulture to a massive amount of new technologies and information on research programs, production, processing, marketing and management. As one of the main functions of Sericultural extension is to communicate and facilitate application of research findings in the field and the vital link between lab to land is the extension worker, he needs to possess the competencies related to manual, knowledge and communication skills. As the extension worker does not work in isolation he has to have a versatile, dynamic, friendly personality with a great communication and inter - personal skills.

The present paper deals with the need of such competencies for rural extension worker under Indian circumstances and the importance of timely training to enhance such competencies in order to make his work more effective and meaningful.

Key words: Sericulture Communication, Inter- personal skills, competencies, Extension Services

Future Prospects of Ericulture in the state of Maharashtra

By

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********Dept. of Zoology, Shivaji University,Kolhapur-416004,India.**

ABSTRACT

The eri-silkworm. (Philosamia ricini Hut.) can be reared on variety of plants. The castor crop (Ricinus communis) is well known as oilseed crop but its potentiality for rearing eri silkworms is not tapped properly in this region. It has further significance being very hardy, resistant to drought and insect pest and very much suited as rain fed crop while many crops fail due to erratic rainfall/intermittent dry spells. It is also substantiated through research findings that ericulture do not lower the yield of oilseed of castor and its cultivation is cost effective than mulberry sericulture. If due weight age is given to this crop for ericulture, the economy of so called marginal and poor farmers associated with marginal lands will definitely increase. Not only farmers will be benefited but the availability of raw material (eri cocoons and silk wastes) for agro-based cottage industries will be ensured from neighboring villages at relatively cheaper rate. Mulbery and tasar silk production is well known to the state, but extensive trials with respect to eri yet to be demonstrated. There are references of silk garments and silk production in Marathi literature from Gyaneshwar to Peshwai period. In 1911, Shri Abbaji Deshpande of Narayangoan (Pune) published a book entitled 'A new art-silk from castor' that had helped a lot for sericulture movement in Maharashtra. However, a non alliance movement of Gandhiji gave set back to sericulture as pupa is killed for unwinding silk. But people took lesson from Shri Deshpande's book and erisilk production introduced in the village of Pirangut but this industry could not be expanded. Maharashtra is considered as a non-traditional state for sericulture. Sericulture did not gain importance in Maharashtra due to alternative cash crops like sugarcane, cotton, grapes, onion and mango and in spite of all these Maharashtra is emerging as a contender for sericulture state among the non-traditional states of India. Ericulture was recently introduced in the State of Maharashtra, initial trials in few districts are very encouraging, and details are discussed in the paper.

Keywords: Eri, Silkworm, Castor

INTRODUCTION

India is blessed with variety of geological formations, diversified climate, vegetation and topography that resulted in the formation of different group of soils. This is also true for sericulture which are adopted on different soils supporting different vegetation (for rearing of silk-worms) in varied climatic environment. Visualising the pedoedaphic factors of Maharashtra and in particular of Vidarbha, ericulture has great potential. The eri-silkworm can be reared on variety of plants. The castor crop (*Ricinus communis*) is well known as oilseed crop but its potentiality for rearing eriworms is not tapped properly in this region. It has further significance being very hardy, resistant to drought and insect pest and very much suited as rainfed crop while many crops fail due to erratic rainfall/intermittent dry spells. It is also substantiated through research findings that ericulture do not lower the yield of oilseed of castor and its cultivation is cost effective than mulberry sericulture. If due weight age is given to this crop for ericulture, the economy of so called marginal and poor farmers associated with marginal lands will definitely increase. Not only farmers will be benefited but the availability of raw material (eri cocoons and silk wastes) for agro-based cottage industries will be ensured from neighboring villages at relatively cheaper rate.

History

Mulbery and tasar silk production is well known to the state, but extensive trials with respect to eri yet to be demonstrated. There are references of silk garments and silk production in Marathi literature from Gyaneshwar to Peshwai period. In 1911, Shri Abbaji Deshpande of Narayangoan (Pune) published a book entitled 'A new art-silk from castor' that had helped a lot for sericulture movement in Maharashtra. However, a non alliance movement of Gandhiji gave set back to sericulture as pupa is killed for unwinding silk. But people took lesson from Shri Deshpande's book and erisilk production introduced in the village of Pirangut but this industry could not be expanded. Maharashtra is considered as a non-traditional state for sericulture. Sericulture did not gain importance in Maharashtra due to alternative cash crops like sugarcane, cotton, grapes, onion and mango and in spite of all these Maharashtra is emerging as a contender for sericulture state among the non-traditional states of India.

Ericulture is still prominent as a Tradition in NEH region, one of the 18 bio-diversity hot spot in the world, and it is opined that the silk moth bio-resource is important to maintain the ecological and land economic stability for silk industry. Sericulture has tremendous potential in Maharashtra and in particular Western Maharashtra has conducive environment for it this tract adjoins Karnataka, the sericulture state of India.

The major crops grown in the state are sugarcane, paddy, groundnut, cotton, soybean, pigeonpea, sorhgum and chillies. Apart from this, the state also has the potentiality to produce both the mulberry and the non-mulberry silks. The Gadchiroli, Bhandra, Chandrapur and Gondia are known as tasar-producing districts. The geo-eco climatic conditions of the state favour commercial production of all the varieties of natural silks. It ranks sixth in mulberry raw silk production and first in tasar cocoon production in the country.

Cropping of large proportion of shallow soils (14.4 m ha), posing stressed environment in Maharashtra is possible through castor planting of which is economically sound because recommended agro-managements used for other rainfed crops may be used for castor too, thus extending its use. In this way, ericulture will bring prosperity in the rural as well as semi-urban area as the plant has multifold uses in the day to day life.

Climate **:**

Basically semi-arid tropical perennial but castor now grows through out the warm temperate and tropical region and flourish under such a variety of climatic conditions that its range cannot be easily defined. It can be found growing from sea level at the coast to high inland mountains. Castor is basically long day plant but is adoptable with some loss of yield to a fairly wide day length range. Castor requires a moderately high temperature, 20-26^{o}C with low humidity throughout the growing period to produce maximum yields. Long clear sunny days are most suitable. The Maharashtra agro-ecology can opt for castor in a large scale (Table 1).

Soils:

Castor will grow and produce a crop in almost any soil with the exception of very heavy clays and those poorly drained. It grows well on the light sandy soils rich in humus. Since castor is often selected for growing in areas, which are marginal for other crops, this adoptability is of considerable economic value. Highly fertile soils favour excessive vegetative growth, prolong the period to maturity and greatly extend the flowering, all of which adversely affect the seed yield.

The effect of topography on land usage and cropping of castor may be seen while traversing near Kondhali but the observation is confined to a relatively small area. An excellent example to this is the succession of soil type for castor, which occurs on rolling undulating topography. By the efforts of CEO Nagpur, plantation of castor was done in the month of July, 2003 on CCT at village, Bharatwada and Kate-Panjra, the crop is in seeding stage and ready for harvest where most of the CCT have soft murrum. It depicts that shallow soils underlain by murrum (weathered parent material/saprolite) may suite to castor. Soils of slightly acid reaction, pH 5.0-6.5 are preferred but castor will tolerate pH up to 8.0. Growth tends to be restricted to a much greater extend on alkaline clays than on other soil type, but there is a scarcity of data on the plants at reaction high soil pH values.

An important factor in land use particularly relevant to castor is soil conservation. Castor plants have little soil binding ability, a fairly open canopy, require efficient weed control resulting in relatively bare soil surface and are often grown in dry areas with high winds and high intensity of rainstorms. On soil, which is liable to erosion, all these factors can cause major damage and adequate conservation measures must be an integral part of any large scale planting. Castor's ability to adopt to environmental factors should be exploited, since selection within the local varieties for a strain suited to a particular soil type can greatly increased the yield.

Data (Table 1) indicate that climate and majority of soils are suitable for castor cultivation in Vidarbha. By doing so, the production of castor oil and eri silk will increase many fold and help poor farmer's in sustaining against vagaries of monsoon, insect pest *etc*.

Availability of eri food plants

Castor (*Ricinus communis*) is one of the major crops in the districts of Yeotmal, Chandrapur and Bhandra districts of Vidarbha region. It is also being cultivated to some extent in Satara, Sangli, Pune, Ahmednagar and Kolhapur districts. The castor is under cultivation for several decades as crop. The average yield of castor seed is 356 kg ha^{-1}, which fetches Rs. 4900/- only unlike in Gujarat where it is cultivated under irrigated conditions and the annual average yield per ha is 1780 kg fetching Rs. 25000/-, five times more than the income earned by their counterparts in Maharashtra.

Eri and Employment generation in Maharashtra

Without touching to the present cultivated area, eri culture can be adopted on fallow land (1024000 ha) which will boost employment in the state. The state has nearly 9000 ha area under castor presently cultivated for only oil purpose. The rearing eri silk on one hectare castor may provide an additional income (Rs. 9000/-) and employment (750 man days) for five crops of eri rearing.

On traversing from Nagpur to Navegaon bandh *via* Bhandara the eyes catch about 2 ha of castor crop owned by Mr. Tukaram Asole. During discussion he informs that from last 7 years he gets a profit of 15000 to 18000 per hectare through castor oil. He is not aware for rearing of eri silk on castor crop. Mr. Tukaram Asole narrated that If castor occupies land at least for 2 years (this being the minimum period) the profitable returns in terms of oil could be obtained in dry land. Some parts of Yeotmal district have perennial plantation of castor and cultivators fetch high returns. In Nagpur, the vigorous growth of wild castor on both sides of NH-6 connecting Bazargaon and Kondhali is observed which is live proof for our hypotheses that castor cultivation can be extended in this non-traditional belt also.

Byproducts

There is a need to explore ways and means for effective utilization of ericulture byproducts to raise the income of the producers on sustainable basis. Both on-farm and off-farm sectors of the industry have high potential to convert their wastes into useful byproducts of commercial value.

Estimated byproducts from the sub-sectors of ericulture

Castor stem biomass

Castor is grown as commercial crop for seed. From ericulture point o view, leaf is the main product, used to feed the eri-silkworms. Like any other field crops, it also yields substantial quantity of above ground bio-mass at the end of crop season.

Castor stems form good source as pulp in paper industry as fuel with a caloritic value of 4767 Kcal/kg and forms a good stratum for oyster mushroom culture. In addition, the castor stems can be used in hut roofs and other on-farm uses.

Bye -products from eri silkworm rearing

During metabolism in silkworms, the waste products are mainly excreted as urine along with fasces. It has been estimated that 45 per cent of the total leaves fed to silkworms goes as waste in the form of unfed leaves and shoots.

Eri silkworm excreta can be effectively used as manure or in biogas production and substrate for mushroom cultivation. In addition its optimum utility can be explored in other production facets as fish and poultry feed. Eri silkworm leaf litter contains higher NPK than cow dung, thus it can be used as a organic manure in crop husbandry. Silkworm litter rich in nitrogen serves as a good source for the growth of edible mushrooms. Thus leaf litter can be further explored in manifold on farm activities.

Prospects

In addition to its production potential, ericulture can play a vital role in polyculture on-farm production facets, efficient waste utilization and renewable energy source. In these lines, the generated information needs to be transferred to the beneficiaries.

Support for raising the eri food plants

With an objective to encourage raising systematic plantation of eri food plants, appropriate technologies and procure improved rearing appliances to enhance cocoon production. Assistance to the tune of Rs.3750/- is provided to eri rearers to raise half acre of castor plantations on their own land as per the package of practices developed by Research Institutes. Each farmer who takes up systematic plantation would be trained in improved rearing practices under one month stipendiary training programme conducted by the State/Central Silk Board. The assistance covers 75% of the cost of seedlings, plantation maintenance and start-up tools. The assistance is provided through the State Department of Sericulture. All farmers who either have half an acre own land or have usufructs right on the community village land, waste land, degraded forest land etc., individually or the groups may contact office of the Directorate of Sericulture in State/District to get themselves aware/updated about ericulture.

Future Strategies;

The agro-ecology of Maharashtra is well suited to castor, on a large scale ,caster is one of the major crops in the many districts of Vidarbha and rest of Maharashtra. With an objective to encourage raising systematic plantation of eri food plants, Directorate of Sericulture, Maharashtra is promoting contract farming of castor through Jayant oils and derivatives Pvt. Ltd., Mumbai with financial help from SBI to castor growers. In near future Govt. of Maharashtra ,Central Silk Board and Jayant Oils & Derivatives have proposed a MOU for castor farming and development of ericulture in the State.

Projections for Silk Production -Physical Targets:

It is evident that the raw silk productionin Maharashtra State is 80 MTs in the year 2006-07 with major contribution coming from mulberry silk. During next 5 years, special emphasis would be given on development of Mulberry, Eri and Tasar silks in the state through harnessing natural resources more effectively. Keeping in view of the present production, productivity and potentialities in the state, the following production targets are envisaged over the next 5 years (2007-2012).

Variety of Silk	Target (MT)
Mulberry	150
Tasar	50
Eri	35

Total	235

Thus, raw silk production would increase from 80 MTs at the end of third year of X Plan to 235 MT by the year 2011-2012 in the State. It is projected that there will be an incremental production of about 193 MTs, 113 MT Mulberry raw silk, 45 MT Tasar reeled silk and 35 MT Eri spun silk over the XI plan period.

The initial rearing trials of eri silkworms in Vidarbha are encouraging. In addition to its production potential ericulture can play a vital role in polyculture on farm production activities, efficient waste utilization and renewable energy source. However, there is a need to explore its potentiality and ensure effective transfer to the beneficiaries. Thus, the abundant castor flora now existing in the state, can well be utilized for eri culture, without affecting the production of castor seeds. It will also create employment opportunities for the rural poor, generate additional income to distressed farmers of Vidarbha and boost eri silk production in the State and Country.

Acknowledgement

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REFERENCES

1) Sathe,T.V. and A.D.Jadhav(2001)*Sericulture and Pest Management* ,Daya Publishing House, Delhi , **1-197**.

2) Jadhav, AD., T.N. Hazare, Jagdish Prasad and S.A. Rode (2004)Prospects of Ericulture in Maharashtra, 2004. *Indian Silk* , 43, (5), 15-16.

3) Nagaveni , V.,M.P. Shree and K. Ravikumar (2002) Effect of feeding eri silkworms with Diseased castor leaves on the

PROGRESS AND PROSPECTS OF SERICULTURE INDUSTRY IN MAHARASHTRA,INDIA

By

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ABSTRACT

Maharashtra is India's third largest state in terms of area and one of the industrially and agriculturally advanced States in the country. The rural population however depends mainly on agriculture activity and over 64% of the people are employed in agriculture and allied activities. Rice, jowar, bajra, wheat, oranges, grapes, bananas, mangoes, and pulses are important food crops. The cash crops include groundnut, cotton, sugarcane, turmeric and tobacco. The net irrigated area is 33,500 square kilometers. 57.07% land is under food grain crops. Sericulture is well known as a highly employment and low capital-intensive plantation crop and having orientation towards agro-based industry. This agro-based industry has high potential to generate the employment especially in rural and semi urban areas under present circumstances. Broadly Maharashtra is divided in four(Western Maharashtra, Konkan, Marathwada and Vidarbha) regions were some climatic variation is observed Maharashtra is a non-traditional Mulberry silk producing state in the country occupying first position among non-traditional States and seventh position among all the Mulberry silk producing States in the country in respect of Mulberry raw silk production. . Sericulture in Maharashtra is practiced in 1441 villages of 22 districts. (Kalantri & Jadhav, 2006). The data shows that area and production in the state is continuously increasing which resulted to generate the employment for rural masses of respective areas. Plantation increased from 1,354 (1988-89) to 6682 acres (Annonymous,2007)) whereas ,consumption of dfls increased from 2.17 lakhs (1988-89) to 18.40 lakhs in (2007). Cocoon production increased from 34.62 M Ts (1988-89) to 766M Ts in (2007). Maharashtra has carved out a distinct place in the world of textiles by virtue of its exquisite "Paithani" a poem in gold and silk a weaving known for extra-ordinary craftsmanship, occupy a place of honor in the world of fabrics. (Jadhav, 1999). Prospects of sericulture Industry Maharashtra has carved out a distinct place in the world of textiles by virtue of its exquisite "Paithani" a poem in gold and silk a weaving known for extra-ordinary craftsmanship, occupy a place of honor in the world of fabrics. (Jadhav, 1999). Details are discussed in the paper.

Keywords: Sericulture,Cocoon, Silkworm

INTRODUCTION

Sericulture is well known as a highly employment and low capital-intensive plantation crop and having orientation towards agro-based industry. This agro-based industry has high potential to generate the employment especially in rural and semi urban areas under present circumstances. Broadly Maharashtra is divided in four (Western Maharashtra, Konkan, Marathwada and Vidarbha) regions were some climatic variation is observed

Maharashtra is India's third largest state in terms of area and one of the industrially and agriculturally advanced States in the country. The rural population however depends mainly on agriculture activity and over 64% of the people are employed in agriculture and allied activities. Rice, jowar, bajra, wheat, oranges, grapes, bananas, mangoes, and pulses are important food crops. The cash crops include groundnut, cotton, sugarcane, turmeric and tobacco. The net irrigated area is 33,500 square kilometers. 57.07% land is under food grain crops. Forest comprises only 14.7% of the state area (67,935 sq. kilometers) covering the eastern region and the Sahyadri range, which open scrub jungle dots plateau. The soils of Maharashtra are residual, derived from the underlying basalts. In the semi-dry plateau, the regur (black cotton soil) is clayey, rich in iron but poor in nitrogen and organic matter. The higher plateau regions have patter soil, which contains more gravel. In brief, the soils are deep black to shallow black, laterite to latritic reddish brown, costal alluvium, costal saline and yellow brown. The temperature ranges from 10^0C to 47^0C and average rainfall is about 1000 mm.

Historic Development :

Maharashtra has carved out a distinct place in the world of textiles by virtue of its exquisite "Paithani" a poem in gold and silk a weaving known for extra-ordinary craftsmanship, occupy a place of honor in the world of fabrics. (Jadhav, 1999). It was seen that several attempts were made to introduce sericulture in Maharashtra during the 19th century. As per earlier records Government officials of the collector rank, who initiated sericulture trials in 1827 ended with failure in 1847 (Souvenir, Museum of Arthropods, Pune – 2002).

The beginning of mulberry sericulture in Maharashtra commenced with very small laboratory of sericulture research station established at Panchgani dist. Satara during 1958-59. This center was established to critically examine the economic feasibility of sericulture as a cottage industry. It is only in the beginning of the sixth plan period, mulberry sericulture was introduced in some of the potential areas of the state by Khadi and Village Industries Board (KVIB).

It was seen that several attempts have been made to introduce sericulture in Maharashtra. However, the industry did not spread beyond borders of Wai taluka of Satara district till 1977-78 (Tayade, 1991). In very small area cultivating the selected mulberry varieties in different agro climatic regions of Maharashtra. Various varieties of mulberry and non-mulberry plants were collected and after finding its suitability on a mass scale cultivation was undertaken with the trial and error methods in 80s.

In the Seventh Five Year plan the Govt. of Maharashtra with the assistance of Central Silk Board had made sincere efforts to promote sericulture activity through KVIB. As a result, sericulture was scattered all over the state in various pockets. The KVIB introduced few schemes under centrally assisted programme i.e. Western ghat development and established few Pilot Extension cum Training Centers, Basic seed farms, Demonstration cum Training Centers for reeling and Chawki rearing Centres. Recently, Govt of Maharashtra has established separate Directorate of Sericulture during 1997 with its headquarter at Nagpur. During 10th.plan period various Schemes were implemented with the assistance of State Govt. as well as CSB. In 11th. Plan period various developmental schemes are being proposed for integrated sericulture development in the state.

WEATHER:

The agro-climatic conditions are like adjoining Karnataka and are suitable for Mulberry and Tasar cultivation in the state. The temperature and humidity from July to March is ideal for Mulberry and Tasar silkworm rearing. Even though some parts of Maharashtra such as Bhandara, Chandrapur, Gondia and Gadchiroli are producing Tasar cocoons, there was no appreciable Mulberry Sericulture in Maharashtra till recently. The higher altitudes, moderate temperature and good soil conditions in Western Ghat and Vidarbha Region of the State offer good scope for Sericulture development specially Bivoltine Mulberry sericulture. The farmers of Solapur, Kolhapur, Marathwada and Vidarbha area have shown that they can produce superior grade cocoons than that of the farmers producing in neighboring traditional State.

The Mulberry cultivation is practiced in 22 districts of Maharashtra comprising Vidarbha, Marathwada and Western region while, in the tribal districts like Bhandara, Chandrapur, Gadchiroli and Gondia Tasar cultivation is practiced for last 300 years. Maharashtra is growing up as a potential Mulberry raw silk producing State among the non-traditional states**.**

Sericulture in Maharashtra has a tremendous potential especially Western Maharashtra has conducive environment and secondly it adjoins to Karnataka the premier sericulture State of India. Maharashtra is considered as a non-traditional state of sericulture. Sericulture in Maharashtra is not new, it is about three decades old. Sericulture did not gain importance in Maharashtra due to alternate cropping pattern like sugarcane, cotton and other agricultural cash crops (Jadhav,1999). Maharashtra has also taken keen interest in this industry and established independent Directorate of Sericulture under the Ministry of Textile during 1997 looking towards the its demand in the national and international market. In Maharashtra very few sections of the society are well acquainted with tasar and mulberry silk production. The state is yet to initiate organized efforts for exploring the possibility of eri silk (Sathe and Jadhav, 2001). However, Dept. of Sericulture has introduced ericulture on 28 th.April 2006,in the presence of Minister of Textile, Govt. of Maharashtra and Chairman ,Central silk Board,Bangalore at Nagpur.

Present Status of Silk Industry in Maharashtra:

Maharashtra is a non-traditional Mulberry silk producing state in the country occupying second position among non-traditional States and seventh position among all the Mulberry silk producing States in the country in respect of Mulberry raw silk production. . Sericulture in Maharashtra is practiced in 1441 villages of 22 districts. (Kalantri &Jadhav, 2006). The data shows that area and production in the state is continuously increasing which resulted to generate the employment for rural masses of respective areas. Plantation increased from 1,354 (1988-89) to 6682 acres (Annonymous,2007)) whereas, consumption of dfls increased from 2.17 lakhs (1988-89) to 18.40 lakhs in (2007). Cocoon production increased from 34.62 M Ts (1988-89) to 766M Ts in (2007). Sericulture is practiced in all three zones except in Konkan region. Western Maharashtra rank first among all the regions with respect to area under plantation, cocoon production and consumption of dfls.

The main districts are Pune, Satara, Sangli, Solapur, Kolhapur, Ahmednagar, Washim, Buldana, Nagpur, Aurangabad, Hingoli and Beed. Besides, it is a minor but traditional Tasar producing state occupying eighth position in production of Tasar silk. Tasar sericulture is practiced by about 678 families belonging to mainly Dheewar Community in about 16,000 ha tasar plantations covering 5 districts in Nagpur and Pune divisions. The districts are Gadchiroli, Gondia, Bhandara, Chandrapur and Thane.

Infrastructure facilities available in the state*:*

Sector	Infrastructure	Under State	Under Central
	Regional Development Office	-	1
	Regional Office	04	-
	District Sericulture Office	18	-
Mulberry	Silkworm Seed Production Centres (Commercial Grainage)	02	- -
	Cocoon Collection Centre	12	-
	Mulberry Silk Production & Demonstration Centers	14	-
	Research Extension Centre	-	2
	Sericulture Demonstration & Training Centre	16	- -
	Twisting & Weaving Units	02	-
	Cottage Basin	74	-
	Multiend Reeling machine (basins)	70	-

Financial Outlay

The total outlay for development of sericulture in Maharashtra comes to Rs. 158.92 Crores for the entire XI plan. As the approach proposed in holistic i.e. from raising of plantation to production and marketing of fabric, the programme costs are phased over the XI plan period (2007-2012) and the annual requirement will vary from year to year.

Source of funds

The development of sericulture has been through the following schemes.

1. State Plan and District Level Schemes.
2. Central Silk Board sponsored CDP Schemes.
3. Employment Guarantee Scheme
4. Western Ghat Development Programme
5. Ministry of Rural Development (MORD) GOI
6. In addition to this certain specific schemes of the Post Cocoon and reeling sector can be implemented through State Plan Scheme

Similarly certain schemes like popularization of high yielding varieties and Central Silk Board hybrids, organic farming ,soil fertility management for sustainable development can be pursued under Western Ghat Development Programme. A detailed note on the above can be submitted by the Directorate of Sericulture if the concept paper is accepted by Government.

Production:

From late nineties, mulberry raw silk production in the state has increased and reached a peak of 80 MTs in the year 2006-2007.

Present productivity:

The present level of productivity in Mulberry

Productivity parameters	

Mulberry	
1.Average leaf yield per acre.	7,000 kgs
2.Rearing capacity utilization	85 to 90 %
3.Rearing capacity per crop per farmer	100-150 dfls
4.Dfls intake per acre	360 dfls
5.Cocoon yield per 100 dfls	45 kgs
6.Renditta	10

Developmental schemes being implemented during X plan:

The development of Sericulture has been done through the following schemes.

1. State Plan & District level Schemes.
2. Non-Plan scheme.
3. Employment Guarantee Scheme.
4. Central Silk Board sponsored CDP scheme.

Catalytic development programme sponsored by CSB during 9th and 10th Plan played an important role to boost the Sericulture activities in the State. It resulted in improving the quality cocoon production, increase per acre production, minimize the renditta, etc. The following schemes are implemented during X Plan under Catalytic Development Programme of CSB.

Approach to boost sericulture in the state:

It is therefore proposed that, during XI Plan, cluster approach would be adopted for sericulture development in the state with proper forward and backward linkages. Adequate infrastructure would be developed in private sector and private participation would be ensured in seed production and post cocoon activities. Though seed subsidy would continue to mitigate the financial burden of the poor farmers, parallel efforts will be made to develop seed production infrastructure within the state. Thrust will be laid on developing a clear-cut Post Cocoon Policy at the State Government level for facilitating the proper growth of post cocoon sector. Reeler-Twister-Weaver interface will be strengthened and a specific zone will be developed for post cocoon activities. Non-Governmental Organizations will also be roped in for the purpose. Holistic approach would be adopted for establishment of all the activities from plantation development to production and marketing of silk fabrics.

Objectives –

a. Revival, expansion and diversification of sericulture in the state especially Bivoltine Mulberry, Eri and Tasar silks.
b. Creating greater opportunities for gainful employment to tribal and other poor sections of the society in rural areas through spread of sericulture concentrating on potential clusters in potential districts.
c. Improving productivity and quality at all levels starting from cocoon production to fabric production through skill up-gradation and integrated extension support.
d. Nurturing and developing local artisans and craftsmanship.
e. Strengthening of Self Help Groups, Cooperative Societies and NGOs involved in sericulture development.
f. Market development through networking and promotional campaigns within and outside the state.

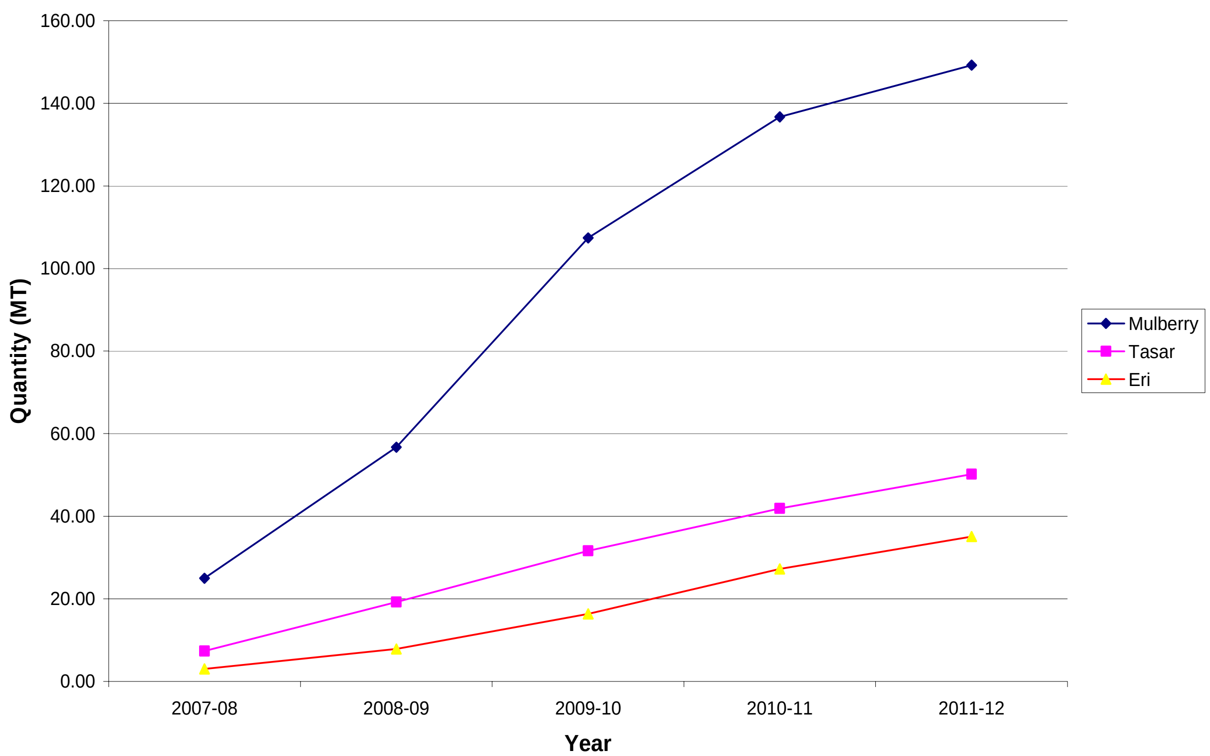
Projections for Silk Production -Physical Targets:

It is evident that the raw silk production is 42 MT in the year 2004-05 with major contribution coming from Mulberry silk. During next 5 years, special emphasis would be given on development of Mulberry, Eri and Tasar silks in the state through harnessing natural resources more effectively. Keeping in view of the present production, productivity and potentialities in the state, the following production targets are envisaged over the next 5 years (2007-2012).

Variety of Silk	Target (MT)
Mulberry	150
Tasar	50
Eri	35
Total	235

Thus, raw silk production would increase from 80 MT at the end of X Plan to 235 MT by the year 2011-2012 in the state. It is projected that there will be an incremental production of about 193 MT – 113 MT Mulberry raw silk, 45 MT Tasar reeled silk and 35 MT Eri spun silk over the XI plan period**.**

Production of Raw Silk during XI Plan



Vertical as well as horizontal growth is visualized in Mulberry and non-Mulberry silk production in the state. It is proposed that cocoon productivity would be increased to 50 kg /100 dfls in Mulberry. Further, the quality of cocoons would be improved so as to get a renditta of 8 in Mulberry, with the percolation of improved technological inputs and technical know-how in the field.

Strategies -

General:

- Adoption of group-based, holistic, cluster-oriented and farmer-centric approach for implementation of need-based Project(s) with clear forward and backward linkages
- System of Command area/contract farming will be adopted in a cluster to avoid outflow of cocoons, to solve marketing problems and development of post cocoon sector
- Skill development, and sharpening managerial abilities and technical skills through appropriate Human Resource Development Programme on a regular basis
- Privatization of Seed Production sector
- Entrepreneurship development in post cocoon sector, concentrating in the areas where specific group of people is located to firm up reeling linkages like Ramanagaram and Sidalghatta in Karnataka
- Development of cooperative culture in sericulture, both in pre-cocoon and post cocoon sectors, by establishing village-level, block-level and district level societies and federating them at apex level
- Involvement of Non Government Organizations, Women Groups, Self Help Groups etc in implementation of the Schemes/Projects/ Programmes
- Integration of sericulture activity with other agro-based rural activities leading to empowerment of rural poor
- Market promotion through exhibitions, product diversification, etc
- Development of seri-systems for implementation and monitoring with role clarity and specific linkages.

Mulberry:

- Development of systematic plantation of Improved Mulberry varieties like S_{1635}, S_{36}, V_1 etc, through saplings with close spacing and assured irrigated facilities
- Popularization of organic farming, green manuring and vermi-composting for soil fertility management and for checking adverse effects of chemical fertilization through use of organic manures
- Setting up quality silkworm seed production infrastructure in private sector by motivating the entrepreneurs and leasing out the state infrastructure facilities
- Development of proper infrastructure facilities like separate rearing house, improved rearing and mounting equipments at farmers' level
- Popularization of high yielding productive hybrids and combinations especially CSR hybrids for bivoltine cocoon production
- Establishment of Cooperative Chawki Rearing Centers for supply of chawki silkworm larvae

- Adoption of Improved silkworm rearing practices developed by CSB Institutes (shelf rearing by shoot feeding technique)
- Contractual disinfection of the rearing houses and appliances to check crop failures and other risks especially in bivoltine rearing
- Setting up of improved silk reeling and twisting units in private sector through individual entrepreneurs, Self Help Groups or NGOs itself
- Strengthening of service sector for supply of farm and non-farm inputs (institutionalizing the input supply) and
- Systematizing the marketing of seri-outputs (establishing forward and backward linkages).

STRATEGIES TO BE ADOPTED

1) Promoting contract farming in Mulberry Plantation, Silk Worm Rearing and Cocoons production.
2) Offering Higher Incentive to the farmer will be doing in Sericulture as compared to other agriculture crops.
3) 50,000 hectors of land need to be identified in the difference of State Conducive Climate, soil and manpower for Cocoon Production.
4) Offering incentive subsidy in the area of Post Cocoon Technology i.e. Reeling and Weaving etc.
5) Declaring State of Sericulture as a Mission to occur thus in the thrust area in the Priority Sector.
6) Developing Soil to Silk and Silk to Fabrics by adopting Textile Silk for approach.
7) Offering SEZ like incentive for development of silk, like exemption in income tax, VAT etc.
8) As a result of above approach and policy in development of silk will generate an employment of 5 Lacks, specially to rural people thereby preventive Rural to urban migration..
9) This will need a package of 5,00 Crores rupees for complete Five Year Plan which will create a revenue of 7,00 Crores

Financial Outlay

The total outlay for development of sericulture in Maharashtra comes to Rs. 158.92 Crores for the entire XI plan. As the approach proposed in holistic i.e. from raising of plantation to production and marketing of fabric, the programme costs are phased over the XI plan period (2007-2012) and the annual requirement will vary from year to year.

Source of funds

The development of sericulture has been through the following schemes.

1. State Plan and District Level Schemes.
2. Central Silk Board sponsored CDP Schemes.
3. Employment Guarantee Scheme
4. Rashtriya Sama Vikas Yojana for Tasar development in Gondia and Bhandara District.
5. Western Ghat Development Programme
6. Ministry of Rural Development (MORD) GOI

In addition to this certain specific schemes of the Post Cocoon and reeling sector can be implemented through State Plan Scheme.Similarly certain schemes like popularization of high yielding varieties and Central Silk Board hybrids, organic farming soil fertility management for sustainable development can be pursued under Western Ghat Development Programme. A detailed note on the above can be submitted by the Directorate of Sericulture if the concept paper is accepted by Government.

Identified Needs of the State:

The constraints before the Directorate of Sericulture M.S. Nagpur in implementing various schemes were as follows.

1. Inadequate manpower for extension related work.
2. Lack of forward backward linkages.
3. Limited success in developing post cocoon sector especially reeling and silk processing.

Directorate of Sericulture would take Sericulture activity in appropriate cluster or agglomeration of activities that would not be merely geographical agglomeration but integrated units.

a) Development of forward and backward linkages.
b) Efforts to develop seed production infrastructure in the state.
c) Developing a clear cut Post Cocoon technology.
d) Strengthen Reeler, Twister, Weaver interface.
e) Develop a Zone/Common Facility Centre for post cocoon activities.
f) Entrepreneurship development in post cocoon sector concentrating in the areas where a specific group of people are located to form up reeling linkages.

Acknowledgement

The authors wish to express their gratitude to capt Dr.L.B. Kalantri, Director, Directorate of Sericulture ,Govt. of Maharashtra, Nagpur, for providing facilities and for his encouragement

REFERENCES

1.Capt. Dr. L.B.Kalantri, Dr. A.D. Jadhav Progress and prospects of sericulture industry in Maharashtra.International Conference on Sericulture ,South Korea,11-15th.Oct.2006.

2.Jadhav, A.D. 1999. Studies on natural enemies of silkworms with special reference to class Insecta, Ph. D. Thesis, Shivaji University, Kolhapur, pp 1-212.

3.Tayade, D.S. 1991. Sericulture in Maharashtra, Challenges and Solutions. Indian Silk, 30:3

PROSPECTS AND STATUS OF BIVOLTINE SILK IN THE STATE OF MAHARASHTRA, INDIA

By

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ABSTRACT

Maharashtra is India's third largest state in terms of area and one of the industrially and agriculturally advanced States in the country. The rural population however depends mainly on agriculture activity and over 64% of the people are employed in agriculture and allied activities. The agro-climatic conditions are suitable for Mulberry and Tasar cultivation in the state. The temperature and humidity from July to March is ideal for bivoltine silkworm rearing. The temperature ranges from 10^0C to 42^0C and average rainfall is about 1000 mm. The higher altitudes, moderate temperature and good soil conditions in Western Ghat Region of the State offer good scope for Sericulture development specially Bivoltine Mulberry sericulture. The farmers of Western Maharashtra region particularly from Pune, Solapur & Kolhapur Districts, have shown that they can produce superior grade bivoltine cocoons. Maharashtra is a non-traditional Mulberry silk producing state in the country occupying second position among non-traditional States and seventh position among all the Mulberry silk producing States in the country in respect of Mulberry raw silk production. The Mulberry cultivation is practiced Vidarbha, Marathwada and Western region while in the tribal districts like Bhandara, Chandrapur, Gadchiroli and Gondia. Tasar cultivation is practiced for last 300 years. Maharashtra is growing up as a potential Mulberry raw silk producing State among the non-traditional states of India. Mulberry sericulture is practiced in 1125 villages of 22 districts of Vidarbha, Marathwada and West Maharashtra by about 5027 families having about 6682 acres Mulberry plantation. The main districts are Pune, Satara, Sangli, Solapur, Kolhapur, Ahmednagar, Washim, Buldana, Nagpur, Aurangabad, Hingoli and Beed. Present bivoltine cocoon production in the State is about 65 MTs .For integrated development of Bivoltine silks in the state, cluster approach would be adopted and separate clusters for bivoltine Sericulture will be identified. While Mulberry cluster will be taken up in Pune, Satara, Sangli, Kolhapur, and Solapur districts in western Maharashtra. For integrated development of bivoltine silks in the state, cluster approach would be adopted and separate clusters for bivoltine Sericulture will be identified. While Mulberry cluster will be taken up in Pune, Satara, Sangli, Kolhapur, and Solapur districts in Western Maharashtra. Integrated bivoltine development program discussed in the paper.

Keywords: Sericulture, Cocoon, Bivoltine, Silkworm

1. INTRODUCTION

Maharashtra is India's third largest state in terms of area and one of the industrially and agriculturally advanced States in the country. The rural population however depends mainly on agriculture activity and over 64% of the people are employed in agriculture and allied activities. Rice, jowar, bajra, wheat, oranges, grapes, bananas, mangoes, and pulses are important food crops. The cash crops include groundnut, cotton, sugarcane, turmeric and tobacco. The net irrigated area is

33,500 square kilometers. 57.07% land is under food grain crops. Forest comprises only 14.7% of the state area (67,935 sq. kilometers) covering the eastern region and the Sahyadri range, which open scrub jungle dots plateau. The soils of Maharashtra are residual, derived from the underlying basalt's. In the semi-dry plateau, the regur (black cotton soil) is clayey, rich in iron but poor in nitrogen and organic matter. The higher plateau regions have patter soil, which contains more gravel. In brief, the soils are deep black to shallow black, literate to latritic reddish brown, coastal alluvium, coastal saline and yellow brown.

WEATHER CONDITIONS:

The agro-climatic conditions are like adjoining Karnataka and are suitable for Mulberry and Tasar cultivation in the state. The temperature and humidity from July to March is ideal for BOVOLTINE silkworm rearing. The temperature ranges from 10^0C to 42^0C and average rainfall is about 1000 mm. The higher altitudes, moderate temperature and good soil conditions in Western Ghat Region of the State offer good scope for Sericulture development specially Bivoltine Mulberry sericulture. The farmers of Western Maharashtra region particularly from Pune, Solapur, Kolhapur Districts, have shown that they can produce superior grade bivoltine cocoons than that of the farmers producing in neighboring traditional State.

1.2 Present Status of Silk Industry in Maharashtra

Maharashtra is a non-traditional Mulberry silk producing state in the country occupying second position among non-traditional States and seventh position among all the Mulberry silk producing States in the country in respect of Mulberry raw silk production. The Mulberry cultivation is practiced Vidarbha, Marathwada and Western region while in the tribal districts like Bhandara, Chandrapur, Gadchiroli and Gondia Tasar cultivation is practiced for last 300 years. Maharashtra is growing up as a potential Mulberry raw silk producing State among the non-traditional states of India.

Mulberry sericulture is practiced in 1125 villages of 22 districts of Vidarbha, Marathwada and West Maharashtra by about 5027 families having about 6682 acres Mulberry plantation. The main districts are Pune, Satara, Sangli, Solapur, Kolhapur, Ahmednagar, Washim, Buldana, Nagpur, Aurangabad, Hingoli and Beed

There is an effective area of about 6000 acres under mulberry plantation in the state. In 2007-08, 4410 new farmers will raise about 5000 acres of mulberry plantation.

Productivity:

The present level of productivity in Mulberry

Productivity parameters	
Mulberry	
Average leaf yield per ha	15,000 kgs
Rearing capacity utilization	85 to 90 %
Rearing capacity per crop per farmer	100-150 dfls
Dfl intake per acre	360 dfls
Cocoon yield per 100 dfls	45 kgs
Renditta	10

Status of Bivoltine Sericulture in the state:

Sr. No.	Year	No. of Beneficiary	Dfls Supply CSR Hybrid	Cocoon Prodn. In	Yield per 100	% supply of BV Dfls against total

				Kgs.	Dfls	Dfls supply
1	2004-05	630	310836	132293.6	43	30.38
2	2005-06	410	259091	113880.7	44	24.93
3	2006-07	311	127650	52411.9	41	7.30

The figures shows decline trend in Dfls supply of Bivoltine hybrid mainly due to-

1- comparative rates of kolar gold to CSR Hybrid are minimum.

2- Low risk in rearing compare to CSR hybrid Bivoltine in Pune region

Bivoltine Sericulture in Pune region-

Sr. No.	Year	No. of Beneficiary	Dfls Supply CSR Hybrid	Cocoon Prodn. In Kgs.	Yeild per 100 Dfls
1	2004-05	605	302990	131800.6	43.39
2	2005-06	380	256491	113402.7	44.21
3	2006-07	296	126550	52110.9	41.17

Sericultural Infrastructure in the State:

The details of infrastructure facilities available under State and Central sector for development of silk industry are indicated below:

Manpower under Sericulture sector:

Technical & Ministerial Staff
349

Infrastructure facilities:

Sector	Infrastructure	Under State	Under Central
	Regional Development Office	-	1
	Regional Office	04	-
	District Sericulture Office	18	-
Mulberry	Silkworm Seed Production Centers (Commercial Grainage)	02	- -
	Cocoon Collection Centre	12	-
	Mulberry Silk Production & Demonstration Centers	14	-
	Research Extension Centre	-	2
	Sericulture Demonstration & Training Centre	16	- -
	Twisting & Weaving Units	02	-
	Cottage Basin	74	-
	Multiend Reeling machine (basins)	70	-

GOVT.SUPPORT :

Developmental schemes implemented during X plan

The development of Sericulture has been done through the following schemes.

1 State Plan & District level Schemes.
2 Non-Plan scheme.
3 Employment Guarantee Scheme.
4 Central Silk Board sponsored CDP scheme.

Limitations:

The State Government has implemented various state and centrally sponsored schemes for development of silk industry during IX and X Plan period resulting in increasing trend in silk production in the state but the momentum could not be maintained during X Plan period due to various socio-economic, Adaptec and administrative reasons and hence silk production has shown declining trend during 2003-04,2004-05 years. The main lessons learnt from the earlier programme implementation are as follows –

- Sericulture activities were spread over a vast area of the state covering almost 75% districts of the state with limited manpower resources,
- Leaf yield and silkworm seed consumption per unit area could not be optimized because of poor knowledge of technology packages, non-availability of farm inputs and low financial support,
- Silkworm seed production are not properly developed within the state and most of the silkworm seed was procured from outside state resulting in inconsistent supply to the farmers
- No private participation was ensured in silkworm seed production and instead the subsidy was extended on the silkworm seed. It has resulted in over dependence on outside agencies for supply of silkworm seed,
- Limited success was achieved in developing post cocoon sector, especially reeling and silk processing, in the state because of commercial linkages, technology related issues, skill development and policy thrust by State Government,
- Proper dissemination and adoption of latest technologies was not ensured through extensive extension support,
- Issues related to infrastructure development and credit flow to silk industry in the state were not properly addressed.

APPROACH TO BOOST BIVOLTINE SERICULTURE IN THE STATE

1. It is therefore proposed that, during XI Plan, cluster approach would be adopted for sericulture development in the state with proper forward and backward linkages. Adequate infrastructure would be developed in private sector and private participation would be ensured in seed production and post cocoon activities. Though seed subsidy would continue to mitigate the financial burden of the poor farmers, parallel efforts will be made to develop seed production infrastructure within the state. Thrust will be laid on developing a clear-cut Post Cocoon Policy at the State Government level for facilitating the proper growth of post cocoon sector. Reeler-Twister-Weaver interface will be strengthened and a specific zone will be developed for post cocoon activities. Non-Governmental Organizations will also be roped in for the purpose. Holistic approach would be adopted for establishment of all the activities from plantation development to production and marketing of silk fabrics.

2. Objectives –

A Revival, expansion and diversification of sericulture in the state especially Bivoltine Mulberry, Eri and Tasar silks.

B Creating greater opportunities for gainful employment to tribal and other poor sections of the society in rural areas through spread of sericulture concentrating on potential clusters in potential districts.

C Improving productivity and quality at all levels starting from cocoon production to fabric production through skill up-gradation and integrated extension support.

D Nurturing and developing local artisans and craftsmanship.

E Strengthening of Self Help Groups, Cooperative Societies and NGOs involved in sericulture development.

F Market development through networking and promotional campaigns within and outside the state.

3 Strategies -

General:

- Adoption of group-based, holistic, cluster-oriented and farmer-centric approach for implementation of need-based Project(s) with clear forward and backward linkages
- System of Command area/contract farming will be adopted in a cluster to avoid outflow of cocoons, to solve marketing problems and development of post cocoon sector
- Skill development, and sharpening managerial abilities and technical skills through appropriate Human Resource Development Programme on a regular basis
- Privatization of Seed Production sector
- Entrepreneurship development in post cocoon sector, concentrating in the areas where specific group of people is located to firm up reeling linkages like Ramanagaram and Sidalghatta in Karnataka
- Development of cooperative culture in sericulture, both in pre-cocoon and post cocoon sectors, by establishing village-level, block-level and district level societies and federating them at apex level
- Involvement of Non Government Organizations, Women Groups, Self Help Groups etc in implementation of the Schemes/Projects/ Programmes
- Integration of sericulture activity with other agro-based rural activities leading to empowerment of rural poor
- Market promotion through exhibitions, product diversification, etc
- Development of seri-systems for implementation and monitoring with role clarity and specific linkages.

Mulberry:

- Development of systematic plantation of Improved Mulberry varieties like S_{1635}, S_{36}, V_1 etc, through saplings with close spacing and assured irrigated facilities
- Popularisation of organic farming, green manuring and vermi-composting for soil fertility management and for checking adverse effects of chemical fertilisation through use of organic manures
- Setting up quality silkworm seed production infrastructure in private sector by motivating the entrepreneurs and leasing out the state infrastructure facilities
- Development of proper infrastructure facilities like separate rearing house, improved rearing and mounting equipment's at farmers' level
- Popularisation of high yielding productive hybrids and combinations especially CSR hybrids for bivoltine cocoon production
- Establishment of Cooperative Chawki Rearing Centers for supply of chawki silkworm larvae

- Adoption of Improved silkworm rearing practices developed by CSB Institutes (shelf rearing by shoot feeding technique)
- Contractual disinfection of the rearing houses and appliances to check crop failures and other risks especially in bivoltine rearing
- Setting up of improved silk reeling and twisting units in private sector through individual entrepreneurs, Self Help Groups or NGOs itself
- Strengthening of service sector for supply of farm and non-farm inputs (institutionalizing the input supply) and
- Systematizing the marketing of seri-outputs (establishing forward and backward linkages).

As sericulture is a subsidiary occupation for the farmers of the state because of limited number of crops that may be taken up in a year. It is essential that it be linked with other economic activities like poultry, dairy, other cash crops etc so as to have sustainable income generation. There would be need-based, region-based and demand-based integration of different activities with the involvement of the concerned departments. A composite team of officials drawn from different departments like sericulture, agriculture, forestry, horticulture, revenue etc shall be constituted district-wise who should be responsible for smooth implementation of the project in the concerned district. In addition, the following approach will be adopted to achieve the goals.

- <u>Identification of potential clusters</u> – Although sericulture is practiced in about 25 districts of the State, it is proposed that the cluster approach will be adopted for boosting the sericulture and silk production henceforth. The potential clusters for different silk sectors will be identified based on feasibility and the field experience of the Extension Workers of the State Government preferably in the existing sericulture area following the village-cluster approach. A diagnostic study will be conducted to assess the strengths and weaknesses in the existing setup, by having discussions with various developmental agencies like NABARD, Financial institutions, NGOs etc., and the prime stake holders of the industry in the concerned cluster. Keeping in view the constraints, potentialities and requirements, as well as proposed programme, a specific action plan will be drawn up having all the forward and backward linkages for speedy development of the cluster.
- <u>Organizing beneficiaries into Self Help Groups</u> - As group approach not only have advantage of social mobilization and enable them to participate fully and directly in decision-making process related to income-generating employment opportunities but also provide accessibility of the assistance – be it in terms of credit or technology or market guidance etc for sustainability of economic activity, the farmers (small and marginal farmers) would be organized into Self Help Groups after ascertaining their interest and commitment in the activity. Preference would be given to those below poverty line. The SHGs would be homogenous with flexibility in the number of persons in a SHG as under SGSY, being of manageable size. These SHGs would be suitably strengthened for taking up on-farm and non-farm sericulture activities.

  <u>Role of NGOs</u> – Group formation and development is not a spontaneous process but requires facilitation at grass root level by the agencies working closely with the communities. NGOs can not only facilitate the process of social mobilization and group development but also help in building their capacity. The state would elicit support from NGOs or community based organizations in sericulture sector for:
  - Motivating and mobilizing farmers to form SHGs and organize groups into Primary Sericulture Societies
  - Management of Government farms

- Organize community chawki rearing and commercial cocoon production management
- Integrated disinfection at field level
- Organizing seed production in private sector
- Managing Common Facility and Silk Processing Units
- Managing Multi-end Reeling, Cottage Basin Reeling, Dupion Silk Reeling and Twisting Units
- Strengthening forward and backward linkages and establishing synergy between various stakeholders
- Assisting in publicity and extension work
- Developing marketing facilities

4. PLANNING :-

For integrated development of Bivoltine silks in the state, cluster approach would be adopted and separate clusters for bivoltine Sericulture will be identified. While Mulberry cluster will be taken up in Pune, Satara, Sangli, Kolhapur, and Solapur districts in western Maharashtra.

Statement Showing Physical Target during TMIS (TECHNOLOGY MISSION OF INDIAN SERICULTURE) Project-

Sr. No.	Name of particulars	**Yearwise Breakup of physical Target**						Toatl
		Unit	2007-08	2008-09	2009-010	20010-11	20011-12	
1	Mulberry Plantation	Acre	300	100	100	100	100	700
2	Beneficiaries	No.	120	40	40	40	40	280
3	DFls Supply	lakh	1.40	2.38	2.70	4.30	5.00	15.78
4	Cocoon Production	MT	70	119	162	258	300	909
5	Raw Silk Production	MT	10	17	27	43	50	147
6	Raising of Sapling	lakh	16.50	5.50	5.50	5.50	5.50	38.50
7	Kisan Nurseries to be Established	No.	13	3	3	3	3	25
8	CRCs to be established.	No.	1			1		2
9	Vermi-compost shed to be Established.	No.	120	40	40	40	40	280
10	Automatic Reeling Unit to be Established.	No.	0	0	0	1	0	1
11	Twisting unit to be Established.	No.	0	1	0	0	0	1
12	Establishment of Technical Service Center.	No.	1	0	0	0	0	1
13	Establishment of Farmer Field School.	No.	2	0	0	0	0	2

How to Go? -

For Bivoltine sericulture, a cluster of 1,200 farmers within a radius of 10-20 kms will be identified and each farmer will be motivated to have one acre of Mulberry plantation of high yielding varieties with assured irrigation facilities, be it flood irrigation or drip irrigation or sprinkler irrigation. This integrated cluster will have the following activity-based components –

- Establishment of Kisan Nurseries for Production & Supply of Mulberry Saplings,
- Raising and maintenance of Mulberry plantation of high yielding varieties,
- Establishment of Chawki Rearing Centres,
- Construction of Individual Rearing Houses,
- Supply of Improved Rearing and Mounting Equipment's,
- Contractual Disinfection of Rearing Houses and Appliances,
- Establishment of Multi-end Reeling Units,
- Establishment of Cottage Basin Reeling Unit,
- Establishment of Dupion Silk Reeling Unit,
- Establishment of Silk Processing Unit,
- Establishment of Weaving Units.

What JICA can do for Bivoltine development in the state –

JICA project, which was introduced in Karnataka, has brought tremendous changes in Bivoltine development in following way-

1 Transfer of Technology to the doorstep of sericulturiest.
2 Changes in the attitude knowledge skill of the farmers offering greater incentives to Bivoltine adopters
3 Capacity building of Staff and farmers is easy handling of BV rearing Technique.
4 Offering competitive rates to BV cocoons.
5 Developing test choice and market for BV cocoons, fiber and fabric.
6 Offering expert avenues to BV product
7 Providing machines and tools and Bivoltine post cocoon Technology.
8 Adoption and popularizing cluster approach.

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RFERENCES

1.Jadhav,A.D., Hajare,T.N., Undale J.P. , Sathe,T.V., Holkar, P.S. and Rode, S.A.(2004)Evaluation of Branch Feeding Technology For Late Age Silkworm (Bombyx mori.Linn.)Rearing In Vidarbha Region of Maharashtra India .International Workshop on Wild Silkmoths and Silks Mahasarkham University ,11th.-14th. October 2004. Khon-khenThailand.- p.32.

2.Kalantri, L.B, Jadhav, A.D., Hajare, T.N., Undale, J.P. and Sathe, T.V. 2006. Prospects of sericulture development Maharashtra India. Proceeding of Asia-Pacific Congress of sericulture and insect bio-technology. Sangju national University, South Korea. Oct. 11-15, 2006. P.60-62

3. Jadhav, A.D., Kalantri, L.B., Hajare, T.N., Undale, J.P. and Sathe, T.V. 2006. Rearing performance of eri silkworm (Philosamia ricin Hutt.) in Vidarbha region of in newly explored area in Maharashtra India. Proceeding of Asia-Pacific Congress of sericulture and insect bio-technology. Sangju national University ,South Korea. Oct. 11-15, 2006 P.48-50

The Romanian sericulture's reorganization after adhesion to the EU

By

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ABSTRACT

The sericulture implementation can create new work places in the rural area, using the human resources with not too much physical power (women, children, older persons, people with physical problems). Also, the silkworm rearing can take place in the schools from rural areas, as an educational practice, but in the same time it may bring some money for the specific needs of those schools.

The sericulture can be performed on the less favorized areas, where the climatic conditions allow it; it's a well known thing that the mulberry (the fodder base of silkworms) can acclimate to some unfriendly conditions.

Thanks to its specificy, the sericulture protects and ameliorates the environmet because this activity doesn't use vitiating substances, the silk fiber being an ecological product, superior to all the other artificial and natural fibers.

Due to the strengthning of sericiculture , a tradional craft is being reborn in Romania, the popular art produces made out of natural silk (marame, national costumes) that are apreciated all over the world.

The launching of sericulture in Romania is possible by reorganiseing the silkworm cocoons' distribution, silkworm cocoons' gathering and primary cocoon proceesing in a private sistem or by the Rearing silkworms' professional association.

This new organizational concept for our country is being used with outstanding results in countries with tradition in sericulture, and that are not practicing intensive sericulture; the traditional agricultural sistem being favourable for this branch of animal husbandry.

The originality for Romania would be some local small and medium enterprises specialized on hatching, rearing and distribution, rearing and distribution of young silkworm, cocoons' gathering, primary processing of them (cocoons' dring), getting the silk fiber (in silk spinning mills) and commercialization on the local and international market.

For these objectives to become reality on a small and medium enterprises level, there were made some financial documentions:

- ***hatching, rearing and distribution of the young silkworms***
- ***cocoons' gathering and primary proceesing.***

The implemetation of all these ideas should be considerate very important for rural development, because it may offer alternative jobs.

The bussiness options from this activity can run to textile industry, by using the silk fiber, and also to the chemestry and pharmacy industries by using the collateral products of silkworms rearing.

For the cocoon production development is necessary that the silkworm rearers can benefit of subventions; also, is needed to help small enterprises with credits for microindustry and access to European programs.

Keywords: launching of sericulture, small and medium enterprises, financial documentions, hatching, rearing and distribution of the young silkworms, cocoons' gathering and primary proceesing

1.General aspects regarding the Romanian sericulture

The sericulture – traditional occupation of romanian countryman - is highlited in some learned man's paperworks who assimilate this science and they belived in its cultural, social and economical's valence.

In 1852 it set up the first mulberry nursery and Pantelimon Sericulture Center.

In 1899 the Agriculture Ministry of that time set up a project to relaunch this branch by the first "Law project to encourage the silk industry".

In 1904 is accepted the foundation of Sericulture Station and Nursery from Cotroceni and in 1916 the location is changed to Kiseleff Road with a new name: Baneasa Sericulture Station.Starting with this date, we can talk about the evolution of the modern sericulture, Baneasa Sericulture Station is moving again in 1954 to the present location.

Romania has the requested factors for sericulture: natural favourable conditions, a material base (mulberry plantations, breeding spaces), remarcable rezults in scientific research and a good tradition, especially to produce biological material.

Nowaday, there are about 300 ha mulberry varities from 4187 ha in 1989. The cocoon production is law, about 5 tons, strictly realised throw Baneasa Research Branch.

It is remarkable in this unfavourable conditions, that the genetic resources (the silkworm breeds from collection) is intact.

2. The ecological and socio-economical impact of sericulture development in Romania

The Romanian agrarian political objectives according to the New Agriculture Policy of European Union consist in:

-sufficient stocks with agrofeeding products for population;
- productivity increasing through technical progres promoting, a better utilisation of production factors, especially the workmen force,
- convenient prices for producers and for consumers;
- agriculture markets stability;
- encouraging the agrofeeding products commerce on European Unique Market and others too;
- guarantee of a mediul life level for farmers,
- harmonise of agriculture development with surrounding areas.

The projects for agriculture development are targeting the present level of agricultre, of macroeconomy and touching the "common bench-marks".

Today, the majority individual farms have a surface of 2,2 ha and few animals. Most of them have a law economical power and the tendency is to work for autoconsumption. This situation of Romanian agriculutre should be sustained by the Gouvernement through well done projects.

The objectives that need to be sustained are:

- to realize a solid organizational and ownership agricultural structure, able to perform economicaly;
- the insurance offer for national products at low prices
- the technical and technological progress promotion based on a scientific research development
- unfavourable areas sustainment
- development of a "friendly" agriculture with the surrending areas.

The promotion of such objectives has the aim to stimulate the interes of private economical agents for rational allocation and uses of natural, material, financial and human resources.

According with the Romanian agriculture situation due to the transition period, the characteristics of sericulture for the same time, are the following:

- low cocoon production and as a consequece, the fiber weight in texture is also low
- dissolve or reorientation of some sericulture productive units;
- the lack of spinning factories;

- the lack of a specific legislation and gouvernamental support.

According to these conditions, the main objectives of a medium term strategy for sericulture are:
- redressing sericulture production, exactingness toward the fiber quality, aspect which
- influence the silk price in EU;
- redimensions, modernization and retechnologisation of sericulture exploatation;
- modeling small sericulture farms;
- sericulture products diversification through the valorification of the secondary products;
- scientific research development based on sericulture production requirments and
- promotion of technological transfer;
- sericulture marketing development.
-

The sericulture implementation can create new work places in the rural area, using the human resources with not too much physical power (women, children, older persons, people with physical problems). Also, the silkworm rearing can take place in the schools from rural areas, as an educational practice, but in the same time it may bring some money for the specific needs of those schools.

The sericulture can be performed on the less favorized areas, where the climatic conditions allow it; it's a well known thing that the mulberry (the fodder base of silkworms) can acclimate to some unfriendly conditions

Thanks to its specificy, the sericulture protects and ameliorates the environmet because this activity doesn't use vitiating substances, the silk fiber being an ecological product, superior to all the other artificial and natural fibers.

Due to the strengthning of sericiculture , a tradional craft is being reborn in Romania, the popular art produces made out of natural silk (marame, national costumes) that are apreciated all over the world.

3.Study on the natural silk and fiber market

Worldwide, the production of fresh cocoon was 722 000 tons in 2005. The main pawns were: China, India., Japan, Brasil and Iran.

In the past, Japan was the main fresh silk producer, sericulture beeing spread also in Europe. The industrial development of Japan and the occident countrtries made the sericulture activity to move toward the less developed countries.

The silk is used especially on 3 markets:

- Asian one – where the silk is used for traditional costumes and other clothing accesories (kimono, sari, etc). In these countries the silk is part of the social and cultural tradition of those nations.
- Haute-couture : demanded by the fashion designers from Paris, Milan, London, New York.
- for the medium quality and western products, who came on the market during the last decades; is the result of fiber rove, who is cheaper, beeing accesible for the medium class.

The largest part of the produced silk is mainly used inside the producer countries, only one third of production reaches world markets.

Silk is sold as a raw material for the silk industry (raw silk or textile). Europe imports almost 20 percent of its raw silk, Italy using almost 85 percent of its raw silk from imports.

Silk consumption is increasing due to sevaral factors:

- ecological reasons: consumers prefer natural fiber;
- cultural reasons: the improvement of taste and refinement;
- social reasons: a boost in buying power and the improvement of the standard of living, mainly in the traditional consumer countries.

4. Methods of sericulture sector reorganisation in Romania, after adheration to the EU

The sericulture activity is an important source of extra incomes for rural areas by elevating the life level, using the human resources with not too much physical power.

The launching of sericulture in Romania is possible by reorganiseing the silkworm cocoons' distribution, silkworm cocoons' gathering and primary cocoon proceesing in a private sistem or by the Rearing silkworms' professional association.
This new organizational concept for our country is being used with outstanding results in countries with tradition in sericulture, and that are not practicing intensive sericulture; the traditional agricultural sistem being favourable for this branch of animal husbandry.

The originality for Romania would be some local small and medium enterprises specialized on hatching, rearing and distribution of young silkworm, cocoons' gathering, primary processing of them (cocoons' dring), getting the silk fiber (in silk spinning mills) and commercialization on the local and international market.
For these objectives to become reality on a small and medium enterprises level, there were made some financial documentions:
- silkworm eggs hatching, larvas' first age delivery to the rearers;
- hatching, rearing and distribution of the young silkworms from the IIIrd age.

The implemetation of all these ideas should be considerate very important for rural development, because it may offer alternative jobs.

- The financial documentiation for silkworms hatching, larvas' first age deliverance to rearers

The hatching represents an important element during the silkworm's rearing process, because it influence the biological and production potential of larvas.

The silkworm biological cycle's activity should be realized by a private centralized system for village rearers or for a surface of maximum 30 km.

These objectives are materialized through an adequate technology, coresponding to the private sistem (pubilished in different booklets and the sericulture's guide) and by an arrangements' finanacial documentation of a hatching and distribution work point for the young silkworm larvas.

The presented financial documentation is for 100 silkworm boxes' hatching – private sistem, beeing delivered to the first age larvals rearers. (Annexes 1 and 2)

For this, the investor needs a surface of mulberry plantation of 200 square meters.

The prices for hatching_larvas as the ones for first ages are in euro, on an average exchange rate of 3,2 lei.

It should be mentioned that in this estimate the silkworms eggs value was included. Nowaday, in Romania, the silkworm's eggs distribution is free of taxes, without any law instructions in this aspect. Because there are not so many rearers, this eggs quantity can be supported by the research institut.

The 1 and 2 annexes analysis show that the hatching of one silkworm box costs 10,05 euro (including the egg value). These money are taking from rearer when he brings the cocoons to the institut. In this moment, the price for 1 kilogram first quality cocoons is 4,6 euro.

A rearer makes 90 euros rearing one box and after he pays all the taxes has left 80. Beside this, the rearer benefit from gouvernamental subventions – 136,3 euro for 20 kg of cocoons/box.

The enterpriser who make the hatching has a profit of 1,67 euro/box, that means 167 euro/100 boxes, money made possible in 15 days.

The activity is very profitable if we elimine the payments for workes from estimates, who are targeting 215 euro.

- The financial documentiation for silkworms hatching and larvas' third age deliverance to rearers

The private enterpriser can extend his activity and beside the haching one he can also rear the silkworms for a period of 2 ages. For this he needs a 1000 square meters mulberry plantation.

The costs for this activity, presented in the annexes 3,4 and 5 lead to a price of 11,88 euro/box, payed by the rearer at delivrance, according with the contract.

The enterpriser's net profit is 1,97 euro/box. If this activity is made with family work hand and doesn't need to be payed, the income raise to 332 euro made in 25 days. During this biological stage, the necessary of mulberry leafs and work hand is reduced.

Analising the private enterpriser's activity, we can see that the income is small, who can be considerated as an extra income, the same with the silkworms' rearer but it doesn't need a high volume of work.

If the enterpriser would endow himself with a cocoon drier mashine (an average price is 2000 euro he can get the dry cocoon who is used to obtain the fiber.

The final step would be a spinning mashine with 20 spinning heads (the price is about 15000 – 18000 euro)

In this way, it is possible for enterpriser to get out on market with raw fiber to a price between 40 – 45 euro.

The business options can develop to textile industry by using the fiber, but also in the silkworms rearing department, by using the sericulture subproducts, highly appreciated in the chemical and pharmaceutical industries.

For cocoons production's development is recomanded to keep up the rearers subventions, but also to uphold the small enterprisers by enabling them to take bank credits and acces to european programs.

Annex 1

General estimate for 100 silkworm eggs boxes (s.e.b.)' hatching in a clasic household system (cardbord – 10 g s.e.b. capacity)

Nr. crt.	Specification	Work volume		Manual labor				Materials			
		MU	Total	Work norm	Total day/ man	Unitary price/ /day/ man	Total value lions	Name	MU	Quanti-ty	Total value lions
1.	The hatching space mechanic cleaning	square meters	50	200	0.25	20	5	. silkworm eggs	boxes	100	2400
2.	Sericulture equipment washing	. square meters	36	150	0.25	20	5	desinfecti on	liters	1	4
3.	Hatching space's whitewash with	square meters .	50	400	0.12	20	2.4	lime	kg	3	6

	calcium hydroxide $Ca(OH)_2$										
4.	The equipment and hatching space disinfection; two times	square meters.	100	400	0.25	20	5	paper	kg	10	20
5.	Boxes manufactures	piece	100	400	0.25	20	5	worming			60
6.	The silkworm eggs setting on boxes in the hatching space	. piece	100	400	0.25	20	5	other materials (%from costs)			40
7.	The hatching space microclimate superviseing	hours	50	8	6.25	20	150				
TOTAL					**7.62**	**20**	**152.4**				**2530**
TOTAL											**2682.4**

Annex 2

Technologic estimate
Phase – 100 silkoworm eggs boxes (s.e.b.)' hatching in a classic household system

Estimate's name/execution phase	Manual labor (lions)	Materials (lions)	Total value (lions)
100 s.e.b. in a classic household system	152,4	2530	2682,4
Total	152,4	2530	2682,4
Cost price/box	152,4	2530	26.82
Adding 20%/box	2682,4 : 100 boxes		5.36
Cost price/box			**32.18**

Cost price at 1.08.2007 ………………..10,05 €/box
(1€ = 3,2 lions)

Annex 3

Technological estimate
Phase – young larvas rearing (y.l.r.) equivalent of 100 s.e.b.

Article no from normative	Specification	Work volume		Manual labor				Materials			
		MU	Total	Work norm	Total day/ man	Unitary price/ day/ man	Total value/ lions	Name	MU	Quantity	Total value/ lions
1.	**The hatching space mechanic cleaning and whitewashing – 2 times**	square meters.	300	600	0.5	20	10	**-disinfection solution** **-lime** **- paper sheets** **-worming** **-other materials,** % from costs (termometer,radiator, baskets, pails)	kg	15	**30** **40** **60** **50** **25**
2.	**Mechanic cleaning, buckling and shelves disinfection**	piece	90	180	0.5	20	10				

3.	**Shelves assembling, cutting and pileing up paper on shelves**	piece	90	300	0.3	20	6.6		kg	30	
4.	**Larvas tranfering from Hatching boxes in rearing spaces**	boxes	100	200	0.5	20	10				
5.	**Maintenance work (feeding, silkworm larvas' sheets changing)**	boxes	100	100/zi	12	20	240				
6.	**Daily disinfections**	piece	300	1500	0.3	20	6.6				
TOTAL					**14.1**		**282**				**205**
TOTAL											**487**

Annex 4

Estimate for larvas rearing, during the young ages from 100 s.e.b. hatching

Estimate's name/execution phase	Manual labor (lions)	Material (lions)	Total value (lions)
Young age rearing of silkworm larvas (I and II ages) from 100 boxes	282	205	487
Total	282	205	487
Cost price/box	487: 100 boxes		4,87
Adding 30%/box			0,97
Cost price/box			**5,84**

Cost price at 1.08.2007 ………………..1,82 €/box
(1€ = 3,2 lions)

Annex 5

General estimatefor 100 S.E.B. hatching in a classic household systemand young age rearing of larvas

Estimate's name/execution phase	Manual labor (lions)	Materials (lions)	Total value (lions)
100 S.E.B. hatching in a classic household system	152,4	2530	2682,4
Young age rearing of silkworm larvas (I and II ages) from 100 boxes	282	205	487
Total	434,4	2735	3169,4
Cost price/box	3169,4: 100 boxes		31,69
Adding 20%/box			6,33
Cost price/box			**38,02**

Cost price at 1.08.2007 ………………..11,88 €/box
(1€ = 3,2 lions)

TRAINING- FESIBLITY OF HUMAN RESOURSE DEVELOPMENT FOR SERICULTURE IN INDIA – A REVIEW

By

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Government of India has taken measures to mitigate growing problems of unemployment, poverty, malnutrition in the rural and urban areas. Of these, crop diversification & rotation are the strategies adopted for speedy improvement of socio-economic transformation in rural areas as an agrarian country. Majority of the Indian divided families are presently poses uneconomical land holdings which are marginal and small, whose share is about 70-80 of total holdings in the country. Hence, the thought is given for utilizing the existing land for better income and the result is the shift in the cropping pattern. Sericulture is an important economic activity becoming increasingly popular in several parts of the country, because of its short gestation period, quick recycling of resources. It suits very well for marginal and small land holders as it offers rich opportunities for enhancement of income and creates own family employment round the year. The emergence of new sericulture technology has not only reduced the production risks (drudgery) but also increased the potential cocoon yield, relative to the traditional technology. The phenomenal growth rate in silk production the country achieved during 1970s till 2005 were purely based on the research breakthroughs made by Central Silk Boards' research organization in general and Central Sericultural Research and Training Institute, Mysore in particular through popularization of agronomical practices for mulberry cultivation, evolution of productive bivoltine silkworm breeds, developing appropriate rearing technologies for Bivoltine races and cross-breeds. The pressure on natural resources like land and water is considerably following the explosion in human population in the country. Hence horizontal expansion would not be possible for increasing the total production of silk. On the other hand, there is a distinct possibility for vertical expansion through productivity increase. lack of knowledge and skill on adoption of various innovations by farmers; and unqualified and low level of trained manpower in sericulture etc. Therefore, in order to achieve the requirement of quality, productivity and future demand in raw silk production, one of the important and vital issues is strengthening of human resource development in sericulture in the country. Dearth of specialized personnel and trained man power to manage various discipline of the industry for evolution of technological developments from lab to field has been one of the major constraints. To provide necessary infrastructure in the non-traditional areas, strengthening and expanding industry as well, generating highly specialized personnel becomes most imperative and paramount. Keeping the above, Central Silk Board (CSB) has established several training Institutions all over the country and trained about 12,500 personnel from various levels at CSRTI, Mysore to produce skilled manpower to meet both State and Central Governments manpower requirement. In this paper attempts have been made to trace out the various sericultural training programmes being conducted in mulberry sericulture in the country. Also deals with the total resources available in the country for the training and the present need of man power for managing the industry.

APPROPRIATE METHODS FOR EFFECTIVE RECYCLING OF SERIFARM RESIDUE INTO PROLIFIC COMPOST AND ITS IMPACT ON COCOON PRODUCTIVITY

By

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Sericulture which is an unique enterprise consists of two biological processes of growing mulberry and rearing silkworms. Both these on- farm activities generate quantum residues during the process of silk production. Although efforts are made to utilize the by-products of silk for diverse purposes, recycling of Seri-farm residue for the generation of prolific compost has not been scientifically studied and documented. In this direction, Regional Sericultural Research Station, Bangalore, a unit of Central Silk Board, Government of India, having an area of 67 acres, utilizing 12 acres of mulberry pioneered the studies on the effective utilization of seri-farm residues for its conversion into prolific compost and reutilization for the mulberry cultivation to improve the productivity. The existing compost technologies viz. Pit method, Wind-row method and Vermi-compost methods were appropriately fine tuned to fit into the process of composting, considering the fact that seri-farm residue has a high lignin content. Utilizing the seri-farm residue of 25MT generated from one hectare of mulberry plantation and reconciling quantity of silkworm rearing, 15 MT of prolific compost was generated, resulting in the cost benefit ratio of 1:3.5. Studies revealed that the modified technology effectively converted the seri-farm residue into highly nutritive compost with 2.46% Nitrogen, 0.49% Phosphorous and 0.48% Potash besides high microbial status. Application of the seri-farm residue compost enhanced the mulberry leaf productivity up to 34% along with augmenting the quality of mulberry leaf, which in turn improved the brushing capacity by 1000 layings/ha. and ensured higher cocoon yields per unit area. The paper discusses the fine tuned technologies, methodologies adopted for accelerating the composting process, qualitative and quantitative improvements in mulberry leaf and cocoon productivity. The economics of suggested modules is discussed.

Keywords: Serifarm residue, vermicompost, organic manure, windrow method of composting, cocoon productivity

AN EMPIRICAL ANALYSIS OF THE IMPACT OF JAPAN INTERNATIONAL CO-OPERATION AGENCY PROJECT ON KOLAR DISTRICT SERICULTURE

By

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Extraction of gold and production of silk are the popular traditional activities of Kolar district located in Karnataka state of India. Sericulture of Kolar district is not only significant by its 38.87% contribution to the country's silk production but also unique in possessing all related spheres like generation of commercial cocoon, reeling and weaving in the clusters like Sidlaghatta and Chickballapur. Traditional sericulture of this dry region invariably confronted by frequent drought and adverse climatic conditions, has traversed a difficult course since decades before finding stability very recently, owing to the implementation of the country's prestigious project for Strengthening Extension System for bivoltine Sericulture in India in association with Japan International Co-operation Agency (JICA). Combination of factors like, the fine tuned tropical bivoltine technology, involvement of active scientific community and the positive approach of valiant sericulture community realized the dreams of gradable bivoltine silk productivity in the region which was bookmarked as 'impossible' even for the quality multivoltine silk. JICA project was implemented in two Technical Service Centers of Kolar District namely, Bangarapet and Kolar, covering 502 farmers. They reared 6.61 lakh of bivoltine hybrid disease free layings in 70 crops obtaining an average yield of 66.53 kg of cocoons for every 100 layings reared, resulting in a net revenue of 714.38 lakh rupees. The present paper discusses the situation that existed before implementation of JICA project, comparative sericulture performance with peers, and impact of technology on bivoltine cocoon production and improved economics of sericulturists.

Keywords: Bivoltine hybrid, Cocoon yield, Silk production

Actual problems of the development sericulture and production fabric from natural silk

By

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ABSTRACT
At modern period of the market relations in silk production sphere and fabric from it actual are a problems of the reception of the high-quality silk-product in its raw state, half-finished item and textile packs high quality winding, promoting reception qualitative fabric, as well as scolded improvement and enrichment of the assortment and quality silk fabric. These problems possible to solve by use cocoon sorts and hybrid of the silkworm differing best technological characteristic, improvement of the preparatory processes to weaver's, as well as by development of the fabric new structures, mastering the new large powered weaver's equipment with broad assortment possibility and modernizations acting technological equipment. Special importance gain the much products of the sort and hybrids of the silkworm combining raised amount of the silk cocoon with fine cocoon by thread, questions of the reduction defects of winding of the silk threads when preparing them to weaver's, as well as questions of the improvement of the technology and technologies of the shaping fabric from natural silk with provision for his(its) specific particularities, and making the gamma of the assortment silk fabric. In this plan actual developments new structures crepe fabric, bed fabric from natural silk, as well as laminated two components for a suit fabric from natural silk and in mixture with cotton filament. At present they are received sorts and hybrids of the silkworm satisfying said requirements, modernized design of the winding mechanism of the machine parallel winding and is improved technology on her(its) base, providing removal defect winding " mess threads beside edges winding " and "loss end to threads" and shaping packs high quality winding, promoting reduction departure cheese. With provision for specific particularities of the natural silk is designed shuttle less loom and new structures crepe fabric, which provide denominated crepe effect fabrics. In new structure crepe fabric rapport on duck is executed consisting of two parts with different location linen entanglement element. Besides, is designed new structures crepe fabric, in which twisted to threads are located with different interleaving of the direction torsion. Amongst looms condition conversions of the threads of the natural silk most satisfy the tool of the type STB SHN. It Is Recommended modernize following main and auxiliary mechanisms and nodes shuttle less loom: in purpose of the relief of the conditions of the shaping fabrics, relieve and modernize the system bared the teeth; for making the happy circumstanceses surf crepe weft threads to edge of a forest fabrics to agree the moment of the furlough to threads of the base and tap fabrics; the abduction of the formed element fabrics is from zone of the edge of a forest fabrics to produce with provision for necessary surf of the strip and without slippage on gross, free winding fabrics on goods platen or free cleaning in drive fabrics; it is required modernization of the brake, comptroller and compensator with provision for particularities crepe weft of the threads.
Keywords: Mulberry silkworm, hybrid, breed, silk-raw material, winding machine, defects of winding, elimination of defects, fabric, assortment, machine tool, beam, system warp guide rod, tap of a fabric, crepe effect, quality.

INTRODUCTION

In the modern period of the market attitudes (relations) in sphere sericulture, manufactures of silk and fabrics from him (it) urgent are the following problems:

1. Reception the much products of selection grades silk tree and updating of fodder base of the silkworm.

2. Deducing (removing) the much products of breeds and hybrids of the silkworm, having high technological properties promoting reception of high-quality silk – raw material.

3. Radical perfection of engineering both technology of processing of cocoons and decision thus problems of reception of high-quality silk – raw material.

4. Reception of semi finished items and textile packs of high quality of windings promoting reception of qualitative fabrics.

5. Radical improvement both enrichment of assortment and quality of silk fabrics.

6. Development of the new high-efficiency weaver's equipment with wide assortments by opportunities and modernization of the working process equipment.

7. Marketing production of silk branch and products from natural silk, segmentation of production and materials.

8. Introduction both development of output and products from natural silk adequate the international standard.

These problems possible to solve by use cocoon sorts and hybrid of the silkworm differing best technological characteristic, improvement of the preparatory processes to weaver's, as well as by development of the fabric new structures, mastering the new large powered weaver's equipment with broad assortment possibility and modernizations acting technological equipment.

Special importance gain the much products of the sort and hybrids of the silkworm combining raised amount of the silk cocoon with fine cocoon by thread, questions of the reduction defects of winding of the silk threads when preparing them to weaver's, as well as questions of the improvement of the technology and technologies of the shaping fabric from natural silk with provision for his (its) specific particularities, and making the gamma of the assortment silk fabric. In this plan actual developments new structures crepe fabric, bed fabric from natural silk, as well as laminated two components for a suit fabric from natural silk and in mixture with cotton filament.

At present they are received sorts and hybrids of the silkworm satisfying said requirements.

Breeds and hybrids of the silkworm for manufacture of fabrics, high-quality products from the breeds and hybrids of the silkworm for manufacture of fabrics, high-quality products from breeds and the hybrids of the silkworm for manufacture of fabrics, are available the breeds combining raised (increased) weight of a cocoon (2,3-2,4 g) to a thin string (3100-3300 m/g), average calibre of a line with thin cocoon by a string (3400-3500 m/g) etc.

The breeds and hybrids of the silkworm most suitable for reception of silk strings of a special special-purpose designation are revealed.

Three basic groups of silk – raw material on a special-purpose designation are generated:

- String of silk - raw material for technical purpose (appointment) (various strings, cords and fabrics of special technical purpose (appointment));
- String of silk - raw material for products of medical purpose (appointment) (surgical and microsurgical strings of various numbers (rooms));
- String of silk - raw material for products of household purpose (appointment) (fabric gown, costume, to lay and others).

Using the modern large powered looms, providing high quality worked out fabric requires the significant improvement a quality preparations main and weft of the threads, which greatly influence upon quality worked out fabric. The Quality of preparing the threads to weaver's in much is defined by quality packs and condition of the realization of the most technological process. From choice of these conditions and optimization of the processes depends capacity of the equipment, quality to product and half-finished item, output departure and level of the consumption cheese and material.

The Imperfection to technologies and a certain type of the technological equipment, processes of preparing the threads to dyeing and weaver's are an ill-conditioned reason got packs, increase the output departure and increasing to specific consumptions of materials to product.

The Analysis quality winding of the threads of the silk-product in its raw state on packs and their further conversion in process warping shows that on machine parallel winding 18 % produced packs have that or other defects winding. From all produced packs 30 % (11 % in weight attitude) packs with different defect winding and because of impossibility of the conversion return with the following technological process on the repeated conversion.

For the reason decisions given problems is designed high effect saving resource technology of the reduction defects of winding on base of the modernizations to designs of the winding mechanism of the machine parallel winding, providing even density winding along forming packs and shaping packs without rake beside flange with high quality winding.

It Is Installed that when using the modernized mechanism of the spreading return packs with process warping grows shorter more then in two times, when return packs because of defect winding "loss end to threads" grows shorter in 4 (four) times, is excluded return because of defect " tangle threads beside edges winding".

As a result of improvements of the structure winding and quality of preparation basis take-off threads in warping fell on 26,83%, capacity warping machines increased on 37,14%, in weaver's take-off threads of the base fell on 18,4 %, but capacity tool increased on 8,78 % that shows acceptability to experienced technology.

It Is Installed that new technology allows to reduce the waste because of the repeated conversion packs (the development defect winding), disregarding carbon-monoxide fumes because of breakaway of the threads, leading-in packs, defect hank and others, on 0,6126% (absolutely) or in 2,36 times, as a whole on preparatory shop - on 24,02%.

As is well known, in assortment silk fabric main place occupy fabrics of the classical assortment of the type crepe-deshin, crepe-chiffon, crepe-jorjet, gown and avrove fabrics han-atlas, as well as fabrics technical and special purpose.

The Analysis of the assortment fabric from natural silk and reference literature shows that in recent years assortment fabrics was repeatedly changed, but in change and renovation goes the trend of the increase to surface density fabrics to account of increasing to linear density to threads.

Increasing to linear density weft to threads brings about reduction of density that allows to raise capacity of the loom. However grow worse the exterior and consumer characteristic fabrics.

Earlier fabrics were worked out from natural silk broad and varied assortment: crepe-sateen, crepe-chiffon, crepe-jorjet, crepe-parizen, linen, faydeshin, chesucha, which on exterior and physico-mechanical characteristic exceed fabrics, worked out now.

The Typical particularity of the production these fabric is concluded in use cheese to small linear density, since only when use such cheese is got high quality fabric and is brightly expressed crepe effect.

Besides, to account of the increase the number of the relationships of the base and duck working characteristic increase on unit of the length.

Technology of preparation basis from silk-product in its raw state of small linear density more labour-consuming and production fabric on looms more production because of high density of the threads on duck.

Our institute conducts work on development of the fabric new structures from natural silk for the reason their productions on shuttle less of the looms of the type STB and company Zulcer. In this plan actual developments fabric in the following directions:

- with use the threads of the natural silk of small linear density, but with greater density of the threads both on base and on duck, this fabrics gown, gown-for a suit;
- with use small pattern and large pattern entanglements, this fabrics gown and chemise;
- a different structures fabrics male and feminine linen assortment with provision for high hygroscopes natural silk and resistance to micro biology to decomposition;
- Various structures of fabrics for to lay of a linen from natural silk;
- Various structures elite of fabrics from natural silk;

- Various assortments stockings and linen products from natural silk;
- Various structures of fabrics from natural silk in a mix with other fibres;
- Various structures jaccard of fabrics from natural silk;
- Various structures of nap fabrics from natural silk in a mix with other fibres;
- Various structures avrove of fabrics from natural silk and in a mix with other fibres;
- Various structures of technical fabrics and fabrics of special purpose (appointment) from natural silk.

The Discriminating particularity crepe fabric is that under their production on looms are formed not only qualitative factors, but also consumer characteristic, in particular, crepe effect - grain, lightness and softness on feel, air, typical briliance and pleasing touch. The Said particularities also hang and from structure fabrics.

Special importance gains the question of the making the gamma of the assortment silk fabric coming from requirements internal and foreign market. In this plan actual developments new structures crepe fabric, bed fabric from natural silk, as well as laminated two components for a suit fabric from natural silk and pat.

Is it At present designed new structures crepe fabric, which provide denominated crepe effect fabrics, reached that that within rapport alternately one weft forms with thread of the base elements (the overlappings) of the linen entanglement, but the other weft forms with thread of the base elements (the overlappings) repsing entanglements moreover, repsing of the entanglement one duck are located to repsing to entanglement other duck without shift or with shift on 1 or more threads of the base.

Besides, in new structure crepe fabric rapport on duck is executed consisting of two parts with different location linen entanglement element.

It Is Designed new structures crepe fabric, in which torsion to threads as minimum of one system are located with interleaving of the direction torsion through one thread and which also increase the assortment an crepe fabric.

Earlier silk fabrics were worked out on mechanical looms CHGSP, Dideriks, TM-61, which were specially designed for conversion of the natural silk, and on automatic AT 2-120-SHL, AT-100-5M. As a result of technical rearmament have begun to use for conversion of the natural silk looms with small-dimensioned pave the way duck type STB, intended for production woolly fabric, later which were modernized under silk variant.

The row of the change were contributed In design tool, allowed to reach more high, in contrast with base for itch tool STB, technical-economic factors of the work and raise the quality silk fabric.

With translation of the production fabric from natural silk on tool of the type STB capacity of the equipment vastly increased and formed at the average 5,50 m/ hour, against 2,30 m/ hour on mechanical tool. However take-off main threads fell not vastly. On production given take-off main threads on tool STB has formed 0,13/2,52 breakaway on 1 meter fabrics, when on mechanical tool 0,17/2,88. Follows to take into account that fact that in the case of breakaway of the main thread on one linen stands and the other linen that brings about reduction KPV tool of the type STB. In this connection reduction take-off main and weft of the threads is one of the main factor of increasing to capacity of the equipment.

The Analysis of the technical-economic factors has shown that KPV for tool at production sister fabric CHGSP-50 is 0,80; TM-61, Dideriks - 0,78, but for STB - 0,70. The Quality worked out fabric on tool STB has formed at the average on branches 50,9% then on mechanical tool 58,9%.

On base of the analysis weaver's vice is installed that on fabrics, worked out such weaver's vices ed on shuttle less of the looms STB, which meet on fabrics, worked out on shuttle tool (tangled, rallies, absence to threads, not brought, compaction, zigzagging duck and others) and appeared the new vices characteristic only to shuttle less to looms (torsion, thickened edge, dirt, fringe, moustache and others.).

The Analysis of the reasons of the reduction sort severe fabric from natural silk, allows to install the following nature of the distribution vice. On crepe fabrics:

the vices 46,4% form on base, in t.ch.

tangled - 18%, absence to threads - 13,4%, not brought - 8% in t.ch.

the rallies and torsion - 25%, zigzagging duck - 10,9%, dirt weaver's - 6%.

A vices are In count; calculate; list wide-spread vice on duck - a rallies, torsion, zigzagging duck. This is explained that that when designing the loom of the type STB is not provided particularities lay weft to threads high (2000-2400 kr/m) torsion.

The Form and profile teeth beater, law of the motion beater mechanism promote to detrition and breakaway to threads of the base, as well as to strip on base, which comes to light after decorating fabrics.

The Absence of the mechanism comptroller of the base at production fabric from natural silk brings about increase the vice tangled - 18%, absence to threads - 13,4%.

Vices - a fringe and moustache after removing severe fabrics with tool are cleaned, only after what fabrics leaves on checking.

The Revealled picture, portioned vice in severe fabrics from natural silk is it is enough typical and for like fabric, worked out on other silk enterprise.

On base of the study and analysis of the reasons of the reduction quality fabric from natural silk and deteriorations of the technical-economic factors is revealled row constructive flaw mechanism existing tool of the type STB, causing determined a type of the vice.

Specifically follows to note the shrinkage ready fabric. According to confirmed branch rates technological shrinkage on ready silk fabrics (the order 146 from 29.03.85) shrinkage fabric crepe-deshin forms - 2 %. At production fabric on tool STB this factor often exceed the normative factors.

The conclusion follows On the grounds of foregoing about that that when designing the loom of the type STB, even under silk variant are not provided typical particularities of the conversion of the natural silk on looms.

On base called on theoretical and experimental studies with specialist CHeboksar SKTBTM and institute, with provision for particularities of the conversion of the natural silk, is designed and made shuttle less loom STB SHN for production fabric from natural silk.

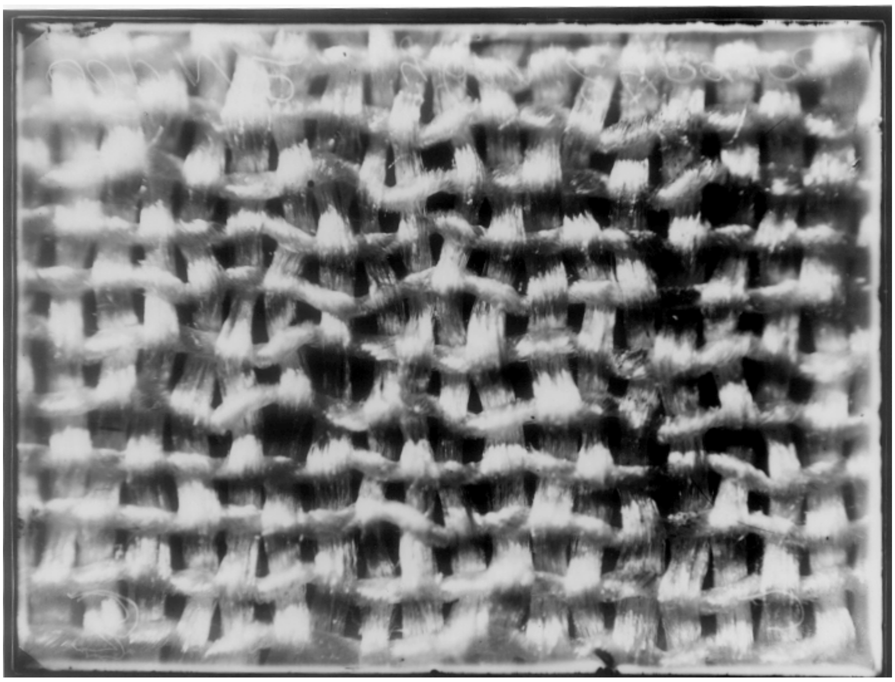
On new shuttle less to looms of the type STB SHN is worked out initial lot fabrics and are received positive results. On drawing 1 and drawing 2 is presented photography fabric, got accordingly on base and new shuttle less tool. The Analysis photography shows that in fabrics, got on base tool of the threads duck in separate, it is not enough safely fixed places have sagging, is noted not direct location duck along width fabrics that causes unevenness of the structure fabrics (drawing 1). As can be seen from photography (drawing 2), in fabrics got on new tool of the threads duck have an even rectilinear location along width fabrics that provides the improvement and leveling the structure fabrics (drawing 2).

Amongst looms condition conversions of the threads of the natural silk most satisfy the tool of the type STB SHN production CHeboksar AC "Tekstilimash".

In park of the available equipment is recommended modernize following main and auxiliary mechanisms and nodes shuttle less loom:

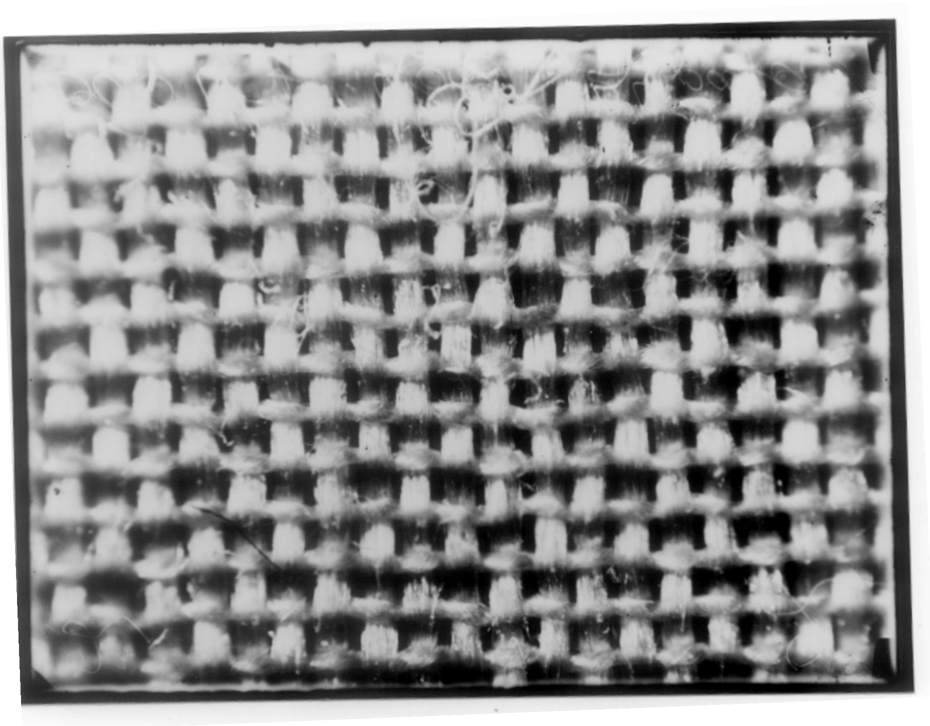
- in purpose of the relief of the conditions of the shaping fabrics, relieve and modernize the system bared the teeth, since at production fabric from natural silk to account of the raised pull of the main threads of these condition are got "heavy";
- for making the happy circumstances surf crepe weft threads to edge of a forest fabrics with provision for her(its) particularities to agree the moment of the furlough to threads of the base and tap fabrics;
- an abduction of the formed element fabrics from zone of the edge of a forest fabrics to produce with provision for necessary surf of the strip and without slippage on the shaft, free winding fabrics on goods platen or free cleaning in drive fabrics;
- is required modernization of the brake, comptroller and compensator with provision for particularities crepe weft of the threads, since mechanical weft comptroller is adapted for checking the threads to high linear density.

It is necessary to note, that in the modern period of the market attitudes (relations) for effective market activity, conducting purposeful struggle in severe constraints of a competition it is necessary to accept the correct decisions on marketing, which are reached (achieved) as a result of realization of marketing researches.



The drawing. 1 Photography fabrics got on base tool STB

1



The drawing. 2 Photography fabrics got on tool STB SHN.

The basic reality of the modern validity is the sharp lack of the correct and checked up information, important and necessary for acceptance of the administrative decision.

The manufacturers work on the intuition, thus because of constant changes, it is not obviously possible to do (make) of fluctuations and presence of a plenty not the necessary or out-of-date data any long-term forecasts, and at times the mistakes conducting to serious consequences are supposed.

The marketing is the integral part of an economic science and practice of managing in conditions of the settled market attitudes (relations). But in conditions of the transitive period functioning and the development of a complex of marketing at the enterprises is connected to a plenty of problems. The part from them is caused by lack at the chiefs of the enterprises of knowledge and qualification necessary for job in conditions of the market, some are called by limitation material and financial resources. To make marketing by a really working element of a control system of business, it is necessary to reveal main of these problems and to show possible (probable) ways of their decision, to lead (carry out) segmentation of production and materials.

Thus, in summary it is possible to make the following conclusions:

1. The most important problems in sphere sericulture, manufacture of silk and silk fabrics requiring (demanding) the prompt decision are determined.

2. The breeds and hybrids of the silkworm most suitable for reception of silk strings of a special special-purpose designation are revealed.

3. The technology of decrease (reduction) defects of winding is developed highly effective preservation of resources on the basis of modernization of a design winding of the mechanism of the machine of parallel winding ensuring uniform density of winding along forming packs and formation packs without slanting at disk with high quality of winding.

4. The ways of expansion of assortment of fabrics from natural silk are established, the various structures crepe of fabrics, bed fabrics from natural silk, and also It is a lot of layers two components costume of fabrics from natural silk and clap (cotton) are developed.

5. The competitive technology of formation brightly - expressed crepe of a fabric from natural silk which is taking into account specific features of processing of natural silk on the weaver's machine tool is developed.

6. The ways of modernization of the basic and auxiliary mechanisms and units shuttle less of the weaver's machine tool are established.

7. Together with the experts CHeboksar SKTBTM and our institute, in view of features of processing of natural silk, is developed and is made shuttle less the weaver's machine tool STB SHN for development (manufacture) of fabrics of natural silk.

8. Among weaver's machine tools to conditions of processing of strings of natural silk most satisfy machine tools such as STB SHN of manufacture CHeboksar joint-stock company AC "Tekstilimash".

9. The marketing is one of the main elements of managing in conditions of the settled market attitudes (relations) and for increase of a role of marketing in a control system of business it is necessary to reveal the main problems, to establish possible (probable) ways of their decision, to lead (carry out) segmentation of production and materials.

Prospects of Reconstruction of popular silk industry in Georgia

By

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ABSTRACT

Analyze of results of realized projects in 2005-2006 are showing us, that all levels of the population are interesting in reconstruction of popular silk industry. This kind of silk industry had a rather great value in national economy in V- XIX centuries, but in XX it were not used over silk manufacturing.

Lovers in different part of Georgia preserved following old Georgian methods: to handling of raw silk, to work on the handloom, with knitting needle and to crochet, to painting with natural colors from plants and minerals.

Today a very small quantity of fresh cocoons (in 2005 was produced about 4 tons in all) is using for silk garments, accessories, interior decorations and church goods. There are preparing manual.

Prospects of Reconstruction of popular silk industry are studding in: Georgian State Agricultural University, Georgian Academy of Agricultural Sciences, Academy of Arts and Academy of Theology

Key words: silk industry, handling, handloom, natural colors.

INTRODUCTION

Analyze of results of realized projects in 2005-2006 are showing us, that all levels of the population are interesting in reconstruction of popular silk industry. This kind of silk industry had a rather great value in national economy in V- XIX centuries, but in XX it were not used over silk manufacturing.

Lovers in different part of Georgia preserved following old Georgian methods: to handling of raw silk, to work on the handloom, with knitting needle and to crochet, to painting with natural colors from plants and minerals.

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Distribution of sericulture in Georgia was started in V century A. D.(Georgian King Vakhtang Gorgasali). In V-XIX centuries popular silk industry had a rather great value in national economy. Indeed, a silkworm became very popular among the Georgians and silk products became the subject of household handicraft in Georgia.

The household silk production in the integrity – preparation of grains, growing of cocoon, floss weaving, dyeing, was intended for manufacturing of silk products for household needs. The housewives made various silk cloth (brocade, satin and so on), caftans, carpets, handkerchiefs, socks, gloves, shawls, veils, scarves, belts, counterpanes, nets and many other things.

The refined thinking of silk craftsmen, technique of waiving and combination of colors are well expressed in the samples of household silk craft displayed in the Georgian museums.

In XX it were used silk manufacturing. In the middle of XX century the annual fresh cocoon production reached 4.0-4.4 thousand tons. In sericulture were engaged about 1 million people. In the silk industry worked 5.5-6.0 thousand workers. Farmers from realization of fresh cocoons received 15-16 million Soviet Rubles annually.

Unfortunetly the nrichest traditions of industry were completely forgotten on the days of the Soviet Union. There aren't clothes (Daraia, Futqi, Jejimi) prodused by ancient Georgian technologies.

The reason of the work was to learn possibility of revival of folk silk industry.

MATERIALS AND METHODS

The materials were adopted in 2004-2006 by NGOs: "Georgian young agrarian scientists union" and "Institute for International Cooperation of the German Adult Education Association (IIZ-DVV), Caucasus Project office" with the financial support in west and east Georgia.

This works took place:

1. Analyses of existing situation in sericulture in nowadays.
2. To find maintained customs in population.
3. Learning Ethnographical materials (Caucasus Sericulture Station) .

In the demonstrational feeding were used Georgian sorts of silkworms and new technologies of silkworm feeding preparing in the Training-researcher Institute of Sericulture (Kandelaki at all; 2004-2006; Chkhaidze, Tsirekidze 2005).

Fresh cocoon was treatment by help 5% NaOH and high temperature. Silk rearing was made manually and mechanically, painting with natural colors and with folk recipes obtained by us.

RESULTS

It was returned out that approximately 30% of the population does not know silkworm feeding and cocoon rearing. In fact, it's forgotten old Georgian methods of cocoon rearing, painting and knitting.

Photo 1. Mechanical spinning

Photo2. Spinning manually

In 2005-2006 was held consultations among farmers about silkworm feeding and cocoon rearing. In this trainings were participating 150 inhabitants of village. Among them were teachers, recipes and children. There were preparing 70 kg fresh cocoon, which were used for preparing silk matters

It was modified original construction of the wool rearing machine (author N. Janiashvili, photo 1.). This machine gives us possibility to rearing cocoon and silk wool.

Also it's possible to make silk successfully by means of spindle (photo 2.).

The designers are interested in this silk production.

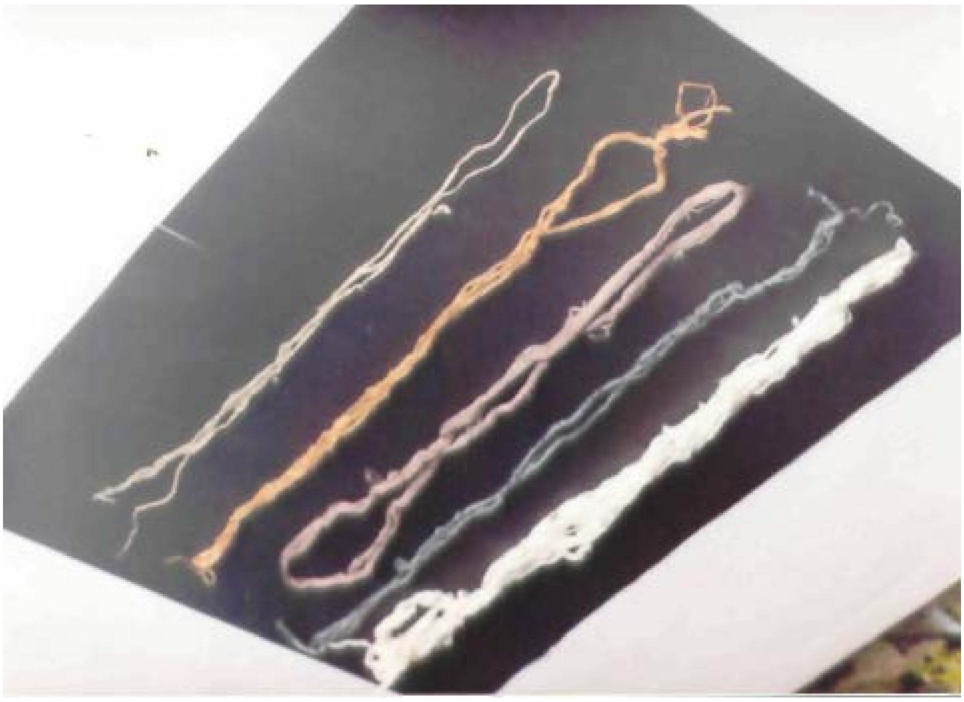

Photo3. Silk with natural colors

Photo 4. Suveniars

Photo 5. Axsesuars

Photo6. Suit.

Based on results of these studies, we have concluded, that it is quite possible to reconstruction of popular silk industry in Georgia.

RFERENCES

1. N. Kandelaki, M. Akhvlediani, N.Ckhaidze, J. Asatiani. Bioecological Resources and the Mechanism Determining Profitability of Sericulture. "International Workshopon Silk Handcrafts Cottage Industries and Silk Enterprieses Development in Africa, Europa, Central Asia, and Near East", Bursa, Turkey, 6-10 March, 2006.
2. N.Chkhaidze, L. Tsirekidze. Hadway for Sericultudist. IIZ-DVV, ISBN 99940-0-413-1. . (in Georgian).
3. N. Kandelaki, G. Nikoleishvili, J. Asatiani, I. Seferteladze, N. Chkhaidze, B.Sakandeidze. Two-stepped, centralized, cooperative feeding of mulberry silkworm - economical mechanism of sericultural branch profitibility. Sertificate N688. Tbilisi. 2004.

PROSPECTS OF ERICULTURE PROMOTION IN MADHYA PRADESH IN INDIA

By

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ABSTRACT

Ericulture is mainly confined to the Brahmputra Valley of Assam and in some tribal inhabited districts of Bihar, Jharkhand, West Bengal, Orissa etc. India produces 1448.00 MT of Eri silk / annum (2004-05), however the demand for the Eri silk is increasing every day due its unique appearance, thermal properties, aesthetic appeal and blending potential with other natural fibres. Often the Eri silk fibre which is spun from the Eri cocoon shell is called "Ahimsa Silk" or 'Heavenly thread' because of its extraction process. Considering the potential for growth and fulfill ever increasing demand of Eri silk, Central Silk Board has given a boost for production of Eri silk in other non- traditional States in the country like, Karnataka, Andhra Pradesh, Uttar Pradesh, Uttarakhand etc. Accordingly, a field trials were conducted in Hosangabad District of Madhya Pradesh, as a prelude to popularize the Ericulture in the state and in this paper, an attempt was made to discuss results on season-wise rearing performance and grainage behaviour of Eri silkworm.

Key word: Ericulture, *Samia ricini*, Castor, rearing and grainage performance

INTRODUCTION

Apart from the marvelous mulberry silk, which is quite popular the world over, there are few other varieties i.e Tasar, Eri and Muga silks that are equally attractive and collectively termed as *'Vanya silks'.* Among them, Eri silk is fast becoming popular in recent years. Eri, also known as *Endi* or *Errandi*, is produced by the Eri silkworm, *Samia ricini (Donovan)* feeding mainly on the leaves of Castor and Kesseru plants. Often the fibre spun from Eri cocoon is called **"Heavenly thread",** because of its graceful gloss, coarse denier, higher elongation rate and stainability (Singh and Benchamin, 2001, 2002). Fabric woven from this silk is also characterized by strength, durability, rustic appearance and soft feel. Unlike other varieties, Eri cocoons do not have continuous filament and hence, are spun. Elegantly designed Eri shawls and C*haddars* are quite popular because of their thermal properties.

The interest on Eri culture in silk circles has been building up for some time. Over the years, Eri silk production has been enhanced by 12 folds compared to that of five decades ago. Though contributes about 8.0% of the total raw silk produced, it accounts for over 78% of the total production of *'Vanya'* silks produced in the country. Traditionally, Ericulture has been confined to the North-eastern states which for nearly 98% of Eri silk produced in the country and balance 2% comes from Andhra Pradesh, Bihar, Orissa, West Bengal and Uttar Pradesh (Deori et al, 2001). Currently, the increasing demand for Eri silk products outmatches the production.

Madhya Pradesh is seventh largest castor cultivating state in the country Castor is grown in Madhya Pradesh in agricultural lands.. Castor is cultivated as a regular agriculture crop in about 2400 hectares during khariff and Rabi seasons in rain-fed lands of many districts like, Hosangabad, Betul, Jhabua, Ratlam, Raisen etc., under rain fed conditions for castor beans as solo crop and also along with urad, maize and soybean crops as intercrop or on bunds under irrigated condition. The total castor oilseed production is 700 MT (2002-2003 statistics) in the state. Besides, the indigenous varieties grow in large tract on the banks of river Narmada. The income from castor cultivation ranges from Rs 5,000-Rs 6,000/- per hectare in rain fed areas and Rs 18,000/- to Rs 20,000/- per hectare in irrigated areas in Madhya Pradesh. The farmers' income can be enhanced up to 20 to 25% by integrating Ericulture with no significant investment and loss to main component i.e. castor beans as it is well known that 25-30% foliage from castor plantations can be utilized for Eri silkworm rearing without affecting the seed production (Mishra, 1999; Raghavaiah, 2003; Krishna Rao, et al, 2004). The common castor varieties and hybrids cultivated in the state are given below.

Common Castor Varieties	**Common Castor Hybrids**
Aruna, Jyothi, Kranti, VI – 9, SKI – 73, Western & Kalpi	GCH-4, GCH-5, GCH-6. DCH-32, DCH-177,

Concurrently, the introduction of new motorized and pedal operated machines for spinning of Eri cocoons has given rise to finer yarns paving the way to a multiplicity of designs and products including blends (Somashekar, 2003). With the perspective of value addition at different stage of processing of cocoon and spun yarn, and export of the Eri silk products, Eri culture could well be promoted to the non-traditional niches within the country where food plants like Castor / Tapioca are traditionally cultivated so that this avocation can become a potential supplementary source of income for the poor, dry land cultivators and gainful employment to the women in the rain fed areas too. In rural environs, the services of the fairer sex could profitably be roped into this enterprise with tremendous economic implications – Hence, trials were conducted to introduce Ericulture in Madhya Pradesh.

MATERIAL & METHODS

The castor cultivators in Dhana village of Nasirabad Block of Hosangabad districts were selected for conducting trial on Ericulture. Farmers were given training on standard package of practices for Eri silkworm rearing, and provided support for supply of silkworm seed and rearing equipments during the year 2004-05. Silkworm seed were collected from CSB Eri Silkworm Seed Production Centre (ESSPC) at Hosur, Tamil Nadu in first trial during September, 2004 and in subsequent crops, seed produced at the Pamchmari and Melakhedi Govt. Seri Farms were used. Details of silkworm seed collected and reared are given in Table-1 below.

Table-1: Crop schedule, source of Silkworm seed and quantity of seed (dfls) reared.

Crop No.	Month	No. of Dfls	Source of Seed
1st	September- 2004	100	ESSP Hosur, TN
2nd	November - 2004	100	ESSP Hosur, TN
3rd	January-February-2005	1530	Hosangabad, M.P.
4th	March-April-2005	350	Hosangabad, M.P

The Hosangabad district is situated at an average height of 331 MSL with average maximum and minimum temperatures of 32^0C and 19^0C respectively and average rainfall of 1343 mm. Overall, the climate of the district is neither hot nor cool except the winter season of the Pachmarhi area.

Data on rearing performance covering details of dfls reared, larval period, cocoon produced in different seasons were collected from the farmers and the information was analyzed to draw inference for cocoon productivity/ 100 dfls, SR% and cropping schedule. The cocoons were preserved for grainage operations and grainage data were recorded to understand the sustainability of the culture on the long term basis. The results were discussed in relation to climatological data of the clusters.

RESULTS AND DISCUSSIONS

1. Rearing Seasons & Climatic Conditions:

It is evident form the data presented at Table-2 that highest productivity of 64.00 kg / 100 dfls of Eri cocoon was obtained during the November, 2004 and lowest of 33.0 kg / 100 dfls during the rearing trials conducted March- April, 2004. the Results are in consonance with the earlier trials conducted in Karnataka, Tamil Nadu and Jharkhand states (Singh and Das, 2006). The higher cocoon productivity during November, 2004 was due to favorable temperature ranging from 12^{O}C to 33^{O}C accompanied with relative humidity of 58% during the crop period whereas lowest productivity of 33.00 kg/ 100 dfls was mainly due to high temperature variation ranging from 20 ^{O}C (minimum) and 42^{O}C (maximum) accompanied by low relative humidity of 44.0%. Further, leaf quality during fourth crop (March-April, 2005) also had bearing on the cocoon productivity since the rearing was undertaken coinciding to the last plucking of castor beans and foliage was over mature. The study indicates that rearing in seasons with temperature of up to a maximum of 37^{O}C and minimum of 12^{O}C are congenial for Ericulture. These finding are in agreement with earlier studies where temperature range of 13^{O}C (minimum) to 36^{O}C (maximum) is suggested for Ericulture (Krishna Rao et al, 2004). The study also indicates that rearing schedule of September, November and January- March are suitable for practicing Ericulture in the district.

Table -2 : Rearing Seasons and Average Cocoon Productivity:

Crop	Month	Temp & RH %			Average Productivity (Kg/ 100 dfls)	SR (%)
		Max (^{0}C)	Min (^{0}C)	RH (%)		
1st	September- 2004	37	17	70	42.70	15.50
2nd	November - 2004	33	12	58	64.00	13.25
3rd	January-February-2005	34	17	53	44.86	14.80
4th	March-April-2005	42	20	44	33.00	13.80

2. **Appropriate size of Rearing:**

Further, the data presented in the Table-3, reveal that the average larval duration was 28.5 to 29 days during third crop (January-February, 2004) across the farmers groups. Farmers who have conducted rearings with less than 75 dfls/ farmer have obtained an average cocoon productivity of 83.00 kg/ 100 dfls, whereas average cocoon productivity has drastically reduced to 52.20 kgs/ 100 dfls in lots with 100 to 125 dfls / farmer and to 23.30 kgs/ 100 dfls in lots with more than 200 dfls farmer. The reasons for low productivity are inadequate rearing space with the farmers and capacity to manage the large rearings. The study indicates that small size of rearing up to 75 dfls / crop/ farmer is ideal in Hosangabad district till the adequate rearing facility and farmer's skill for rearing management are further developed.

Table-3: Farmers- wise rearing performance during Jan-February, 2005

Rearer	No of Dfls	Larval Period (days)	Total Cocoon Production (Kg)	Cocoon Productivity(Kg)/ 100 dfls
Group-A (rearing size up to 75 dfls/ farmer)				
01	75	27	60.0	80.00
02	75	29	56.0	74.00
03	75	29	42.0	56.00
04	50	29	50.0	100.00
05	50	29	45.0	90.00
06	30	30	29.4	98.00
Sub –Total	**355**	**28.8**	**282.4**	**83.00**
Group-B (rearing size of 100 to 125 dfls/ farmer)				
01	100	27	58.0	58.00
02	100	31	45.0	45.00
03	125	28	61.0	48.80
04	125	28	71.0	56.80
Sub –Total	**450**	**28.5**	**235.0**	**52.22**
Group-C (rearing size of more than 200 dfls/ farmer)				
1	250	29	52.0	20.80
2	225	29	55.0	24.44
3	250	29	62.0	24.80
Sub Total	**725**	**29**	**169.0**	**23.30**
TOTAL	**1530**	**29**	**686.40**	**44.86**

1. Grainage Performance:

The study also attempted grainage performance of Eri Silkworm during three seasons i.e. October, December & March at Govt. Seri Farms at Panchmari and Malakhedi. Seed cocoon were preserved and processed for seed preparation by following standard package of practices. The data presented in Table -4, reveals that pupal period ranges from 14 to 15 days in October and March, and 20 days in December. Moth emergence (%) was recorded ranging from 90 to 95 % and average fecundity ranging from 300 eggs (in October) to 355 eggs (in December & March). The cocoon: dfl ration was obtained ranging from 3.8 to 4.7. These parameters are at par with the grainage performance of Eri Silkworm in other traditional & non-traditional states like Uttar Pradesh (Pandey, 2003).

Table-4: Grainage Perf0rmance of Eri Silk Worm

Grainage Season	Place	Cocoon Preserved (Nos.)	Pupal Period (days)	Moth Emergence (%)	Dfls (nos.)	Average Fecundity	Cocoon : Dfl Ratio
1st October-04	Pachmarhi	403	14	90	106	300	3.8
2nd December-04	Malakhedi	7845	20	91	1669	352	4.7

3rd March-05	Malakhedi	5018	15	95	1115	355	4.5

2. **Foliage requirement:**

Observation on leaf ingested, larval duration & larval weight presented in Table-5 reveals that in the above study, one dfls of Eri silkworm ingested 13.43 kg of leaf during an average span of 26.5 days of larval period and attain an average weight of 7.13 gms. The difference during different seasons was insignificant except in September where one dfls has consumed 11.8 gms of foliage. Low consumption of foliage in September month may be due to faster growth and short larval period due to climatic conditions whereas higher consumption of leaf in other seasons may be due to longer larval period. The observations are in line with the observations of earlier authors (Singh, et al, 2004).

Table-5: Observation on Leaf Ingested, Larval Duration & Larval Weight.

Crop	Month	Leaf Ingested (Kgs/ Dfl)	Larval Duration (days)	Larval Weight (gm)
1st	September- 2004	**11.8**	**19**	**6.0**
2nd	November - 2004	**14.2**	**30**	**7.0**
3rd	January-February-2005	**14.6**	**29**	**8.0**
4th	March-April-2005	**13.1**	**28**	**7.5**
	Average	**13.43**	**26.5**	**7.13**

Thus, the study concludes that climatic conditions in Hosangabad district of Madhya Pradesh are suitable to promote Ericulture in larger way. Eri silkworm crops can be successfully reared for economic gain during three seasons i.e. September, November and January-February. Further, study also suggests that the local conditions are also conducive for quality Eri silkworm seed production and support sustainability of Ericulture in the district.

REFERENCES

Deori, S., Teotia, R.S., and Bajpeyi, C.M. (2001), Silk Industry of North Eastern States- Status & Future Prospects. Proceedings of Workshop on Rural Development through Sericulture in North East, Guwahati: 16-23.

Krishna Rao, J. V., Sathyanarayana, K ., Teotia, R.S. and Mukund V. Kirsur (2004) Ericulture in India. Proceedings of International Seminar on “Castor seed, Castor oil & its value added Products”, 8th February, 2004, Ahemdabad, India: 39-45.

Mishra, S.D. (1999) Aruna Variety, a unique host for the Eri silkworm. Part-1. Two revenues from the same source. Indian Journal of Sericulture, 38(2): 95-101.

Pandey, R.K. (2003) Eri culture in Uttar Pradesh. Indian Silk : 41(12): 21-24.

Raghavaiah, C.V. (2003). Strategy for promotion of Eri Silk through utilization of castor for foraging. Indian Silk, 42(1): 33-35.

Raghavaiah, C.V. (2003). Prospects of Eri silk (*Philosomia ricini*) production along with castor beans *(Ricinus communis L.)* and Tapioca *(Manihot utilisimma)* production in Andhra Pradesh. Key note address at Workshop on Strategies for development of Ericulture in Andhra Pradesh organized by Central Silk Board at Hyderabad, India.

Singh, B.K., Sahu,J., Krishna Rao, J.V. and Das, P.K. (2004) Sustainable development of traditional States through improved rearing practices. Proceedings of National Workshop on Potential & Strategies fro Sustainable development of Vanya Silks in the Himalayan States, November, 8-9. 2004, Dehradun, Uttarakhand, India : 236-239.

Singh, B.K. and Das, P.K (2006) Prospects and problems for development of sericulture in non-traditional States. Abstracts of Regional Seminar on Prospects & problems of Sericulture as an Economic Enterprise in North west India, November, 11-12, 2006, Dehradun, Uttarakhand, India. 60.

Singh, K.C and Benchamin, K.V. (2002), Biology and Ecology of Eri Silk moth, *Samia ricini (Donovan)* Saturniidae*)*-A review. Bulletin of Indian Academy of Sericulture. ***6(1):*** *20-23.*

Somashekar, T.H. (2003) Recent advances in Eri silk Spinning, weaving and future prospects, 41(12): 49-52.

The prospects of the European Sericulture within the frame of the EU Common Agricultural Policy

By

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Introduction

The European Union (EU) is characterised by a predominantly rural geography, influenced by human occupation and activity. The various rural areas show particular differences, since their natural environments have been affected by numerous schemes of farming and forestry and the associated with them crafts and industries. Agriculture and forestry in the EU represent the major land users, having in this way a dominant role in influencing the rural economies and the rural landscape as well.

Agriculture today may appear less important to the economies of rural areas, compared to past periods, but it still has a significant contribution to their economic growth and environmental sustainability.

EU agriculture is a multi-dimensional activity, involving many different functions, among them the majors being food and fibre production, countryside management, nature conservation, and tourism. Farming can thus be described as having multiple functions.

The today's EU farming sector appears modern and competitive occupying a leading position on world markets, both as a major exporter and the world's largest importer of food, mainly from developing countries. Besides that the sector targets to sustainability, efficiency, using safe, clean and environmentally friendly production methods. It simultaneously serves rural communities, taking in consideration their tradition and diversity and trying to guarantee the survival of the countryside as a place to live, work and visit.

Europe's agricultural policy is determined as Common Agricultural Policy (CAP), monitored by the governments of Member States and operated by the Member States. It involves support to the farmer's income and also encourages the production of high quality products and the development of additional ways of improving the agricultural businesses.

The EU Common Agricultural Policy (CAP)

The first ideas concerning a European CAP first appeared, among the western European countries, in early 1950s right after the heavy damages of the agriculture, caused by the war, and the need for guaranteed food supplies. This early CAP's attempt was to encourage better productivity in the food chain and provide to the consumers a stable supply of affordable food, and also to ensure that Europe as a union could have a viable agricultural sector. This early CAP approached its goals by offering subsidies and guaranteed prices to farmers. Financial assistance was provided as well, for the restructuring of farming, aiding farm investments and aiming to ensure that farms will develop in size, management and technology.

The adopted by the European countries CAP was very successful in meeting its objective of moving the newly established EU towards self-sufficiency. By the 1980s though, the EU faced almost permanent surpluses of the major farm commodities, some of which were exported, mostly with the help of subsidies, and others had to be stored or disposed of within the EU. These necessary measures created a high budgetary cost and distorted some world markets. In this way they had become unpopular to consumers and taxpayers and did not always serve the best interests of farmers. At the same time society became increasingly concerned about the environmental sustainability of agriculture.

The CAP of today

Since those first attempts many changes had been made to the CAP, the most important of them around the 1990s. Limits put on the production helped to reduce product surpluses and emphasis was placed on environmentally sound of farming. Farmers had to activate themselves more to the direction of market place, while receiving direct income aid by means of subsidies, and to respond in a better way to the public's changing priorities.

This shift of emphasis included as major new element the rural development policy, encouraging farmers to diversify and improve their product marketing and to restructure their businesses.

In 2003 a further fundamental reform was agreed. From then on farmers are no longer paid just to produce food. Today's CAP takes consumers' and taxpayers' concerns fully into account, while giving EU farmers the freedom to produce what the market wants. The concept of this reform is that in future, the vast majority of aid to farmers will be paid independently of what or how much they produce. In the past, the more farmers produced the more subsidy payments they received. Under the new system farmers will still receive direct income payments to maintain income stability, but the link to production has been set aside. In addition, farmers will have to respect standards concerning environment, food safety and animal welfare and farmers failing to do this will face reductions in their direct payments. Removing the link between subsidies and production, the so termed 'decoupling', is expected to make EU farmers more competitive and market-oriented. They will be free to produce according to what is most profitable for them while still obtaining a stability of income through the direct income payments.

The EU brought in policy during the 1980s and 1990s tried also to limit the production of surplus products. Several measures had been used in this direction, first voluntary and later compulsory, set-aside where farmers leave a percentage of their land uncultivated. Among the measures were fixed quotas on milk production and limits on the area of crops and numbers of animals for which a farmer could claim subsidies. Gradually these policies succeeded and surpluses were reduced. The CAP reforms in the 1990s, had also to take in consideration the World Trade Organisation (WTO) agreement of 1995 and reduce the capacity to use export subsidies. Due to its policy though EU has succeeded to reduce its use of export subsidies and at the same time maintain and even increase its agricultural exports.

This proves that recently more and more consumers are prepared to pay for guaranteed quality products, deriving through special production processes promoted by the EU, like integrated and biological. Even in the EU single market of 450 million consumers, the CAP ensures that genuine products can be readily identified and that consumers are not misled by imitation products. In addition member States have the possibility to use policy measures under the CAP, including incentive payments, to encourage farmers to participate voluntarily in EU or national schemes designed to improve and guarantee the quality of agricultural products.

Within these frames the exceptional nature and quality of some products derives from both their place of production and the methods used to make them. Both consumers and the food trade are increasingly interested in the geographical origin of products and other characteristics of them. The EU has developed to this direction three 'quality logos' connected to Protected Designations of Origin and Protected Geographical Indications (PDO and PGI). They both apply to agricultural products or foodstuffs with a strong link to a specific region or place. A product that carries the PGI logo has a specific characteristic or reputation associating it with a given area, and at least one stage in the production process is carried out in that area.

A product bearing the PDO logo has proven characteristics which can result solely from the terrain and abilities of producers in the region of production with which it is associated. PDO products, thus require all stages of the production process to be carried out in the area concerned.

The third logo is the Traditional Speciality Guaranteed (TSG) logo, and is used for products with distinctive features and which either have traditional ingredients or are made using traditional methods.

Organic agriculture within the CAP
Organic farming is a production method that maintains soil structure and fertility, promotes a high standard of animal welfare, and avoids the use of synthetic pesticides, herbicides, chemical fertilisers, growth promoters such as hormones and antibiotics, or genetically modified organisms. Farmers use techniques that help sustain ecosystems and reduce pollution. Only a very limited number of additives and processing aids can be used in organic farming. The EU rules guarantee the authenticity of organic farming products wherever they are produced and ensure that the labelling of organic products is accurate. By law the use of the word ‘organic’, and its equivalent in other languages, is reserved solely for products of organic farming. This gives guarantees to consumers about the quality and reliability of the organic produce they buy.
EU organic agriculture is one of the most dynamic sectors, accounting in 2002 for an estimated 4.4 million hectares (3.3 % of total agricultural area) on 150. 000 holdings. Many farmers have joined schemes to encourage them to convert farmland to organic production under EU rural development programmes.

Agri-environment measures within the CAP-rural development
Agri-environment schemes have been supported by the EU since they were introduced in 1992. They encourage farmers to provide environmental services which go beyond following good agricultural practice and basic legal standards. Aids may be paid to farmers who sign up voluntarily to agri-environment commitments for a minimum period of five years. Longer periods may be set for certain types of commitment, depending on their environmental effects. It is obligatory for Member States to offer such agri-environment schemes to farmers. This illustrates the political priority attached to these schemes.
Numerous opinion polls in both EU-15 and new Member States clearly demonstrate that a living and sustainable countryside matters to European citizens. Landscapes and the countryside are places where people live, work, and travel around and find essential resources such as water and soil in which to grow crops and feed livestock. Landscapes therefore reflect the activities of the people who live in them. Rural areas cover around 90 % of the EU territory and so rural development becomes a vitally important policy area. Farming and forestry are the main land uses in rural areas, and as such they should share more attention. The 2003 CAP reform involved a major strengthening of rural development policy by reducing direct payments for bigger farms and transferring the funds into rural development measures, such as:

- Financial assistance to encourage change by, for example, reducing the numbers of animals per hectare of land, leaving field boundaries uncultivated, creating ponds or other features, or by planting trees and hedges and so going beyond conventional good farming methods.
- Helping with the cost of nature conservation, insisting that farmers must respect environmental laws and laws on public, animal and plant health, and look after their land properly if they wish to qualify for direct income payments.

Another important measure is the bottom-up approach of the public and private partnership initiative known as Leader+, whereby local rural development projects are funded by both the EU and national governments and private bodies. The main emphasis is on providing local communities with the possibility of selecting and funding projects which suit the local environment and can have long term benefits. In addition, the Leader approach encourages the generation of novel ways to provide sustainable rural development which, through sharing with others across the EU, can go far beyond the initial project and can influence and enhance rural development policy.
There are fewer farmers today than in the past, and they do not work alone. They need the services of all kinds of businesses to prepare their own produce and to transform and sell it. An additional source of income is often provided by farm holidays (farm cottages or bed-and-breakfast), or farm shops. These activities only work if farmers can make the surroundings attractive, maintaining and respecting the environment. Farming families and people living and working in the countryside are

consumers too and they want the same benefits from the rural environment as society as a whole. For these reasons the scope of rural development policy is much wider than traditional 'agricultural' activities, including measures to protect and improve the environment, schemes to support rural communities and to develop the rural economy as a whole. The EU rural Development Policy is based on three main instuments:

- The EU strategic guidelines for Rural Development
- The Council Regulation on support for rural development by the new European Agricultural Fund for Rural Development (EAFRD)
- The Commission Implementing Regulation.EU

The EU strategic guidelines are

1. Improving the competitiveness of the agricultural and forestry sectors
2. Improving the environment and the countryside
3. Improving the quality of life in rural areas and encouraging diversification
4. Building Local Capacity for Employment and Diversification
5. Translating priorities into programmes
6. Complementarity between Community Instruments

Sericulture in the EU today – future prospects

Silkworm rearing within the E.E.C. countries is practiced only in the southern part of Europe and more specifically in the Mediterranean and southern Balkan countries. Sericulture as an agricultural activity in the present time holds a minor share among the rest activities but it is considered as one of the protected and promoted ones, being subsidized by around Euro 132 per box of 20.000 eggs (EU Regulation 845/1972, Article 1).
This subsidy creates a considerably interesting income to the farmer involved to sericulture, added to the cocoon value, being though at the same time inseparable to the mulberry cultivation, which provides the sole food of the silkworm. Mulberry plantation compared to other traditional crops becomes very interesting taking in consideration the fact that according to the EU Regulation 1782/2003 (council 23-0-2003, EU Journal 21-10-2003) the yearly subsidies of the traditional crops will be restricted up to 2012 by the following scheme:

2005	**-3%**
2006	**-4%**
2007	**-5%**
2008	**-5%**
2009	**-5%**
2010	**-5%**
2011	**-5%**
2012	**-5%**

In addition to this article 53 of the same EU regulation involves obligation to cessation of cultivation of a certain percentage of the farmer's total land, while article 54 provides a subsidizing to this cessation of cultivation. In the same time article 56 permits alternative uses of land during cessation of cultivation and leaves open the possibility of additional national subsidy, up to 50% of the costs for the establishment of perennial crops for biomass production onto lands under such treatment. The interesting point of this possibility is that mulberry tree is included in the perennial crops, being simultaneously considered as ''energy crop'', for which article 88 provides an additional subsidy of 45 euro/ha/year.

All the above are far more strengthened by EU Regulation 1257/1999 whose paragraph 3 (articles 31 and 55) provide additional subsidy according the afforestated area of each country, giving to mulberry tree more opportunities for establishment. The above described advantages for mulberry field installation and further silkworm rearing can be additionally benefited by EU Regulation 1257/1999, (paragraph 3 article, 55), and EU Title II, (chapter V, articles 13 to 21), which both provide subsidies for disadvantageous areas according to their area. Such areas in the most of the cases are suitable for silkworm rearing.

Conclusions

The above facts considered in parallel with the continuously increasing demand for silk products within Europe and the entire world as well, predispose a promising future for sericulture in EU countries. This out coming conclusion is additionally strengthened by its complete coincidence to the main topics and targets of the new CAP, and more specifically:

- Sericulture provides reasonable income to the farmer.
- It can by it self very easily participate to the production of Protected Designations of Origin and Protected Geographical Indications (PDO and PGI) and Traditional Speciality Guaranteed (TSG) products.
- It certainly contributes, due to its nature to sustainability and efficiency of land and labour use.
- It, by all means represents, a safe, clean and environmentally friendly production method.
- It serves rural communities, taking in consideration their tradition and diversity, and contributes to all the above described EU strategic guidelines.
- It definitely contributes to rural Development and guarantees the survival of the countryside as a place to live, work and visit.
- It represents by itself an ideal form of organic farming.

References

1. Eugene Leguen de Lacroix: The Common Agricultural Policy Explained. European Commission Directorate General for Agriculture, October 2004, ISBN 92-894-8204-4.
2. Elena Seraceno: Leader+ Observatory point, April 2007, Brussels, Belgium.
3. Silk, a tradition with future: Trade Forum, Issue 1, 1999.
4. Kipriotis Evripidis: Sericultural industries in GreeceBack round – recent situation – aspects and prospects. Paper contributed to the "First International Workshop on Revival and Promotion of Sericultural Industries and Small Silk Enterprise Development in the Black & Caspian Seas Region"Tashkent, Uzbekistan, 11^{th} – 15^{th} April 2005, Food and Agriculture Organization, Rome.
5. Kipriotis Evripidis:Follow – up activities of Tashkent Workshop and National strategy for sericulture revival and development in Greece. Paper contributed to the International Workshop on Silk Handcrafts Cottage Industries and Silk Enterprises Development in Africa, Central Asia, Europe and near East. Bursa, Turkey, 6-10 March 2006,Second Executive Meeting of Black, Caspian seas and Central Asia Silk Association (BACSA),Food and Agriculture Organization, Rome.

REPORT

On the Black, Caspian Seas and Central Asia Silk Association (BACSA) activities during the period March 2006 – September 2007

Presented by Dr Panomir Tzenov, BACSA president at the 3rd BACSA executive meeting, held on 20th September 2007 at Vratza, Bulgaria

I. Activities on the implementation of the decisions taken at the 2nd BACSA meeting, held from 6 to 10 March 2006 at Bursa, Turkey.

1. The regional project proposal: "Improvement of Income-Generation Options Based on Revival of Sericultural Industries and Promotion of Small Silk Enterprise Development in Eastern Europe and Central Asia"

Until May 2006 the already prepared draft project proposal was revised and submitted officially to the FAO through the governments of Azerbaijan, Armenia, Bulgaria, Romania, Tajikistan and Uzbekistan. Then the FAO returned it back to BACSA with their recommendations for necessary revision. After the draft project proposal was revised according to FAO' recommendations, the name of it was changed as "Improvement and Revival of Sericulture Industries in Eastern Europe and Central Asia". Finally in February 2007 FAO informed BACSA that the project proposal was cancelled. Still we don't know the real reason of this cancellation. Most probably because of the reduced FAO's budget recently.

By the same time following the decisions taken at the second BACSA executive meeting a Project Concept Note, summarizing the project content was prepared and submitted to the following potential donors in May 2006: UNDP, ADA, CIDA, DCI, DEZA, DFID, FAO, GTZ, IFAD, ITC, UNCTAD, JICA, KOICA, NORAD, SIDA, UNIDO, USAID, EBRD and the World bank. The purpose of this initial approach to the prospective donors was just establishing on-line status and letting them know about BACSA and its activities in operating a field project in the region and seeking for funds. Still no any donor manifested any interest in funding this project.

Therefore we may be concluded that until now BACSA failed in finding funding for the regional project for sericulture revival and development.

However we plan to continue our efforts in this direction by approaching some possible donors, more ready to provide support to some of BACSA member countries rather than to the whole region.

2. The regional mini-project: "Comparative studies of silkworm hybrids performance for sericultural enterprise development in Black, Caspian seas and Central Asia region"

This project has passed very successfully.

From the testing as a general conclusion appear that the silkworm hybrids, produced in BACSA member countries have comparatively high hatchability, pupation rate, cocoon weight, shell weight and fresh cocoon yield by one box of silkworm eggs, but compared with the Japanese and Korean hybrids the local hybrids manifested lower cocoon shell ratio and raw silk percentage. Therefore the breeding work in the BACSA member countries should be directed towards improvement the silk productivity of the hybrids, by the same time preserving their comparatively high pupation rate and cocoon yield.

3. The registration of BACSA as a legal entity in Bulgaria.

In April 2006 BACSA was registered as a legal entity with statutory office in Vratza, Bulgaria and copies of this registration were sent to all the BACSA National coordinators.

4. Informing the local governments about the 2nd BACSA executive meeting Until May 2006 most of BACSA' national coordinators managed to inform the local governments about the 2nd

BACSA executive meeting results and decisions and provided official "Letters of support" on behalf of the government respective about principle support to the regional project for sericulture revival and development.

5. Translating in Russian and publish the book "Sericulture Training Manual". The book is under translation and the publishing of it will be supported by the Greek NAGREF, Agricultural Research Station of Komotini.

6. During the previous BACSA meeting a decision to hold **the 3 rd BACSA executive meeting** in the end of September 2006 at Vratza, Bulgaria had been taken, but due to some financial and organizational constraints it wasn't hold in the last year. However BACSA was a co-organizer of the celebration of the 110 jubilee of Sericulture Experiment Station, Vratza and the scientific conference "Problems of maintenance and utilization of mulberry and silkworm genetic resources", held from 26 to 28 Sep. 2006 in Vratza.

II. Other activities

1. Working out national sericulture development plans. The BACSA national coordinators in Armenia, Azerbaijan, Bulgaria, Tajikistan and Uzbekistan with the assistance of BACSA president prepared sericulture national development plans for the period 2007 – 2015. The plans were disposed to the attention of the government of each country, submitted to the FAO and uploaded at the BACSA web site.

2. Strengthening the relationships and cooperation in sericulture between the BACSA member countries and other countries as well.

2.1. Making bilateral agreements for cooperation
During the period several bilateral agreements for scientific and technical cooperation were signed between the Sericulture Experiment Station, Vratza, Bulgaria and the Uzbek Sericulture Research Institute, Tashkent, the Commercial Society "Sericarom", Bucharest, Romania, Institute of Bioengineering, Biotechnology and Environmental Protection - S.C. BIOING S.A**.,** Bucharest and Institute of Genetic Resources, Kyushu University, Japan. In progress are also the negotiations for signing bilateral agreements for cooperation with the Sericulture Experiment Station in Padua, Italy, Agricultural Research Station of Komotini, Greece and the Queen Sirikit Institute of Sericulture in Bangkok, Thailand. Through these agreements for bilateral cooperation are exchanged mulberry and silkworm germplasm resources, new scientific and technical information, visits of researchers, is realized joint participation in research projects etc., therefore the making of agreements and their implementation is very useful for all the participating parties.

2.2. Common projects:
During the period several bi and multilateral project proposals have been prepared and submitted to the financing organizations respective.

The project proposal **"Support for unlocking and developing the research potential of silkworm breeding and innovative management techniques in Bulgaria, Greece and Romania, targeting to the small silk enterprise development"** was submitted for possible financing by the EU **FP 7 "Capacities" Programme, Part 4 Research Potential, Activity Area: ''Unlocking and developing the research potential in the EU's convergence regions and outermost regions''**
The main target of this project is improving the capacities of the involved in sericulture selected centres in Bulgaria, Greece and Romania by know-how and experience transfer to the scientific and technical personnel from the participating EU countries (France and Italy). The planned project budget is around **800,000 EUR** for two years and the term for announcing the results of this

competition is October 2007. The project was prepared by the efforts of researchers from Bulgaria, Greece, France, Italy and Romania and finally revised, generalized and submitted in the end of April 2007 to FP_7 programme by the project coordinator Dr E. Kipriotis from Greece. However yesterday Dr Kipriotis informed me that the project was not approved for financing. So obviously BACSA should find a more flexible scheme for preparation of the project, mean probably to use the services of some company, specialized and experienced in preparation of such kind of projects. In any case the BACSA efforts in getting FP 7 project(s) should continue.

Two projects with the participation of Romanian and Bulgarian researchers were submitted for financing to 2007 Competition, organized by The National Centre for Programme Management, Romania. These projects are **"Advanced textile products accomplished by integrated systems of processing non-spinnable silk cocoons"** whose coordinator is THE RESEARCH - DEVELOPMENT NATIONAL INSTITUTE FOR TEXTILE AND LEATHER, Bucharest, Romania and **"Conservation of genetic resources and native silkworm germplasm biodiversity"** with a project coordinator - University of Agricultural Science and Veterinary Medcine, Cluj Napoca, Romania.

The project **"APPLICATION OF MODERN METHODS FOR PROCESSING THE PRODUCTS AND SWEEPINGS RESULTED FROM SERICULTURE IN ORDER TO OBTAIN NEW ECOLOGIC AGRICULTURE FOOD"** was jointly prepared by the Institute of Bioengineering, Biotechnology and Environmental Protection - S.C. BIOING S.A., Bucharest, Romania and the Sericulture Experiment Station, Vratza, Bulgaria and further submitted in June 2007 for financing both to Ministries of Education and Science of Bulgaria and Romania through a bilateral agreement for support of scientific cooperation between the two countries.

3. Popularization of BACSA in the world.

3.1. The visits of BACSA president to Japan, Romania and Thailand.

During the period I as BACSA president visited and attended meetings in Japan, Romania and Thailand.
During the visit to Japan in February/March 2007 I presented at a meeting, organized in Kyushu University, Fukuoka the BACSA aims, structure etc. A detailed report on the visit was uploaded at the BACSA web site as well.
In Romania during the international conference on "INTENSIFYING PROCEEDINGS OF BIOMATERIAL PROCESSINGS", organized by the Institute of Bioengineering, Biotechnology and Environmental Protection - S.C. BIOING S.A**.,** Bucharest and held from 20th to 23rd August 2007 at Sinaia I presented a paper on "PRESENT STATUS FOR UTILIZING OF SERICULTURAL GENETIC RESOURCES IN SOME EASTERN EUROPEAN AND CENTRAL ASIAN COUNTRIES".

In Thailand I attended the **"Thai Silk Fair - 2007"**, organized by the Queen Sirikit Institute of Sericulture in Bangkok and presented a paper on **"Situation, Strategy and Marketing of the Silk Production in the Black, Caspian seas and Central Asia (BASCA) Region Countries".**
I attended all the three events as an invited speaker and I may say that my presentations were met with high interest and contributed in popularizing of the sericultural industry in the BACSA region countries.

3.2. BACSA web site functioning

The web site is well maintained and all the important news and useful information are uploaded regularly at it. According to many BACSA members and other people engaged in sericultural industry development the web site is really very informative and useful. By the same time we appreciate any new idea and suggestions for the site improvement.

3.3. Accepting new BACSA members
18 persons submitted their filled BACSA membership application forms during the period with requests to be accepted as members of our association. 15 new BACSA personal members from India and 2 from Romania were accepted during the period. As a member of the BACSA Executive committee was elected Prof. Dr H. Z. Lea, ex-technical officer in FAO and highly reputed internationally scientist and sericulture expert.
A special certificate for membership was designed and sent to all the Executive committee members and it is also available for sending to all the BACSA members by their request.

I would like also to remind and analyze the implementation of the BACSA main tasks and planned future activities at its creation.
The association's main tasks are to:

- generate sericulture projects from external resources, including bilateral and multilateral cooperation; - **in this regard still we don't have any evident results.**
- sensitize respective governments and prospective donors; - **its is doing**
- promote local and regional joint efforts which allow the cooperation between the countries of the Black, Caspian seas region and Central Asia to develop concrete actions that fortify the sustainable development of the sericulture in the region; - **it is doing**
- promote making agreements for international scientific-technical cooperation and business relations between the countries involved; - **it is doing**
- promote market studies, training, and dispersion of sericultural germplasm, and silkworm eggs. – **it is doing in some extent, except for the training**

The planned activities were focused on:

1) On the basis of the analysis of the extensive real information on a present state of sericulture in all countries of the region, develop more optimum short/medium-term strategy of sericulture revival and development at a regional level and coordinate all joint actions necessary in this direction. – **it is already done**
2) Prepare and search for possible donors for funding a regional project for sericulture industries revival in the Black, Caspian seas and Central Asia countries. – **still we do not have success in this**
3) Creation of an international fund on revival and development of sericulture industry and handcraft manufacture of silk in the countries of the Black, Caspian seas and Central Asian region. - **still we do not have success in this**
4) Creation of uniform standardization system for production of silk branch of the countries involved. – **we will make efforts to start this work in the next year**
5) Prepare a draft project proposal in development of methods and means for innovation of the cocoon/silk processing technique and technology. – **first we should find the most possible donor for a such kind of project. We will make efforts to start this work in the next year**
6) To function as a regional network of services to the sericulture activities of the Black, Caspian seas and Central Asia community of nations – **it is going on**
7) Promote cooperation between the local sericulture research institutes, to jointly advance projects with European, Chinese, Indian, Japanese, Korean, etc. Universities and Research Institutes. – **we are making efforts in this work**
8) Favor the qualification improvement of research and technical staff taking advantage of the knowledge and experiences in the sericulturally more developed countries. – **unfortunately until now BACSA couldn't mobilize any financial resources for**

this purpose. However BACSA informs regularly the members about all the possibilities to attend training courses.

9) Organize training courses in the member countries. Creation of Centres for personnel training and improvement of professional skills of silk industry experts. **- unfortunately until now BACSA couldn't mobilize any financial resources for this purpose**

10) Promote the accomplishment of workshops, congresses, encounters, agreements of scientific cooperation in sericulture. Foundation of periodical regional exhibitions along with training workshops and possibility of direct presentation of each country's silk products – **we are doing this**

11) Favor the exchange of information, between the countries, on the successful experiences and difficulties found in the sericulture activity. It is necessary to make bilateral and multilateral contracts between the countries of region about exchange of genetic resources of silkworm and mulberry, an exchange of scientific and technical, technological and other helpful information. – **we are doing this**

12) Promote activities of diffusion and promotion of silk handcrafts production, management of the micro artisan and/or farmers companies, marketing courses, micro companies administration courses. – **In the last year March at Bursa, Turkey by the FAO technical and financial assistance we organized and conducted a workshop on the promotion of silk handcraft cottage industries and silk enterprise development, with the participants from 22 countries.**

13) Providing experts of the Silk Sector to the different Black, Caspian seas and Central Asia countries, with individual programs with base in specific necessities. – **still no any BACSA country asked BACSA for providing experts**

14) Improve the promotion and commercialization of sericultural products. **- we are doing this**

15) Dissemination of market information via workshops, meetings, internet presence and publications. **- we are doing this**

16) Promote the exchange of sericulture genetic resources and comparative testing them. **- we are doing this**

17) Favor that the Black, Caspian seas and Central Asia region countries integrate in their national development plans the sericultural industries and small silk enterprise. **- we are doing this**

18) Organize a permanent forum with the delegates of each one of the countries. **- we are doing this**

19) Open and maintain a web site. **- we are doing this**

After analyzing the targets put and their implementation I may make the main conclusion, that BACSA managed to mobilize the power of its human resources, mostly on a voluntary bases, but unfortunately we couldn't provide any significant funding for our planned projects.
Therefore the key problem of finding funding for the BACSA activities is the most important now.

Final document

of the 3rd BACSA meeting, held on 20th September 2007 at Vratza, Bulgaria during the international conference "Sericulture Challenges in the 21st Century" (Serichal 2007)

The BACSA executive committee in the forum: **Third Executive Meeting of Black, Caspian seas and Central Asia Silk Association (BACSA), 20 September 2007, Vratza, Bulgaria** took the following decisions:

1. Express formal gratefulness to the Food and Agriculture Organization of the UN, the Government of Republic of Bulgaria and National Centre of Agricultural Sciences, Sericulture Experiment Station, Vratza Bulgaria for organizing the international conference "Sericulture Challenges in the 21st Century" (Serichal 2007) and the 3rd BACSA meeting, 18 -21 September 2007, Vratza, Bulgaria.

2. Express formal gratefulness to the Food and Agriculture Organization of the UN for providing technical assistance and financial support to the international conference "Sericulture Challenges in the 21st Century" (Serichal 2007) and the 3rd BACSA meeting, 18 -21 September 2007, Vratza, Bulgaria.

3. Express formal gratefulness to the Sericulture Research Institute, Gandja, Azerbaijan, Sericulture Experiment Station, Vratza, Bulgaria, Commercial society "Sericarom" – Research department, Bucharest, Romania, Apicultural and Sericultural Department, Faculty of Animal Husbandry and Biotechnology, University of Agricultural Science and Veterinary Medicine, Cluj Napoca, Romania and Uzbek Sericulture Research Institute, Tashkent, Uzbekistan for conducting the international silkworm hybrid testing and to all the silkworm egg providers for their participation in the mini BACSA regional project "Comparative studies of silkworm hybrids performance for sericultural enterprise development in Black, Caspian seas and Central Asia region".

4. Express formal gratefulness to the Food and Agriculture Organization of the UN for providing technical assistance and financial support to conduct the mini BACSA regional project "Comparative studies of silkworm hybrids performance for sericultural enterprise development in Black, Caspian seas and Central Asia region".

5. The BACSA' national coordinators to inform their governments about the 3rd BACSA executive meeting results and decisions.

6. Until the end of year 2007 the BACSA National coordinators in Albania, Georgia, Greece, Kazakhstan, Romania, Turkey and Ukraine to prepare sericulture national development plans for the period 2007 – 2015 and to put them on the attention of the government respective for approval and consideration in the national agricultural development plans. The sericulture national development plans to be uploaded at the BACSA web site.

7. The BACSA Executive committee recommends to all BACSA member countries to continue and expand their bi/multi lateral cooperation in exchange, testing and use of silkworm and mulberry genetic material.

8. The BACSA Executive committee recommends to all BACSA member countries their silkworm breeding programmes to be directed towards improvement the silk productivity of

the hybrids, by the same time preserving their comparatively high pupation rate and cocoon yield.

9. The BACSA Executive committee recommends to all BACSA member countries their sericultural organizations to make bi and multi lateral agreements for international cooperation for exchange of mulberry and silkworm germplasm resources, new scientific and technical information, visits of researchers, participate in joint research projects etc..

10. The BACSA Executive committee recommends to the BACSA member countries to try submitting sericulture projects through the FAO TCP facility programme which is under the responsibilities of the FAO country representative or the Regional FAO office.

11. The BACSA members should continue their efforts in popularizing the association's activities in the world by the web site, attending at international meetings and conferences etc/.

12. Until April 2008 the BACSA president to prepare a draft for an uniform standardization system for production of sericultural branch of the BACSA countries and distribute it to all BACSA members for their review, comments and suggestions. After revising the draft to present it during the 4th BACSA meeting for approval by the Executive committee members.

13. To make efforts in strengthening the possible technical and scientific cooperation among the BACSA and other countries through the European framework programmes. The EU member countries (Bulgaria, Greece and Romania) and candidates (Turkey) should be especially active in searching for foreign partners and initiation of joint research projects and cooperation.

14. The BACSA Executive committee to make efforts in finding funding for the next four points:

- Creation of uniform standardization system for production of silk branch of the countries involved.
- Prepare a draft project proposal in development of methods and means for innovation of the cocoon/silk processing technique and technology.
- Creation of an international fund on revival and development of sericulture industry and handcraft manufacture of silk in the countries of the Black, Caspian seas and Central Asian region.
- Providing experts of the Silk Sector to/from different Black, Caspian seas and Central Asia countries, with individual programs with base in specific necessities.

15. BACSA Executive committee recommends to the Bulgarian Sericulture Association and the Commercial society "Sericarom", Romania to make efforts the governments of Bulgaria and Romania to request officially the European commission about implementation after 2009 of the EUROPEAN COUNCIL REGULATION (EC) No 1544/2006 of 5 October 2006 laying down special measures to encourage silkworm rearing and the COMMISSION REGULATION (EC) No 1744/2006 of 24 November 2006 on detailed rules for aid in respect of silkworms.

16. BACSA Executive committee recommends to the Bulgarian Sericulture Association and the Commercial society "Sericarom", Romania to suggest to the governments of Bulgaria and Romania providing national financial direct support to the silkworm reareres in 2008 and 2009.

17. Due to the recent retirement of the BACSA National coordinator in Greece, Ms. E. Rammou the BACSA Executive committee has elected unanimously Dr Evripidis Kipriotis, Director of the Agricultural Research Station if Komotini as National coordinator in Greece.

18. Considering that Iran is one of the leading silk producer in the Caspian region, having very old and recent tradition in sericulture the BACSA Executive committee has taken a decision to accept Iran as a BACSA member country if some of the sericultural Iranian institutions (University of Guilan, Iran Sericulture Research Institute, Iran silkworm rearing Co.) agree.

19. BACSA Executive committee has taken decision to accept as personal BACSA members Dr B.N. Susheelamma from India and Mr. K. Etebari and Ms. L. Matindoost from Iran.

20. The BACSA Executive committee recommends to the Sericulture Experiment Station, Vratza, Bulgaria to prepare, print and distribute by post the Proceedings of the international conference "Sericulture Challenges in the 21st Century" (Serichal 2007) and the 3rd BACSA meeting held in Vratza, Bulgaria from 18 to 21 September 2007. By the same time BACSA will upload the conference proceedings at its web site.

21. To organize the next 4th BACSA executive meeting during the International Sericultural Commission 21st congress which will be held from 3 to 6 November 2008 at Athens, Greece.

22. The BACSA national coordinators and the Executive committee members to make efforts in organizing national/regional meetings or conferences on the occasion of the International year of natural fibers 2009.

LIST

of the participants at the International conference "Sericulture Challenges in the 21st Century" (Serichal 2007) and the 3rd BACSA meeting, held in Vratza, Bulgaria from 18 to 21 September 2007.

Name	Country	Post & Organization
1. Mr. K.W. Sohn	South Korea/Italy	Technical Officer (Sericulture & Beneficial Insects) Agricultural and Food Engineering Technologies Service Rural Infrastructure and Agro-Industries Division (AGST) FAO-Rome Viale delle Terme de Caracalla - 00100 Rome Italy e-mail: KeeWook.Sohn@fao.org
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4. Dr. B.N. Susheelamma	India	Scientist – C Central Sericultural Research & Training Institute, Srirampura, MYSORE – 570 008, INDIA. e-mail: bnsusheela@yahoo.com

5. **Mr. Shivappa Gowda Chickkamagaravally Thimmegowda**	**India**	**Accompanying person**
6. **Ms. S. Cappellozza**	**Italy**	**Researcher, Instituto Sperimentale per La Zoologia Agraria** **Sezione Specializzata per la Bachicoltura** **Via Dei Colli,28-35143** ***Padova*** ***Italy*** **e-mail: silvia.cappellozza@sezionebachicoltura.it**
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10. **Ms. C. Glavan**	**Romania**	**Commercial society "Sericarom", Bucharest**
11. **Ms. E. Ionita**	**Romania**	**Commercial society "Sericarom", Bucharest**
12. **Ms. M. Ionita**	**Romania**	**Commercial society "Sericarom", Bucharest**
13. **Ms. V. Vasile**	**Romania**	**Commercial society "Sericarom", Bucharest**
14. **Ms. E. Niculae**	**Romania**	**Commercial society "Sericarom", Bucharest**
15. **Ms. C. Antof**	**Romania**	**Commercial society "Sericarom", Bucharest**
16. **Ms. Androne Magda**	**Romania**	**Commercial society "Sericarom", Bucharest**
17. **Mr. Ungureanu Cristian**	**Romania**	**Commercial society "Sericarom", Bucharest**
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34. Dr Z. Petkov	Bulgaria	Senior researcher, Sericulture Experiment Station, Vratza
35. Ms. D. Pantaleeva	Bulgaria	Researcher, Sericulture Experiment Station, Vratza
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38. Mr. J. Irinchev	Bulgaria	Officer, Bulgarian Sericulture Association, Sofia
39. Dr M. Panajotov	Bulgaria	Head of sericulture department, Agrarian faculty, Thracian university, Stara Zagora
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The the participants at the International conference "Sericulture Challenges in the 21st Century" (Serichal 2007) and the 3rd BACSA meeting, held in Vratza, Bulgaria from 18 to 21 September 2007.