7th BACSA INTERNATIONAL CONFERENCE
"Organic Sericulture – Now and the Future"
"ORGASERI" 2015
Sinaia, Romania

April 19th – 24th 2015

P R O C E E D I N G S

Black, Caspian Seas and Central Asia Silk Association (BACSA)

Institute for Bioengineering, Biotechnology and Environmental Protection – S.C. BIOING S.A.
Bucharest, Romania

Sinaia, Romania, 2015

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“ORGASERI” 2015
Sinaia, Romania

April 19th – 24th 2015

PROGRAMME

Organizing committee:

President: Prof. Dr. P. Tzenov, President of BACSA and Director of Sericulture and Agriculture Experiment Station, Vratsa, Bulgaria.

Vice-president: Dr. Maria Ichim, General Manager, Institute for Bioengineering, Biotechnology and Environmental Protection, Bucharest, Romania.

Secretary: Mr. Liviu Ionel Ichim, Institute for Bioengineering, Biotechnology and Environmental Protection, Bucharest, Romania,

Members:

Dr. Silvia Cappellozza, Head, Council of Research and Experiments in Agriculture, Apiculture and Sericulture Unit of Bologna, Padua seat, Italy;
Prof. Dr. Dimitar Grekov, Rector, Agricultural University, Plovdiv, Bulgaria;
Assoc. Prof. Dr. Mihail Panayotov, Vice dean, Agricultural faculty, Thracian University, Stara Zagora, Bulgaria.
Mr. Durmush Yilmaz, Advisor, Kozabirlik sericultural cooperative, Bursa, Turkey;
Dr. Udo Krause, Technische Universität Dresden Institute of Genetics, Dresden, Germany;

Scientific committee
Dr. S. Cappellozza
Assoc. Prof. Dr. M. Panayotov
Prof. Dr. D. Grekov
Prof. Dr. P. Tzenov

<u>Venue and Dates:</u>

Sinaia resort, Romania, **Rina hotel Sinaia**, April 19th – 24th 2015.

19 April, Sunday
Arrival of the participants, check in at Rina Sinaia hotel and registration.

20 April, Monday
9:00 – 9:40 registration.
9:40 – 9:50 **Opening** by Prof. Dr. P. Tzenov, President of BACSA
9:50 – 10:00 **Welcoming speech** by Dr. Maria Ichim, General manager, Institute for Bioengineering, Biotechnology and Environmental Protection – S.C.BIOING SA, Bucharest, Romania

1. **Organic sericulture Session. Chairman: Dr. Silvia Cappellozza**

10:00 – 10:30 Lead paper: “The Organic Sericulture in the Context of Biological Agriculture and Organic Textile” by Prof. Dr. Panomir Tzenov, Asoc. Prof. Dr. Diliana Mitova, Dr. Maria Ichim.

10:30 – 10:45 “Technical specifications for organic sericulture presented to the Italian Ministry of Agricultural, Food and Forestry Policies” by Dr. Silvia Cappellozza, Dr. Alessio Saviane, Dr. Paolo Foglia.

10:45 – 11:00 “Situation of Organic Sericulture in Thailand” by Siriporn Boonchoo.

11:00 – 11:15 “Carbon Footprinting of Thai Silk Fabric Products” by Kannika Sonthi, Siriporn Boonchoo, Kanokwan Kunatom, Nakon Mahayosanan, Sate Sampattagul, Lukkana Jareansuk.

11:15 –11:30 “Knowledge Extension Model of Good Chemical Fertilizer with Organic Fertilizer Application for Increase Sericulture Productivity” by Somying Chooprayoon, Apaporn Khantee, Kanokwan Wonrawongsomkam, Lumpan Sarnchantuk, Choomyanut Comwong, Watcharapong Khawhom.

11:30 – 12:30 Discussion

12:30 – 13:30 Lunch

14:00 – 14:30 visit the sericulture exhibition

2. Scientific – technical reports session 1. Chairman: Dr. Małgorzata Łochyńska

14:30 – 14:45 “Present status of mulberry genetic resources and its utilization in Korea” by Dr. Gyoo-Byung Sung, Dr. Yong-Soon Kim, Dr. Kee-Young Kim, Dr. Mi-Ja Kim, Dr. Sang-Deok Ji, Dr. Nam-Suk Kim and Dr. Pil-Don Kang

14:45 – 15:00 “Study on some silkworm, Bombyx mori L breeds susceptibility to artificial diet feeding” by
R. Gancheva, Assoc. Prof. Dr. M. Panayotov, Prof. Dr. P. Tzenov and V. Sharkova.

15:00 – 15:30 Coffee break.

15:30 – 15:45 “Testing and Evaluation of New Bulgarian Silkworm, *Bombyx mori L.* Non Sex-Limited and Sex-Limited Commercial F1 Hybrids” by Assoc. Prof. Dr. M. Panayotov, Prof. Dr. P. Tzenov, Prof. Dr. D. Grekov, Assoc. Prof. Dr. Y. Vasileva, D. Pantaleeva, Dr. K. Avramova.

15:45 – 16:00 “New protein studies in Polish sericulture” by Dr. Małgorzata Łochyńska.

16:00 – 16:15 „BmAtg5 and BmAtg6 mediate the initiation of apoptosis in response to autophagy induced by 20-hydroxyecdysone or starvation” by Dr. Kun Xie, Dr. Ling Tian, Dr. Xinyu Guo, Dr. Kang Li, Dr. Jianping Li, Dr. Xiaojuan Deng, Dr. Zhijun Huang, Dr. Qingrong Li, Dr. Qingyou Xia, Dr. Sheng Li, Dr. Wanying Yang and Dr. Yang Cao.

16:15 – 17:30 Discussion

19:00 Welcoming Dinner

21 April, Tuesday

3. Scientific – technical reports session 2. Chairman: Assoc. Prof. Dr. Mihail Panayotov

9:00 – 9:15 “Regulation of Antibacterial Peptide genes by Starvation in Silkworm, *Bombyx mori*“ by Dr. Jie Zhang, Dr. Weike Yang, Dr. Junfeng Xu, Dr. Wanying Yang, Dr. Yang Cao, Dr Xiaojuan Deng.

9:15 – 9:30 “Cloning and Expression Analysis of Hsp70 Gene of Beauveria bassiana from the Different Geographical Regions in South China” by Dr. JiPing Liu & Dr. XiangLin Li

9:30 – 9:45 “Sericulture in Turkey” by Durmus Yilmaz

9:45 – 10:00 “Sericulture in Turkey – current situation, restrictions and policies” by Dr. Berrin Taskaya Top.

10:00 – 11:00 Discussion

11:00 – 12:00 Poster presentations session

12:30 – 13:30 Lunch
14:00-17:00 - Visit Sinaia Monastery

19:00 Dinner

22 April, Wednesday
Field visit: "Transylvania – ancient history and traditional agriculture"
- Bran Castle (Dracula's Castle).
- Poiana Brasov
- Brasov city
- Farmer's markets
- lunch during the tour
- Dinner at the hotel

23 April, Thursday
Sightseeing trips: Beautiful Transylvania
9:00 – 12:00 Visit Peles Castle
12:00 – 13:00 Lunch
13:00 – 17:00 Visiting the park share gondola 1400
18:00 – 19:00 BACSA Executive committee meeting
20:00 - Farewell diner

24 April, Friday
9:00 – 10:00 Closing the conference
Departure

Conference List of Participants

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Opening Speech

By

Prof. Dr. Panomir Tzenov, President, Black, Caspian Seas and Central Asia Silk Association (BACSA)

7th BACSA INTERNATIONAL CONFERENCE
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Ladies and gentlemen, Sericulturists and Distinguished delegates,

It is a privilege and an honor to meet all of you here and 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 like thank very much to Dr Maria Ichim, Mr. Liviu Ichim and the staff of BIOING for their tremendous efforts in organizing the present conference.

The silk is a natural fiber, which has been the center of our attention for many years. 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.

The silk has many excellent properties and it may be the most environmentally positive crop, actually improving the condition of the soil.

In Europe for example mulberry requires no any pesticides and is naturally resistant to most of insects, fungus, and other pests, that's why mulberry could be easily grown as an organic crop.

Why recently some people prefer to wear organic silk?

The rate of people experiencing a wide barrage of health problems such as rashes, allergies, respiratory problems, and difficulties focusing mentally due to chemical sensitivities has been growing alarmingly. Many people diagnosed with Multiple Chemical Sensitivities find organic clothing to be essential in reducing their exposure to the vast array of toxic chemicals. Also the recent eco-fashion should be considered.

The sericulture is a unique industry, concerning the organic production because it's final agricultural product – the cocoons is actually not a final product because it needs of further long processing in order to become really final product – silk fabrics and garment. This specificity of sericulture can unfortunately make without any sense an organic cocoon production, I mean that even though the cocoons and even raw silk have been produced by an organic manner, then if the cocoon and silk processing are by the conventional methods the final silk fabrics and garment are not organic. Considering this fact it is very much important to have a good coordination between the three levels of production: sericulture farmers, dry cocoon and raw silk producers and silk weavers and finishers. Without such a coordination it may appear at a moment that the organic cocoons have no any different value, compared with conventionally produced ones because the end users just do not need of them.

In fact the recently developing new direction of sericulture products use for non-textile purposes gives some new opportunities to produce organically, especially in the agricultural part of sericultural industry, like mulberry fruit, leaf for tea and medicine, silkworm powder etc. In this case an organic mulberry and cocoon production could be economically viable because the final products are not so much dependant on the end users like in silk for textile.

The present international conference aims to arise and try to give answers to many questions concerning the organic sericulture, such as the difference between natural and organic fibers, what the organic clothing is, why to wear organic silk, what are the organic textile standards requirements, the problem of higher costs of organic production, is silk organic, sustainable, ethical, healthy etc.

Considering that cocoon production in most of European and Central Asian countries is practically organic, but not certified as such, whether the customers to look for cocoons and raw silk having organic certificate or they better to look for buying cocoon and raw silk from certain countries or regions.

I truly hope that this conference will at least be useful in giving some ideas in solving some of the many problems, facing the organic sericulture and silk production development.

I also believe that the scientific and technical reports which will be presented in the fields of moriculture, silkworm genetics, breeding and rearing technology, silk reeling and processing, sericultural economics etc. will contribute to the knowledge development.

Finally, I wish you all pleasant stay in Sinaia and Romania, a successful participation in this conference to the end, and a safe trip back to your home countries, bringing with you some work plans and business ideas to be put into practice for further development of sericulture in your respective countries and for further progressive international collaboration.

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 “Organic Sericulture – Now and the Future” - “ORGASERI” 2015.

Thank you very much for your kind attention!

Welcoming speech

by

Dr. Maria Ichim, Director of S.C. BIOING S.A., Bucharest, Romania

Ladies and gentlemen,

It is a great pleasure for me to welcome all of you in Romania, at the beautiful resort of Sinaia, where for 4 days we will discuss a very interesting topic of 7th INTERNATIONAL CONFERENCE OF BACSA " Organic sericulture - Now and the Future "organized by the Black, Caspian Seas and Central Asia Silk Association (BACSA) together with the Institute of Bioengineering, Biotechnology and Environmental Protection SC BIOING SA, Bucharest,

Romania during the period from 20th to 24th of April 2015, which I think is very exciting for the future of organic products.
As the host of this conference I regret that if we could have some financial support by the Romanian Government the participants of this conference would be much more. Unfortunately in Romania the sericulture is still not sufficiently supported neither by the Government nor by the EU funds, resulting in few locally produced sericulture products, available at the market.
I do believe however that after the present conference debates, there will be made some important proposals to be approved by the Romanian government so that in the future to have a better support to our sericultural activities.
I will do everything possible, that the conference materials and conclusions to be disseminated nationwide, proposing that ecologically clean products will be better promoted in Romania for a clean life.
In addition I truly hope that the present Organic sericulture conference will definitely help in developing of not only Romanian, but the regional sericultural industry too.
We hope that the conference deliberations and conclusions will achieve to raise the standard of research in developing green products, and participating countries governments would provide more financial support for ecologically cultivated mulberry and will also increase the subsidies per kg of fresh cocoons or box of silkworm eggs reared, if the products are environmentally friendly.
I am convinced that the conference will be very successful, proposing solutions for a cleaner world.
Finally I wish to express my gratitude to those who prepared the documents to be presented and discussed during the conference dedicated to the problems of organic agriculture and textile, which is now a global concern.
At this international conference participants from 14 European and Asian countries are presented. For instance the number of people wishing to attend this conference was much more, but unfortunately some of them couldn’t get visas, others couldn’t provide sufficient financial support.
With these thoughts, thank you again for your presence here and I hope that the forthcoming conference will represent Romania as it should be.
Please allow me to say that Sinaia is a touristic city, very important for Romania and visited by many foreigners. Sinaia is located in Transilvania – one of the most beautiful, clean and with rich historical heritage part of our country. Considering this the Conference Organizing committee decided to visit the Sinaia Monastery, Bran Castle where is the Dracula's famous Museum, Peles Museum, gondola ride at the rate in 1400 and some other amazing places around.
I wish a success to our conference!

April 19th – 24th 2015

Organic sericulture Session

LEAD PAPER!

The Organic Sericulture in the Context of Biological Agriculture and Organic Textile

By

Prof. Dr. Panomir Tzenov*, Asoc. Prof. Dr. Diliana Mitova,**
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ABSTRACT
The organic agriculture is a method of production which aims to preserve the natural resources, the health of people and animals. The bioagriculture has a multiple effect on the whole agriculture sustainable development, such as high added value, quickly developing market, free market niches, export potential, preservation of the nature, rehabilitation the soils and preservation of the biodiversity, higher necessity of manual labor, job opportunity and association of marginal and socially weak groups of people. The most common natural fibers used to make clothing are cotton, hemp, ramie, linen, wool, and silk. When evaluating the eco-friendly properties of any clothing garment, must look at how the fiber was grown and produced and also at how the fiber was processed to create fabric and ultimately the clothing garment. For example the organic plants require to be produced without using any pesticides, hormones, fertilizers, sewage sludge-based fertilizers, bio-engineering, ionizing radiation, or any other synthetic or toxic substances. No artificial flavors or colors can added. They should not be irradiated or produced from Genetically Modified Organisms. Both the fiber growing and the fabric manufacturing must be free of harsh, toxic chemicals to quality the garment as being organic and healthy for the consumer and the environment in which it was produced and manufactured. Growing the natural fibers organically is only half the equation to qualify as organic clothing. The manufacturing process is the other half and often the half that is the most abused by toxic chemicals. Organic clothes do not receive any synthetic chemical finishes or treatments such as moth resistant, fire retardant, easy care, anti-pilling, stain resistant, or wrinkle-free. Dyes used on organic clothing should be either plant / mineral derived or if not of natural origin are environmentally responsible low impact dyes. No heavy metals or other harmful chemicals should be used in the dyeing process. An ethically and environmentally aware approach is extended to all aspects of the organic clothing industry. Fair Trade practices

to insure that the farm and garment workers receive a fair and just wage for their efforts are also a cornerstone of the organic clothing industry. The rate of people experiencing a wide barrage of health problems such as rashes, allergies, respiratory problems, and difficulties focusing mentally due to chemical sensitivities has been growing alarmingly. People wouldn't eat a bowl of pesticides drenched in insecticides, so why would they want to cover themself in clothes doused in chemicals? There is another reason why people are becoming excited about organic clothing and that is because of the fashions that are starting to come from some of the hot, new designers turning to eco-fashion. One last important development in organic textile standards has been the development of the Global Organic Textile Standard (GOTS) that begins the process of harmonizing all the different and slightly varying organic textile standards. At first blush, might think that organic should be less expensive to grow because organic doesn't use expensive GMO seeds, expensive petroleum-based fertilizers, or expensive toxic herbicides and pesticides like conventionally grown crops. But organically grown crops still must contend with weeds and fight devouring insects and this all costs money, actually more money than conventional chemical methods which is why conventional methods use all those toxic and deadly chemicals.

Concerning the sericulture if not implement chemical fertilizers and herbicides that means the labor costs for delivery and spreading farm yard manure and for manual weed control will increase. Organic fabrics are more expensive to manufacture. If the organic fabric is manufactured in facilities that also process and manufacture conventional fabrics from conventionally grown agriculture crops, before the organic fiber can be processed in these facilities, all the weaving or knitting machines must be cleaned of all residues from the processing of the conventional fiber. But there is another more significant factor why much conventional clothing is so inexpensive – cheap labor, by exploiting the poorest and most desperate workers and paying incredibly low wages to workers. Fair trade and fair pay for workers are important cornerstones of the organic and natural clothing industry and significantly add to the cost of organic and fair trade apparel. Organic garments are more expensive to ship to distributors, retailers and customer because the market size is so much smaller. Organic clothing retailers find it more expensive to advertise and market. Organic growers, manufacturers and retailers lack the mass buying power and the economies of scale found in the large retail chains.

Presumably organic silk would involve growing the mulberry trees organically, without chemicals, and raising the silkworms humanely and without hormones. Organic and sustainable certification organizations are working on standards for organic silk but they have not yet been finalized and adopted. Only the raw silk, just pure silk fibers without any chemicals or treatments added may be considered as fully organic, of course if mulberry and silkworm have been grown by an organic manner. However there appears the ethical problem that in order to produce high grade raw silk the pupae in the cocoons should be killed.

Generally all the silks, produced from cocoons, without killing the pupae are called peace silk or vegetarian silk. Animal rights organizations are concerned about the destruction of about 4000 domesticated silkworms to produce 1 kg of raw silk. However if we go in this direction should stop slaughtering of any domestic animals for food and the whole mankind to become vegetarian. In our opinion even organic, in order to remain a viable industry the way of obtaining the raw silk, namely by killing the pupae and then reeling the cocoons should be like it is now. If the pupae will be left to transform into moths and then the moths to pierce the cocoons it will not be possible to produce any good quality filament silk. The properties of filament silk are different from those of spun silk, thus the spun silk can not substitute the filament silk. Many silk fibers are probably already being produced in an organic environment, especially those

produced in smaller villages and rural environments. For example in some countries like Bulgaria, Georgia, Turkey etc. most of mulberry trees are located in the villages and are not treated at all by any fertilizers and pesticides. The problem is that these so many trees scattered in many villages can not be controlled by any certifying agency in order to give an organic certificate. Silk fabric when produced by weavers on handlooms has a near zero energy footprint and satisfies most of the guidelines for sustainable fabric production.

Trade organizations are concerned about the exploitive low wages often paid to silk textile workers. However the low wages are paid not only to the silk textile workers, but also to the sericulture farmers. The sericulture in now a days in many countries became a kind of "cheating the farmers" because their labor is paid at too low rates, even much lower than the minimal wages in the respective country. In addition the whole risk of the production is taken by the farmers themselves because any failure in the cocoon crop leads to getting very low incomes, even to an extent that they can not cover their material costs. This is mainly because usually the people who produce the fresh cocoons are different from those who reel the cocoons and the reelers are different from silk twisters and weavers. By this way the fresh cocoons are usually paid at too low prices, irrespective of the fact that the end products are sold sometimes at incredibly high prices. In this respect in our understanding an organic silk production could be organized on a cluster basis, where the payment of labor is sufficiently high due to a fair distribution of the profits throughout the whole production chain.

Domesticated silk fabrics are typically dyed with a mild acid dye or environmentally low impact fiber reactive dyes. Textile acid dye processes typically require high levels of chemicals, many of which have been classified by the Environmental Protection Agency as being of moderate to high concern as carcinogens. In order a silk to be organic no any cleaning or dyeing or finishing chemicals should be used in the silk processing. The main issue that causes concern in determining if silk is organic is the dyeing processes. Some producers use environmentally friendly non-natural dyes that are claimed to be "organic." Real organic silk is dyed by natural dyes. The use of 100% natural dyes made from tree bark, vegetables, grasses and flowers provide the best option for purely organic silk.

Eco-fabrics like organic silk do not contain any added chemicals that kill bacteria, and fight odours. Pure-dyed silk is just colored with dye and not weighted. The metallic salts used to weight silk can cause health risks and problems for some people. Chemical treatments are also added to silk to improve anti-static, water and oil repellency, flame retardant, dimensional stability and other wash-and-wear properties that our easy-care culture seems to expect. Many of these chemicals are also toxic and suspected carcinogens.

Recommendations about Organic Silk Production Development: The government should have a strong policy in organic agriculture, including sericulture; Stable and permanent financial support by the government to organic agri/sericulture; Providing higher subsidy per ha of mulberry under organic cultivation and subsidies per kg of fresh cocoons or per box of silkworm eggs reared if organically produced; State/EU financial support to organic cocoons and raw silk production investment projects; To develop national strategy for organic silk production; The state policy for organic agriculture, including sericulture support to consider also the specific local agro-ecological conditions as well as the ecological and social effects from bio agri/sericulture; Developing of suitable technologies for organic mulberry leaves production, eco-methods for disinfecting the silkworm rearing houses, equipment and rearing bed disinfectants, natural silk dyes; Economical analyses of organic mulberry leaves/cocoons/raw silk production costs in comparison with the conventional production costs; Dissemination and exchange of information and spreading knowledge

in organic mulberry cultivation and cocoon/raw silk production; Improving the coordination and collaboration between the government, NGOs, silk farmers, retailers and processors for organic silk problems solving; Establishment of organic silk clusters, providing sufficient purchasing prices for the bio cocoons and raw silk; Providing governmental/EU support to the organic silk clusters; Creation of organic mulberry leaf, cocoon/raw silk production information data base, available on BACSA web site; Establishing clear rules for organic silk certification and labeling; Involvement of the retail chains in the organic silk trade; Attracting the public attention to the organic silk production and its promoting; State support to the organic silk production and trade by lower VAT rate for the organic silk.

Key Words: sericulture, silk, organic, textile

The Bioagriculture

The organic agriculture is a method of production which aims to preserve the natural resources, the health of people and animals. The bioagriculture is a part of the biomanagement of agriculture and has a multiple effect on its sustainable development, namely:

- Economical: high added value, quickly developing market, free market niches, export potential;
- Ecological: Preserves the nature, rehabilitates the soils and preserves the biodiversity;
- Health: production of healthy and not dangerous biofoods;
- Social: higher necessity of manual labor, job opportunity and association of marginal and socially weak groups of people.

The land under organic agriculture increases very fast in the European union. For example for a period of only 7 years (2003 – 2010) the total agricultural land under organic production increased from about 6 million ha to 9 million ha. The share of areas under conversion from conventional to organic agriculture also increases.

What Are Natural Fibers?

Natural fibers fall into three main groups:

- Vegetable fibers which come from plants such as cotton, hemp, and flax;
- Protein fibers such as wool, alpaca, and cashmere which come from the wool and hair of animals;
- Strong elastic fibrous secretion of silkworm larvae in cocoons which is used to create silk.

The main ingredient in all vegetable fibers is cellulose, a carbohydrate found in all plant life. The most common natural fibers used to make clothing are: cotton, hemp, ramie, linen, wool, and silk.

Natural Fibers vs. Organic Fabric

Most garments that are produced from natural fibers such as cotton are not organic. Conventionally grown cotton is the most chemically treated crop in the world. About one fourth of all toxic chemical pesticides produced each year are used on cotton crops. The damage and destruction to the ecology and wildlife and to the health of farm workers and residents living near cotton fields is enormous. When evaluating the eco-friendly properties of any clothing garment, must look at how the fiber was grown and produced and also at how the fiber was processed to create fabric and ultimately the clothing garment.

For example the organic plants require to be produced without using any pesticides, hormones, fertilizers, sewage sludge-based fertilizers, bio-engineering, ionizing radiation, or any other synthetic or toxic substances. No artificial flavors or colors can added. They should not be irradiated or produced from Genetically Modified Organisms.

Both the fiber growing and the fabric manufacturing must be free of harsh, toxic chemicals to quality the garment as being organic and healthy for the consumer and the environment in which it was produced and manufactured.

Conventionally manufactured fabrics rely heavily upon chemicals to clean and bleach the fibers and to prepare the fibers to be spun into yarns for weaving or knitting. Conventional dyes are often high in dangerous heavy metals and use large amounts of water to flush and clean the fabrics resulting in heavily polluted waste waters. The final stage of the garment manufacturing process is the finishing step. Finishing is often one of the most chemically intensive steps, especially if the garment is chemically treated to be stain-resistant, wrinkle-resistant, odor-resistant, or any of the other treatments that are being called “smart fabrics” to make life easy. All of these labor-saving treatments come at the expense of chemical treatments. That’s why the people’s chemical sensitivities are a growing problem.

Although most people tend to assume that most of what they wear is natural fiber clothing, this is far from the truth. Even if the label on a shirt states that it is 100 percent cotton or wool, it never mentions the amount of chemicals the fabric may have been in contact with up until that point. In fact, the only way to be certain that you are wearing natural fiber clothing is if they are certified to have been created using organically grown elements.

What is Organic Clothing?

Simply, to qualify as being organic, organic textiles are made from raw natural fibers such as cotton, hemp, ramie, wool, silk and alpaca that have been grown without the use of synthetic chemical fertilizers, pesticides, growth regulators or defoliants. Growing the natural fibers organically is only half the equation to qualify as organic clothing. The manufacturing process is the other half and often the half that is the most abused by toxic chemicals. Organic clothes do not receive any synthetic chemical finishes or treatments such as moth resistant, fire retardant, easy care, anti-pilling, stain resistant, or wrinkle-free. Dyes used on organic clothing should be either plant / mineral derived or if not of natural origin are environmentally responsible low impact dyes. No heavy metals or other harmful chemicals should be used in the dyeing process. An ethically and environmentally aware approach is extended to all aspects of the organic clothing industry. This “ethical and environmental awareness” found throughout the organic clothing industry is one of its more fascinating qualities. To simply be organically grown and manufactured isn’t adequate. “Living lightly upon the Earth” is entrenched into the organic clothing industry and market. Fair Trade practices to insure that the farm and garment workers receive a fair and just wage for their efforts are also a cornerstone of the organic clothing industry.

Why Wear Organic?

Just as concern over the harmful effects of insecticides and pesticides in our food supply has given rise to the demand for organic produce and vegetables, concern over the high use of insecticides and pesticides in growing cotton and other natural fibers has given rise to demand for organic cottons and garments free of these and other poisons and carcinogens.

But organic cotton is not the only healthy fabric. The silk has many excellent properties and it may be the most environmentally positive crop, actually improving the condition of the soil. In Europe for example mulberry requires no any herbicides and is naturally resistant to most of insects, fungus, and other pests, that’s why mulberry could be grown as an organic crop.

The rate of people experiencing a wide barrage of health problems such as rashes, allergies, respiratory problems, and difficulties focusing mentally due to chemical sensitivities has been growing alarmingly. Many people diagnosed with Multiple Chemical Sensitivities find organic clothing to be essential in reducing their exposure to the vast array of toxic chemicals that we are unknowingly exposed to every day. People wouldn’t eat a bowl of pesticides drenched in insecticides, so why would they want to cover themself in clothes doused in chemicals?

There is another reason why people are becoming excited about organic clothing and that is because of the fashions that are starting to come from some of the hot, new designers turning to eco-fashion.

The organic textile standards

Environmentally and socially balanced organic textile standards should have two critical similarities:

- **Lowest practical ecological impact** during the growing and processing of natural, organic fibers into textiles and garments. At the present time, the use of chemical compounds in organic fiber processing cannot be completely eliminated, the types of materials – such as low impact dyes – used for organic fiber processing can be greatly restricted and the use and disposal of the materials is environmentally sustainable to minimize harm to people and the environment.
- **Fair Trade guidelines** that respect and promote a positive social impact for all growers, employees and workers involved in the complete supply chain for bringing sustainable and organic clothing and garments to market. Somehow, it is inconceivable and unconscionable to imagine putting a "green" sustainable label on a garment that was produced through the misery of workers under sweatshop conditions.

The Organic Trade Association (OTA) in the U.S.A. developed "The American Organic Standards for Fiber Processing" which defines four levels of organic labelling:

1. **"100% Organic"**. All components are organically grown and certified, including the sewing threads, and all processes used to manufacture the garment conform to the processing requirements stated in the standard;
2. **"Organic"**. At least 95% (by weight) of the agricultural fibers are organically grown and all processing adheres to the environmental processing requirements given in the document;
3. **"Made with organic (specified fiber products)"**. At least 70% (by weight) of the garment have been organically grown;
4. **"Less than 70% organically produced constituents"**. Maybe it has some organic fiber content, maybe not. All non-organic garment components may be processed and handled without regard to the OTA standards.

For levels 1 through 3, all chemicals used in the manufacturing processes – knitting, weaving, cleaning, scouring, dyeing, and finishing – must conform to the process requirements defined in the OTA document to insure environmental sustainability and must not be carcinogenic, mutagenic, teratogenic, toxic to mammals, or an endocrine disrupter. All degreasers, detergents, surfactants, and soaps for scouring wool and animal fibers must be biodegradable. Synthetic waxes can be used on yarn but they must be water soluble and free of alkyl phenol ethoxylates. All knitting and weaving oils must be water soluble. Any non-organic items in the garment such as button, zippers, elastic yarns or fabrics must be on the list of approved items for which there are no organic counterparts available. The use of chlorine bleach, plastisols, some AZO dyes, formaldehyde and synthetic chemicals for functional finishes (all the "anti-" stuff such as anti-wrinkle, anti-fungal, anti-pilling, anti-odor, etc.) is prohibited. Also, no Genetically Modified Organisms (GMOs), including GM cotton, are allowed in any phase of the process from growing organic fibers to final finishing and packaging.

The Soil Association in the U.K. developed organic textile standards in 2003 that were closely based on criteria established by the International Federation of Organic Agriculture Movements (IFOAM). The Soil Association organic textile standards use a two-tier label. To qualify for the highest organic standard, raw materials must contain at least 95% certified organic materials – excluding accessories such as buttons and zippers. Provided that they are not on the list of toxic and disallowed fibers and components, the remaining 5% of fibers can be non-organic or synthetic if sufficient organic fibers are not available. GMO's and GM cotton are also banned in the Soil Association organic textile standard.

One last important development in organic textile standards has been the development of the Global Organic Textile Standard (GOTS) that begins the process of harmonizing all the different and slightly varying organic textile standards. The Global Organic Textile Standard was developed by the International Working Group on the Global Textile Standard as part of the International Conference on Organic Textiles (INTERCOT). The Global Organic Textile Standard is a collaborative effort between the Organic Trade Association, Soil Association, International Association Natural Textile Industry (IVN), and Japan Organic Cotton Association (JOCA). GOTS is intended to allow organic textile manufacturers to export their organic fabrics and garments using this one certificate that will be accepted in all the major world markets. Before, manufacturers needed different certificates to market into different countries.

The global market is still ruled by a half dozen slightly varying standards that are generally similar in intent and purpose. Efforts such as the Global Organic Textile Standard are working to unify the differences in a way that will provide meaningful protection to the environment, all workers from the fields to the factories, and to the health and well-being of the consumer.

The High Cost of Organic Clothing

At first blush, you might think that organic should be less expensive to grow because organic doesn't use expensive GMO seeds, expensive petroleum-based fertilizers, or expensive toxic herbicides and pesticides like conventionally grown crops. But organically grown crops still must contend with weeds and fight devouring insects and this all costs money, actually more money than conventional chemical methods which is why conventional methods use all those toxic and deadly chemicals.

Concerning the sericulture if not implement chemical fertilizers and herbicides that means the labor costs for delivery and spreading farm yard manure and for manual weed control will increase.

Organic fabrics are more expensive to manufacture. If the organic fabric is manufactured in facilities that also process and manufacture conventional fabrics from conventionally grown agriculture crops, before the organic fiber can be processed in these facilities, all the weaving or knitting machines must be cleaned of all residues from the processing of the conventional fiber. Of course, the facility owners add the additional costs for this cleaning and equipment downtime to the production costs for the organic fabrics.

Organic garments are more expensive to manufacture for many reasons. Some of them relate to the relatively small size of the organic clothing market and the need to frequently share manufacturing facilities with conventional clothing. Like the manufacturing process, all sewing machines and work areas must be cleaned of conventional garments and contaminants before being used for sewing organic garments.

But there is another more significant factor why much conventional clothing is so inexpensive – cheap labor that often borders near being sweatshop or indentured. Basically, most large clothing retailers contract with many dozens of clothing manufacturing facilities scattered in developing countries around the world. Many of these facilities exploit the poorest and most desperate workers and pay incredibly low wages to workers who sew long hours under appalling conditions to make those cheap, inexpensive shirts, pants and undergarments that fill the large, mega stores in cities and shopping malls.

Fair trade and fair pay for workers are important cornerstones of the organic and natural clothing industry and significantly add to the cost of organic and fair trade apparel.

Organic garments are more expensive to ship to distributors, retailers and customer. This isn't because they are organic, but because the market size is so much smaller. The large retail chains can deliver a large trailer load of clothes to their stores at significantly lower per-

garment prices than it costs for a box or two of organic clothes to some local organic clothing store.
Organic clothing retailers find it more expensive to advertise and market. The huge retail chains can use their enormous marketing budgets and muscle to get the most cost-effective advertising. This, also, is really a small store vs. enormous chain store issue but it figures into the perception of organic clothing being more expensive than conventional clothing.
Organic growers, manufacturers and retailers lack the mass buying power and the economies of scale found in the large retail chains.
An inconvenient truth is that organic and all-natural clothing will always be more expensive than conventional, chemical clothing. The good news is that the price gap will continue to shrink as the market size of organic clothing grows and the economies of scale improve.

What Means Organic Silk?

Even though silk is a natural fiber that has been woven into fabric to dress China's Empresses since 2900 BC silk is just starting to be proclaimed as a "natural" fabric, but how organic, sustainable, ethical and healthy is silk? Presumably organic silk would involve growing the mulberry trees organically, without chemicals, and raising the silkworms humanely and without hormones. Organic and sustainable certification organizations are working on standards for organic silk but they have not yet been finalized and adopted.
Only the raw silk, just pure silk fibers without any chemicals or treatments added may be considered as fully organic, of course if mulberry and silkworm have been grown by an organic manner. Up to this point the raw silk threads could easily be produced to comply with emerging sustainable and organic standards for silk and be manufactured into silk eco-fashion and organic clothing. However there appears the ethical problem that in order to produce high grade raw silk the pupae in the cocoons should be killed.
On the other hand the spun silk is produced from different cocoon/silk wastes, a part of them are pierced cocoons which are waste from silkworm egg production. Generally all the silks, produced from cocoons, without killing the pupae are called peace silk or vegetarian silk. These are the silks from some wild silkworm moths: Not all wild silk is Peace silk, but most still is. This includes Tussah, Eri and Muga silks from India. All three of these species, and a few more, are semi cultivated in India. Tussah is currently cultivated in China. Most cultivation of wild silk produces Peace silk. This is especially true of hand raised, hand processed silks of rural India. It is less true of factory processed Chinese tussahs.
"Ahimsa silk" is the term now current in India. There is a patent in India for Bombyx mori (cultivated) Ahimsa silk. "Ahimsa silk" producing company contracted with local south Indian silkworm egg production mills and buy their pierced cocoons, after that the cocoons are spun and woven in small local mills and villages.

Is silk organic, sustainable, ethical, healthy?

Silk, like other protein fibers coming from living beings such as sheep and alpacas, can easily be created according to organic guidelines as they begin to be approved. And many silk fibers are probably already being produced in an organic environment, especially those produced in smaller villages and rural environments. For example in some countries like Bulgaria, Georgia, Turkey etc. most of mulberry trees are located in the villages and are not treated at all by any fertilizers and pesticides. The problem is that these so many trees scattered in many villages can not be controleed by any certifying agency in order to give an organic certificate.
To boost productions and improve efficiencies, large corporate farms typically use heavy chemicals.
In the same way, the raising of domesticated silkworms and the life of wild silkworms is, by nature, sustainable. Silk fabric when produced by weavers on handlooms has a near zero

energy footprint and satisfies most of the guidelines for sustainable fabric production. Silk produced in large powerloomed textiles factories must be evaluated on a company-by-company basis to determine their sustainability.

Ethical silk: Evaluating the ethics of silk is always a more complex and more personal question. Animal rights organizations are concerned about the destruction of about 4000 domesticated silkworms to produce 1 kg of raw silk. However if we go in this direction should stop slaughtering of any domestic animals for food and the whole mankind to become vegetarian. In our opinion even organic, in order to remain a viable industry the way of obtaining the raw silk, namely by killing the pupae and then reeling the cocoons should be like it is now. If the pupae will be left to transform into moths and then the moths to pierce the cocoons it will not be possible to produce any good quality filament silk. The properties of filament silk are different from those of spun silk, thus the spun silk can not substitute the filament silk.
Trade organizations are concerned about the exploitive low wages often paid to silk textile workers. However the low wages are paid not only to the silk textile workers, but also to the sericulture farmers. The sericulture in now a days in many countries became a kind of "cheating the farmers" because their labor is paid at too low rates, even much lower than the minimal wages in the respective country. In addition the whole risk of the production is taken by the farmers themselves because any failure in the cocoon crop leads to getting very low incomes, even to an extent that they can not cover their material costs. This is mainly because usually the people who produce the fresh cocoons are different from those who reel the cocoons and the reelers are different from silk twisters and weavers. By this way the fresh cocoons are usually paid at too low prices, irrespective of the fact that the end products are sold sometimes at incredibly high prices. In this respect in our understanding an organic silk production could be organized on a cluster basis, where the payment of labor is sufficiently high due to a fair distribution of the profits throughout the whole production chain.

Healthy Silk: While being a comparatively healthy and organic natural fiber, silk, like other fibers containing protein chains such as wools, is an allergen for some people. Silk allergies can cause asthma or allergic rhinitis with symptoms of runny nose and itchy eyes that are similar to hay fever. Medical researchers have found a wide variety of causes for a small number of people experiencing silk allergies: some are allergic to wild silk, some to domesticated silk, and some to micro-fine dust that can be given off by spun silk. Often, the allergies are traced to the diet of the silk worm – such as mulberry or oak leaves – which influence the protein chains found in the silk strands produced by the silk worm.
Some silk allergies come from excessive sericin in silk that has not been adequately degummed. The waste silk, also called silk noil, from damaged cocoons and broken strands is often used as filling in silk duvets and lower quality spun silk fabrics. Sometimes the waste silk / silk noil is not sufficiently degummed resulting in excess sericin in the products that can result in silk allergic reactions for some people.

Dyed Silk: As with any fabric, the dyeing of silk can also create health problems for people with chemical sensitivities. Because silk fibers are highly absorptive, Bombyx mori silk takes dyes exceptionally well and is one reason for the brilliance and luster of dyed silk fabrics. Domesticated silk fabrics are typically dyed with a mild acid dye or environmentally low impact fiber reactive dyes. Textile acid dye processes typically require high levels of chemicals, many of which have been classified by the Environmental Protection Agency as being of moderate to high concern as carcinogens. Textile acid dyeing also typically discharges large amounts of contaminated waste waters that require treatment. Low impact fiber reactive dyes have a much smaller environmental footprint but still create some health problems for the chemically sensitive.

In order a silk to be organic no any cleaning or dyeing or finishing chemicals should be used in the silk processing. The main issue that causes concern in determining if silk is organic is the dyeing processes. Some producers use environmentally friendly non-natural dyes that are claimed to be “organic.” Real organic silk is dyed by natural dyes. In addition, with organic silk, the mulberry trees they feed on are grown organically, without pesticides or fertilizers.
The use of 100% natural dyes made from tree bark, vegetables, grasses and flowers provide the best option for purely organic silk.
Eco-fabrics like organic silk do not contain any added chemicals that kill bacteria, and fight odours.
If wish to avoid dyes, the options are raw silk and natural undyed silk.

Weighted Silk: “Weighting” is a textile manufacturing practice peculiar to and particular to silk manufacturing and involves the application of metallic salts to add body, luster and physical weight to silk fabric. The reason for adding metals to silk fabric is to increase the weight of the fabric and, because silk fabric sells by the weight, the extra weight increases the selling price of the fabric. Generally, only the finer and more expensive reeled silks are weighted rather than the less costly spun silks. Some of the different salts of metals used to weight silk include chromium, barium, lead, tin, iron and sodium magnesium.
Weighting can increase the weight of silk by three, four, fivefold or more. Silk can be weighted because it is highly absorptive and the metal salts are easily absorbed into the silk fibers. Silk was originally weighted to make up for the loss of weight caused by degumming which removes the sericin reducing the weight of silk by about 25 – 30 %. Silk is one of the strongest natural fibers but the metals used to weight silk cause it to lose much of its strength and durability if the weighting is not done properly. Pure-dyed silk is just colored with dye and not weighted. The metallic salts used to weight silk can cause health risks and problems for some people.

Finishing Silk: The purpose of the fabric finishing process is to give the fabric its final desired feel, appearance and care properties. A variety of environmental and health hazards can be introduced during the finishing phase of silk fabrics and garments. Water-soluble substances such as starch, glue, gelatin and even sugar are sometimes used to finish silk and provide extra body to the fabric.
Silk creases and wrinkles easily, especially when damp or wet. Some silk clothing manufacturers apply softeners, elastomers, and synthetic resins such as EPSIA – a silicone-containing epoxy crosslinking agent – to increase the dry and wet anti-wrinkling and crease-resistance performance of silk garments. With the family of silicone epoxy crosslinking agents (EPSIA, EPSIB and EPTA) this crease resistance occurs because chemical cross links occur between the silk fibroin strand and the epoxy groups.
Chemical treatments are also added to silk to improve anti-static, water and oil repellency, flame retardant, dimensional stability and other wash-and-wear properties that our easy-care culture seems to expect. Textile chemicals have become an integral and important component of conventional textile and clothing manufacturing. Textile chemicals, also know as textile auxiliaries, have two primary purposes: to increase the efficiency and lower the costs of conventional textile manufacturing; and to create special finishing effects and properties for the clothing.
The first category of textile auxiliaries and chemicals to improve manufacturing efficiencies are used in the spinning, weaving, scouring, bleaching and dyeing processes. Textile manufacturers claim that these textile chemicals can all be washed and removed from the final garments and are used to save time, reduce labor costs and reduce material costs. Environmental impact is seldom considered, especially in garment factories in developing countries, and many of the chemicals are discharged as untreated waste waters into rivers and ground water supplies.

The second category of textile chemicals are used mostly in the fabric and garment finishing processes and are intended to be permanent. These textile auxiliaries are supposed to give clothing special properties such as a smooth silky feel, easy care, mildew resiliency, flame retardant, and easy wear. Many of these chemicals are also toxic and suspected carcinogens.

Organic silk production

If the primary concern is healthy and organic silk then may consider as such the raw silk, noil silk, Muga silks or Eri silks that are undyed or dyed with low-impact, fiber-reactive dyes. The silk fabric should not be weighted or have any easy care or protective finishes. Silks produced in small villages by local weavers are usually the most pure.

If the concern is about the ethics of silk raising then may choose wild silk, spun silk or Eri silks which do not destroy the silk worm to produce reeled silk. Also the silk garments had to be produced according to Fair Trade principles which protect the workers involved in all phases of producing the clothing.

If the concern is about sustainable and eco-friendly silk, then seek silks dyed using low-impact and fiber reactive dyes or vegetable dyes without any finishes. Handloomed silks are the most energy-neutral. Silk is also biodegradable and will decompose gracefully in landfills. Although, given its durability, silk is ideal for recycled ecofashion.

Recommendations about Organic Silk Production Development

- **The government should have a strong policy in organic agriculture, including sericulture.**
- **Stable and permanent financial support by the government to organic agri/sericulture.**
- **Providing higher subsidy per ha of mulberry under organic cultivation and subsidies per kg of fresh cocoons or per box of silkworm eggs reared if organically produced.**
- **State/EU financial support to organic cocoons and raw silk production investment projects.**
- **To develop national strategy for organic silk production.**
- **The state policy for organic agriculture, including sericulture support to consider also the specific local agro-ecological conditions as well as the ecological and social effects from bio agri/sericulture.**
- **Developing of suitable technologies for organic mulberry leaves production, eco-methods for disinfecting the silkworm rearing houses, equipment and rearing bed disinfectants, natural silk dyes.**
- **Economical analyses of organic mulberry leaves/cocoons/raw silk production costs in comparison with the conventional production costs.**
- **Dissemination and exchange of information and spreading knowledge in organic mulberry cultivation and cocoon/raw silk production.**
- **Improving the coordination and collaboration between the government, NGOs, silk farmers, retailers and processors for organic silk problems solving.**
- **Establishment of organic silk clusters, providing sufficient purchasing prices for the bio cocoons and raw silk. Providing governmental/EU support to the organic silk clusters.**
- **Creation of organic mulberry leaf, cocoon/raw silk production information data base, available on BACSA web site.**
- **Establishing clear rules for organic silk certification and labeling.**
- **Involvement of the retail chains in the organic silk trade.**
- **Attracting the public attention to the organic silk production and its promoting.**

- **State support to the organic silk production and trade by lower VAT rate for the organic silk.**

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Technical specifications for organic sericulture presented to the Italian Ministry of Agricultural, Food and Forestry Policies

by

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ABSTRACT: In the textile field GOTS (Global Organic Textile Standard) was developed with the aim to unify the various standards in the ecotextile processing and to define world-wide requirements that ensure organic status of textiles. This standard ranges from harvesting of raw materials through environmentally and socially responsible manufacturing up to labelling. As GOTS requires the uses of certified organic fibers, it is of basic importance to establish technical specifications also in order to produce organic cocoons. Until now these specifications have been not been set up neither at some country's national level nor at international level. Therefore here we present the first attempt at obtaining the approval of these technical standards from the Italian Ministry of Agricultural Food and Forestry Policies (MIPAAF), for the production of organic cocoons, according to the procedure laid down in article 42 of EC Regulation 834/2007. The regulatory procedure was defined by ICEA (a private Environmental and Ethical Certification Institute, a Consortium that controls and certifies companies carrying out their activities in respect of people and nature, by defending workers dignity and rights of consumers) in collaboration with CRA - Honey bee and Silkworm Research Unit, Padua seat.

Key words: organic cocoon production, Global Organic Textile Standards, MIPAAF

INTRODUCTION

In 2007 the European Council of Agricultural Ministers agreed on a new Council Regulation (Council Regulation (EC) No. 834/2007) setting out the principles, aims and overarching rules of organic production and defining how organic products should be labelled.
The regulation set a new course to develop organic farming further, with the following aims:

- sustainable cultivation systems
- a variety of high-quality products.
- greater emphasis on environmental protection
- more attention to biodiversity
- higher standards of animal protection
- consumer confidence
- protecting consumer interests.

Organic production respects natural systems and cycles. Biological and mechanical production processes and land-related production should be used to achieve sustainability, without having recourse to genetically modified organisms (GMOs).

In organic farming, closed cycles using internal resources and inputs are preferred to open cycles based on external resources. If the latter are used, they should be:

- organic materials from other organic farms
- natural substances
- materials obtained naturally, or
- mineral fertilisers with low solubility.

Exceptionally, however, synthetic resources and inputs may be permissible if there are no suitable alternatives. Such products, which must be scrutinised by the Commission and EU countries before authorisation, are listed in the annexes to the implementing regulation (Commission Regulation (EC) No. 889/2008).

Organic clothes and textiles have become increasingly popular in the last decade. When textiles are certified as organic it means that both the production of the fibre on the farm, and the processing of this fibre into textiles has met organic standards and been checked at every step of the processing supply chain for social and environmental responsibility.

GOTS (http://www.global-standard.org/images/GOTS_Version4-01March2014.pdf) or Global Organic Textile Standard is a technical regulation for organic textile certification, supported at international level by some of the main organizations which promote organic farming around the world (Organic Trade Association, IVN, Japanese Organic Cotton Association, Soil Association). The whole supply chain from field through manufacture to final product must be certified.

A textile product maybe defined as Certified Organic when: a**)** it is made with natural fibres that are produced and certified as organic by an independent certification body in accordance with the requirements laid down in the reference laws i.e.: Regulation (EEC) No 834/2007 and Regulation (EEC) No 889/2008, in Europe; the National Organic Program (NOP), in force in the USA; the National Programme for Organic Production (NPOP) in force in India b**)** it has been manufactured in compliance with the environmental and social requirements of the Global Organic Textile Standard (GOTS)

Organic products from non-EU countries can be distributed on the EU market only if produced and inspected under conditions that are identical or equivalent to those applying to EU organic producers. The rules introduced by the 2007 regulation are more flexible than the previous set-up, under which organic goods could be imported from outside the EU only if they were EU-certified, their production was monitored by the EU countries and an import licence had been issued. The import licence procedure has been replaced by new import rules. Control bodies (Certifying organisations) or CBs operating in non-EU countries are now directly authorised and monitored by the European Commission and EU countries. This allows the EU Commission to supervise and monitor the import of organic products and the checks carried out on organic guarantees.

The growth of GOTS, organic and sustainable, certified facilities in 2013 in Europe grew in Germany by +66%, Austria +14%, Switzerland +27%, Portugal +73%, Italy +13% and France +12% (GOTS Annual Report 2013) (http://sightmode.com/the-demand-for-organic-fashion-is-growing/).

The Environmental and Ethical Certification Institute (ICEA) recorded a need for organic silk production, since the Italian silk companies, which are shown in Tab. 1, asked to obtain a certification of production of organic silk according to GOTS (and are currently certified by ICEA).
Actually these companies acquire silk certified by international CBs, which however do not have a specific standard to apply in order to control the procedures for organic cocoon production. Therefore, generic protocols, designed for other animal species instead of silkworm and other crops instead of mulberry, are applied, generating uncertainty on the quality of the currently produced organic silk.
Thus, ICEA decided to set up a standard for Italy, in collaboration with CRA-API, to establish guidelines which could be internationally accepted. In this paper the first attempt in establish good practices for cocoon organic production is presented and discussed.

Tab 1: Italian Silk Companies certified by ICEA for organic silk production

Company name	Location	Web-site	Certification	Products
Ongetta	Ponte di Piave (TV) Venetian region	www.ongetta.it	GOTS 2013-16	Silk yarns
Tessiture seriche di Olmeda SpA	Grandate (CO), Lombardy (Italy)	www.teseo.como.it	GOTS 2014-01	Woven fabrics
CEL Srl Unipersonale	Cernobbio (CO), Lombardy (Italy)	www.cel-srl.it	GOTS 2014-13	Finished Fabrics
Se.Le.Ma. Srl	Colverde (CO), Lombardy (Italy	www.selema.eu	GOTS 2014-14	Woven fabrics
Fratelli Vitali Spa	Calco (LC),Lombardy (Italy)	www.vitalitessitura.it	GOTS 2014-22	Woven fabrics
Taroni S.p.A	Grandate (CO), Lombardy (Italy)	www.taroni.it/	GOTS 2015-004	Woven fabrics

MATERIALS AND METHODS

The first methodological problem was to identify what is possible to certify as agricultural production, because agricultural production does not regard textiles. Therefore, we identify the "Council Regulation (EEC) No 2658/87 of 23 July 1987 on the tariff and statistical nomenclature and on the common custom tariff" as the legal basis to enclose silkworms among live animals allowed in the agricultural productions.

The second methodological problem was how to deal with sericulture, which is divided into: moriculture, silkworm egg production and cocoon production. Therefore we considered separately the three phases.

The third methodological problem regarded definition of breeding stocks in insects, because of their very short life cycle.

The fourth methodological problem concerned artificial diet, which is not an integration of the food in the silkworm, but a complete substitution of the food.

We needed to define some biological phenomena and a technical jargon in order to establish a standard which could be issued by Italian Ministry of Agricultural Food and Forestry Policies.

RESULTS

The first result was to define what is possible to certify as organic at the farm level: the agricultural product is the silkworm live cocoon, which can be enclosed in the "Council Regulation (EEC) No 2658/87 of 23 July 1987 on the tariff and statistical nomenclature and on the common custom tariff", Annex 1 "Combined nomenclature", part II - Schedule of customs duties - Live animals: animal products 1) Live animal: 01060099. The category is shown in Fig. 1

Fig. 1: Definition of organic cocoon category: see red arrow: 01060099

CN code	Description	Rate of duty: autonomous (%) or levy (AGR)	Rate of duty: conventional (%)	Supplementary unit
1	2	3	4	5
0105	**Live poultry, that is to say, fowls of the species Gallus domesticus, ducks, geese, turkeys and guinea fowls :**			
	– Weighing not more than 185 g :			
0105 11 00	**– – Fowls of the species Gallus domesticus**	12 (AGR)	—	p/st
0105 19	**– – Other :**			
0105 19 10	– – – Geese and turkeys	12 (AGR)	—	p/st
0105 19 90	– – – Ducks and guinea fowls	12 (AGR)	—	p/st
	– Other :			
0105 91 00	**– – Fowls of the species Gallus domesticus**	12 (AGR)	—	p/st
0105 99	**– – Other :**			
0105 99 10	– – – Ducks	12 (AGR)	—	p/st
0105 99 20	– – – Geese	12 (AGR)	—	p/st
0105 99 30	– – – Turkeys	12 (AGR)	—	p/st
0105 99 50	– – – Guinea fowls	12 (AGR)	—	p/st
0106 00	**Other live animals :**			
0106 00 10	– Domestic rabbits	10	6	—
0106 00 20	– Pigeons	12	10	—
	– Other :			
0106 00 91	– – Primarily for human consumption	Free	Free	—
0106 00 99	– – Other	Free	Free	—

With regard to moriculture, in the standard any pesticide, fungicide, fertilizer... or other chemical are identified to add in the field, since the active ingredients permitted in organic farming for tree crops are already defined in the Council Regulation (EC) No. 834/2007.

On the other hand, we were obliged to define the origin of the silkworm eggs, which should be obtained by a certified egg production plant. Currently, CRA-API required to undergo the certification process, so that it can be recognized as the first egg production site in Europe certified to produce organic silkworm boxes.
Another interesting point concerning silkworm feeding was that artificial diet was inserted in the organic cocoon production, because all the ingredients necessary to produce the leaf substitute are enclosed in the Annexes to the Regulation (EEC) No 889/2008. We specified only few additives (see the standard, page 5) which are not enclosed in the additives for animal feeding, but which are however enclosed as technological additives for human food.
It is important to underline that we specified that it is not possible to treat silkworm larvae during the cycle with any chemical (especially antibiotics and formalin), with the exception of lime.
Furthermore, particular attention was devoted also to the use of disinfectants between one larval cycle and the following. We banned the use of formalin, which is particularly dangerous for the man and the environment, and persistent in the rearing room. In fact, CRA-API has tested other alternative ways of disinfecting eggs and rearing rooms in the last years, and there are other possible safer chemicals to use, which are enclosed in the Annexes to Regulation (EEC) No 889/2008. The standard which is reported in the following pages was issued on 14th March 2015 by Italian MIPAAF.

STANDARD FOR ORGANIC MORICULTURE AND SERICULTURE

INDEX

Redazione RCV	Verifica RAQ	Verifica CNC-CSI	Approvazione CDA	Tipo di revisione	Data	Pagina/e	Ed.	Rev.e
							01	00

1 Introductory notes

"Silkworms" as "live agricultural or unprocessed products" enclosed in the Section 1 "Live animals; animals products", Chapter 1 "Live Animals", Code NC 0106 49 00 "Other Live Animals – Insects – Others" of the European common tariff nomenclature, about which in Annex I of Council Regulation (EC) 2658/1987 regarding tariff and statistical nomenclature and common Customs tariff, last amended by Commission implementing Reg. No 1101/2014, are products enclosed in organic production according to Reg. (CE) No 834/2007.

2 Definitions

"*Silkworm*" – larva of the moth of the species Bombyx mori, belonging to the family Bombycidae.

"*Polyhybrid*" – Silkworm originated by the cross of 4 parental lines and devoted to the cocoon production for commercial aims.

"*Silkworm eggs*" - eggs from which first instar larvae hatch.

"*Fresh cocoons with live pupa*" – cocoons from which the moths can emerge, as the pupae have not undergone drying process.

"*Silkworm egg box*" – international measurement unit of the silkworm eggs, usually consisting in small boxes with a wooden framework, covered with cotton lint and containing, per each box, 20.000 eggs ready for hatching. The measurement unit is the reference to establish the welfare condition and density of the silkworm larvae.

3 Scope and field of application

Except what foreseen by applicable laws and regulation on organic agriculture, the current standard disciplines the silkworm rearing activity, in conformity with what is foreseen by the art. 42, second paragraph of the Council Reg. (EC) No 834/2007.

The certification applies to the whole rearing process and the "fresh cocoon with live pupa" and "silkworm eggs" represent the certifiable products.

4 Moriculture

Mulberry trees shall be cultivated in conformity to the requirements Regulation (EC) No 834/2007 and Regulation (EC) No 889/2008.

For fertilization and amendment of soil of the mulberry fields, farmers are suggested to use the crop and silkworm rearing residues, through apt practices of shredding, composting, and burying.

5 Silkworm rearing

[redacted] Origin of insects

Use of silkworm eggs laid by strains acclimated in the environment where they are reared is preferred.

Silkworm eggs shall be obtained laid by mother moths reared with the organic method.

[redacted] Silkworm egg production

Pure line or parental line silkworm egg production: silkworm eggs are laid by mother moths belonging to pure lines maintained in the germplasm banks[1] and here reproduced. In these centres, at every rearing season, parental lines are constituted from the pure lines, to produce polyhybrid silkworm eggs.

Polyhybrid egg production: polyhybrid eggs are laid by mother moths crossed among them and belonging to different parental lines, with inbred rearing in the germplasm banks or given to specialized farmers [2] by the germplasm banks themselves for multiplication at a larger scale.

[1] In Italy this activity is carried out by CRA-API Honey bee and Silkworm Research Unit

[2] These farmers, after parental lines rearing, return the fresh cocoons to germplasm banks or egg production plants, so that crossing among moths can be performed in order to produce polyhybrid silkworm eggs. The same eggs are packed as silkworm egg boxes to distribute to silkworm rearers to produce commercial polyhybrid cocoons from which silk is obtained.

Mother moths must be certified for the absence of hereditary diseases. We consider pebrine (*Nosema bombycis*) as the only hereditary disease until new scientific evidences are found.

With the aim of avoiding microbiological contamination of the egg shell surface, eggs can be disinfected by using all the products enlisted in the Annex VII of the Reg. (EC) No 889/2008, with the exclusion of formaldehyde.

Silkworm eggs ready to be distributed are packaged in silkworm boxes containing about 20.000 silkworm eggs of the approximate weight of 11-12 g

[redacted]Facilities

5.3.1 Silkworm egg incubation facilities

Silkworm egg incubation must be carried out under apt conditions of temperature, humidity and photoperiod (according to the kind of reared silkworm hybrid), and in devoted facilities, separated by the rearing rooms of the following larval instars.

Incubation rooms should guarantee the complete control of temperature and humidity, and a good ventilation to remove damaging gases. Furthermore, they should be easy to disinfect.

5.3.2 Rearing facilities

Rearing rooms must be controlled for environmental temperature and humidity, and ventilated for air exchange.

Rearing of the first three instars and of the last two instars should be carried out in separate rooms. Nevertheless, in case of silkworm rearers who carry out one rearing cycle per year only, it is possible to perform all the larval instars in the same room provided that larvae of different instars are not in the same room at the same moment. Moreover, subsequent rearing cycles must not be carried out without respecting the interval for sanitary break of at least 3 days including disinfection period.

Tab. 1 - Rearing surface of about 20.000 larvae

Larval instars	Surface occupied at the end of each instar (sqm)
1st instar	0.4-0.8
2nd instar	1.0-1.8
3rd instar	2.0-3.6
4th instar	4.0-10
5th instar	15-20

The farmer, according to the art. 66 of the Reg. (EC) No 889/2008, shall keep a stock account with records about dates of beginning of rearing and duration of each larval instar, in addition to moulting dates.

[redacted] Management of fourth and fifth instar rearing

5.4.1 Rearing methods

The following rearing methods are allowed:

a) shelf-rearing;
b) rearing on the floor or shoot rearing
c) mechanised rearing

[redacted] Silkworm health and welfare

With the aim to avoid disease spreading, silkworm larvae must be reared, according to the used rearing method, in the respect of the density indicated in Tab. 1.

A particular care of the density limit shall be taken during the fifth instar.

[redacted] Silkworm feeding

Raw materials and feeds used for silkworm nourishment must be conform to criteria laid down in the Reg. (EC) No 834/2007 and Reg. (EC) No 889/2008 on the organic production.

It is allowed the use of:

a) mulberry mature and fresh leaves harvested from organic mulberry fields;
b) feeds containing organic mulberry leaf and other organic raw materials (like, for example, soybean and cereal meals);
c) all the additives employed in the animal feeding and reported in the Reg. (EC) No 889/2008, Annex VI, including all the vitamins and pro-vitamins, about which it is specified at point 3a) of the quoted Annex.
d) in addition to the additives for feeds employed in the animal feeding about which it is specified at point b), the use of the following jelling agents, enclosed in the Reg. (EC) No 889/2008, Annex VIII, is authorized
   i agar agar,
   ii carragenin
   iii potassium alginate

The use of antibiotics in silkworm feeding is prohibited.

[redacted] Prophylaxis and veterinary treatments

5.7.1 Prophylaxis

With the aim of avoiding crossed contaminations and multiplication of pathogens, rearing and leaf storage facilities, machineries and instruments must be duly cleaned and disinfected.

Products listed in Annex VII of Reg. (EC) No 889/2008, with the exclusion of formaldehyde, can be used for cleaning and disinfection.

In order to inhibit multiplication of bacteria and fungi, distribution of lime on leaves during the larval moulting is allowed.

5.7.2 Veterinary treatments

Veterinary treatments are generally prohibited, due to the fact that, considering the short larval cycle, they are not effective to assure cocoon production. On the other hand, it is mandatory to respect the interval for the sanitary break between one cycle and the following one and the material possibly infected must be composted at high temperature or burnt in the farm or buried.

If veterinary treatments are strictly necessary, the product obtained from rearing fails to be qualified as organic, for the whole biological cycle during which the veterinary treatments have been applied.

6 Labelling

In the labelling and advertising of certified product may be used only, in addition to what foreseen by applicable laws, declarations complying with the requirements laid down in Reg. (EC) No 834/2007 and Reg. (EC) No 889/2008.

DISCUSSION

The organic sector in the EU has been rapidly developing during the past years. According to Eurostat data, the EU-27 had in 2011 a total area of 9.6 million hectares cultivated as organic, up from 5.7 million in 2002. Although this is a remarkable increase, the whole organic area represents only 5.4% of total utilized agricultural area in Europe. The organic area is cultivated by more than 186 000 farms across Europe. Most of the organic land (78%) and of organic farms (83%) are situated in the EU Member States having joined the EU before 2000, in which national and European legislation, among others, helped stimulate the development of this sector. The European countries having joined the EU since 2004 are quickly expanding the organic sector as well. They registered a 13% yearly growth rate in their organic area from 2002 to 2011 and saw their number of holdings increase almost tenfold between 2003 and 2010 (http://ec.europa.eu/agriculture/markets-and-prices/more-reports/pdf/organic-2013_en.pdf).

Sericulture, on the other hand, has always been an almost organic crop, at least in temperate countries, where environmental and non-intensive farming conditions permitted to limit the fertilization amount, to use mechanical control of weeds, to employ milder chemical products or mechanical control of the mulberry insect pests (for example *Hyphantria cunea*, whose nests are yearly removed by mulberry trees and burnt in the juvenile instars of the first generations).

On the other hand, the very quickly larval cycle of the silkworm does not encourage the use of chemicals to control diseases, while the focus is on the rearing hygiene and accurate disinfection of tools and rearing rooms.

For this reason, ICEA regards as possible to accelerate the conversion procedures for traditional mulberry crops so that they can be certified as organic in a very short time in Europe. On the other hand, this process appears to be much more complicate in tropical countries, where massive use of fertilizers, insecticides and formalin is employed respectively to maintain soil fertility, to control mulberry pests, to avoid disease outbreaks in silkworm rearing.

Therefore, we hope that organic production will develop easily in temperate countries, conferring an added value to the a possible revival of sericulture in Europe. The organic and also ethical character of an European sericulture might justify a higher price of raw silk than the international one giving place to an interesting economical opportunity to European farmers and industries.

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4) Organic farming: http://ec.europa.eu/agriculture/organic/

Organic Sericulture in Thailand:Current State and Future Developments

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Abstract

Awareness of climate change and other environmental concerns has increased in the last few decades. People are becoming more conscious for their health and environment. Due to a major contributor to carbon dioxide emissions of agriculture practices, the high degree of eco-friendly and organic agriculture are encouraged all over the world. Similar to sericulture industry in Thailand, it has continuously transformed from chemically based technology to organic farming. Both private sector and government sector are taking part in this process. According to the policy support of green economy, the Green Agriculture City Project has been implemented by the Queen Sirikit Department of Sericulture (QSDS) since 2014 with the cooperation of others organizations in the Ministry of Agriculture and Cooperatives. The QSDS initiated several activities under the Green Agriculture City Project across the country such as knowledge development, production improvement, standard compliance, and marketing. Currently, more than 371 rai (approximately 147 acres) are certified Good Agriculture Practice (GAP) Standard and organic standard and estimated to be almost double in 2015. 130 kilograms of organic silk cocoons (Eri silk) and more than 1,900 kilograms of organic silk yarns are produced in 2014. More than 200 kilograms of organic silk cocoons and more than 4,600 kilograms of organic silk yarns are estimated to be certified in 2015. At present, four silk fabric companies are already certified to the Global Organic Textile Standard (GOTS) - an important standard to ease the EU market penetration and boost the trust of European consumers. The use of eco-label marks also increases in Thai silk industry. Five companies certified the first silk product carbon footprint for handkerchief, scarf, shawl, and fabric in March 2015 and expect to certify more variety of products in the near future.

Organic Sericulture in Thailand:Current State and Future Developments

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1. Background

In the past, developing countries focused on industrial production and trade. Allow farmers to agricultural monoculture.And agricultural chemicals that used chemicals more than necessary. The forest land overrun contributes to the degeneration of the natural environment. Impact on global warming. As a result, farmers are aware of the problem. It bundles of traditional agricultural. Used as a model of developing sustainable agriculture by the philosophy of sufficiency economy. This organic agricultural, it is a potential for the development of sustainable agriculture. Food security and safety to the environment. Not destroy the natural environment.According to the demand for the organic products in countryand abroad. In such operations at a later stage it is essential to contributes to development of Organic National Strategic Plan No. 1 of 2551 to 2554 BC(2008-2011 AC) and 2ndOrganic National Development StrategyFY 2015-2021.

1.1 The Definition of Organic Agriculture

1.1.1 International Federation of Organic Agriculture Movements–Which the network of organic international organization. The definition of organic is “Organic agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local condition, rather than the use of inputs with adverse effects. Organic agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved”

1.1.2 Ministry of Agriculture and Cooperatives has announced standards for agricultural products, organic agricultural, Volume 1: the production, processing labeling and distribution of organic products. Which defines the organic farming "Organic agriculture is a production system as a whole. Supporting the ecosystem including biodiversity, biological cycles by using natural materials. Avoid to using the synthetic materials, plants, animals or microorganisms. Derived from genetic modification or genetic engineering techniques.Product managementby focused on the transforming with caution. To maintain its status as organic and quality of the products at every step. "

1.2 The Importance of Organic Agriculture.

1.2.1 Awareness of the health of consumers. Sincethe consumers are aware about the problemof illness from unsafe foodssuch as Cancer, Kidney disease etc. Due to the residues insecticide, antibiotics and chemicals cause the consumers changed their attitudes and focused on the consumption.

1.2.2 Awareness of the environmental. Result from chemicals agriculturalfor the resource and environment such as degeneration of soil, loss biodiversity, pollution and global warming etc.

1.2.3 Awareness of the finding alternatives farming to avoid from the cycle of chemicals agriculture. Causing problem in healthy, environmental including the continued inflated production costs. The concept to finding alternatives farming systems, called natural agriculture, nontoxic agriculture, organic agriculture, agroforestry and green agriculture etc.

1.2.4 Organic agriculture is the production system that considered about the environment, unequal treatment and biodiversity including bring the folk wisdom to use. In Thailand as an importance manufacturer and exporter of food in the world, appropriate and potential to be a source production in organic agricultural system for capability support in international competitions.

1.3 Organic Agricultural Principles.

International Federation of Organic Agriculture Movements, specify principles the importance of organic agricultural production in 4 sides are Health, Ecology, Fairness and Care (ref.: Earth Net Foundation) details of the 4 principles are followings,

1.3.1 **Health**, the organic agricultural must encouraged and sustainability of health in a holistic way of soils, plants, animals, Humans and Global.

1.3.2 **Ecology**, the organic agricultural must base on ecosystem and natural cycles. Agricultural production must be consistent with the way of nature and makes the systems and nature cycles are increased and more sustainable.

1.3.3 **Fairness**, the organic agricultural must be base on fairness relationship with all of natural and organism. The fairness meant parallelism, respect, justice and participation to protecting world in which we live. Between humanities and between human with other environments

For this principle, the relationships of the person concerned to the production process and organic product management in every level should correlated fairy well. Including the farmers, worker, processors, distributor, dealers and consumers. All people should be given the opportunities to have the better quality.

1.3.4 **Care**, the organic agricultural management should be conducted carefully and responsibly. To protect the health and well – being of the people, both now and in the future, including to protected allof the environments.

2. World's Organic Agricultural Situation.

2.1 Production

The world's organic agricultural situations are likely to increase since from 2002. The report from the survey in 156 countries in 2011 from The Research Institute of Organic Agriculture(FiBL) and International Federation of Organic Agriculture Movements (IFOAM) total of the organic area is 232.78 million rai.

The countries with the highest organic production is Oceania group (Australia and in nearby islands). The second is European group and the rest areas in developing countries (The countries of Latin Americas, Asia and Africa).

The Country has the largest organic agricultural production areas namely Australia, the production areas are 75.01 million rai. The second namely Argentina, the production areas are 23.72 million rai. The third namely United States of America, the production areas are 1.22 million rai. Philippines, the production areas are 0.6 million rai, respectively.

In Thailand, the organic agricultural production area ranked 55th in the world and ranked 7th in Asia of 0.21 million rais.

FiBL and IFOAM 2013.Database on the certificate from the private sector and government.

Table 1:Organic agriculture areas in the world in 2011

Country	Organic Agricultural area (Rai)	Ratio organic agricultural areas on the agricultural areasof the country (Percentage)
Top 15, the country has a largest organic agricultural area.		
1. Australia	75,010,775	2.93
2. Argentina	23,725,850	2.70
3. United States of America	12,180,915	0.60
4. China	11,875,000	0.36
5. Spain	10,136,865	6.52
6. Italy	6,855,557	8.61
7. India	6,776,663	0.60
8. Germany	6,347,663	6.01
9. France	6,064,631	3.55
10. Uruguay	5,818,531	6.29
11. Canada	5,257,600	1.24
12. Brazil	4,293,998	0.27
13. England	3,990,800	3.60
14. Poland	3,808,825	3.94
15. Austria	3,390,956	19.65
Countries in Asia		
42. Philippines	601,980	0.81
44. Indonesia	461,716	0.14
55. Thailand	217,683	0.18
Total (156 countries)	232,785,535	0.86

Note : Update the existing section using a hectare : 1 hectare = 6.25 rai

Ref : The World of Organic Agriculture 2013

2.2 Marketing

Value of organic agricultural products in the world market in 2011 reached 1.88 trillion baht. Increased by an average of 10 percent per year (Ref.: The World of Organic Agriculture 2013).

Number one of organic product market is in North America with value 0.94 trillion baht with a market share of 50 percent. Consisting of the United States and Canada, which the both are principal manufacturer and exporter.

United States is the principal country of manufacturer, export and import the organic products. Major organic products are including fruits, vegetable, crops, butter, bread and daily supplies. The major export products are including soy, condiment, juice, frozen fruits and vegetables and dried fruits. The main markets are Canada, Japan, European Union and import from the importance competitor, Middle East countries, Australia and Africa.

Canada is the manufacturer of organic products, both materials and finished products. The popular products are vegetable products, fresh fruits, cosmetic, spa products and apparels such as cotton fabric made from Organic Cotton. United States is the main market. The second are European Union, China, Brazil and Indonesia.

The second organic products market, followed by Europe with value 0.86 trillion baht. Market share is 46 percentage, the major export organic products are fruits, vegetable, herb, spices and olive oil.

For the Asian market and other markets, valued 0.07 trillion baht, the Asian market is the major producing countries, including China, India, Thailand, Indonesia and Philippines, respectively. Partner countries are Japan, Taiwan, Hong Kong, and Singapore. The major export organic products are fruits, vegetable, herb, spices, rice and condiment.

3. Organic Sericulture in Thailand

Organic agriculture is rapidly expanding both in production and marketing not only in developed countries. In Thailand, organic agriculture is considered as one of important policies that must be implemented quickly to serve the rise in demand in this market. Due to the awareness of health and environment, sericulture producers have to adapt their production to follow that eco-friendly and organic standards.

3.1 Background: Types of Sericulture Business in Thailand

Mulberry planting, silk rearing, silk yarn production, silk weaving and silk handicrafts have created the jobs for people in the rural area in Thailand for many decades. More than 100,000 farmers are involved in sericulture and silk weaving production. Sericulture business could be classified into 4 types according to their main products as followed.

1) Mulberry leaf production – farmers grown mulberry field and harvested mulberry leaf to mulberry tea factory.

2) Cocoon production group– farmers reared silkworms and sold their cocoons to the market.

3) Silk yarn production – both farmers and reeling factories are engaged in the process of silk reeling to produce silk yarns.

4) Silk fabric production – silk fabrics woven by small farmers and weaving factory, however the main production(85%) done by small weavers which done by hand.

They do their productions in many forms of businesssuch as (1) individual farmers were about 60% of the total producers. Most of them are farmers, who integrated in all steps of production (mulberry planting, reeling, bleaching and dyeing, and weaving) for personal use and selling. (2)Community Enterprise is engaged about 20% the total producers. The farmers/producers are gathering together to form production groups which are support by the government. (3)SMEs mostly are silk weaving producers with hand-loom as known as silk handicrafts . This type is took about 20% of the total producers in Thailand. (4) Company andfactory, which they do sericulture business as a big scale production by using model machine with standard products for export and local market.

3.2 Organic Sericulture Standards

Regard to the complex of the process in sericulture and silk production, many standards are associated with its production. The standards are certified to the productsfrom downstream to upstream products for example ;

Mulberry leaf → Silkworm Rearing (cocoons)→ Silk Yarn → Silk Fabric

3.2.1 Mulberry

There are 2 levels of organic standards that are concerned with mulberry planting are as followed.

3.2.1.1 Domestic standard

1) <u>Organic Thailand Standard</u> : This standard was certified by Department of Agriculture, Ministry of Agriculture and Cooperatives , which the government sector.

2) <u>Organic standard</u> : This standard was certified by Organic Agriculture Certification Thailand (ACT), who is private association.

3.2.1.2 International standard

1) Organic standard certified by International Federation of Organic Agriculture Movements (IFOAM) – the standard that is widely accepted in international market such as Australia, New Zealand, Hong Kong, Singapore, Malaysia, etc.

2) USDA organic standard verified by a USDA-accredited certifying agent before products can be labeled USDA organic.

3.2.2 Silk Yarns/ silk Fabrics

In the process of organic silk yarns and fabric production, producers need to follow the regulation of organic silk production starting from mulberry planting, reeling, bleaching and dyeing, and weaving. One of the worldwide leading textile processing standard for organic fibers and fabrics is The Global Organic Textile Standard (GOTS).

The GOTS defines world-wide recognized requirements that ensure organic status of textiles, from harvesting of the raw materials, through environmentally and socially responsible manufacturing up to labelling in order to provide a credible assurance to the end consumer.Textile processors and manufacturers are enabled to export their organic fabrics and garments with one certification accepted in all major markets especially in EU.

Only textiles produced and certified according to the provisions of the standard can carry the GOTS label.The standard provides for a subdivision into two label-grades:

(1) Label-grade 1: “organic”

≥ 95% certified organic fibers, ≤ 5 % non-organic natural or synthetic fibers

(2) Label-grade 2: “made with X% organic”

≥ 70% certified organic fibers, ≤ 30 % non-organic fibers, but a maximum of 10% synthetic fibers (respective 25% for socks, leggings and sportswear), as long as the raw materials used are not from certified organic origin, a sustainable forestry management program or recycled

The only differentiation for subdivision is the minimum percentage of 'organic' material in the final product. This is analogous to leading organic regulations in the food market, such as USDA/NOP. Blending conventional and organic fibers of the same type in the same product is not permitted. Conventional cotton, angora and virgin polyester are no longer permitted in the remaining balance of fibers relevant for the fiber composition.If raw fibers with the certified status 'organic - in conversion' are used instead of certified 'organic’ fibers, the corresponding label grades are named 'organic - in conversion' respective 'made with x% organic - in conversion materials'.

3.3 Development of OrganicSilk Yarns/ Fabrics Production

- **The Initiation Phase**

The Queen Sirikit Department ofSericulture (QSDS), Ministry of Agriculture and Cooperatives initially promoted green and natural products from the SCRIPT project funded by the EUsince 2011. The SCRIPT project was dedicated to apply self-control procedures and third party certification to Thai products and services in two particular sectors, silk and spa, by using an EU-inspired approach. The main objective of the SCRIPT project is to reassure consumers that Thai products, that meet International standards, are safe, efficient and good for the environment, thus enhancing Thailand trade potential.

For the Silk sector the project team has worked in collaboration with the Queen Sirikit Department of Sericulture (QSDS), Ministry of Agriculture and Cooperatives. The standard selected by the project was GOTS (Global Organic Textile Standards); the main reference at international level. In this project, 5 out of the 25 companies were selected and trained to develop internal control procedures. At the end of the project, all the 5 companies managed to be certified against international standards: 3 companies, Chul Thai Silk, Ruenmai-Baimon and Spun Silk World, were certified GOTS, first silk companies in all ASEAN area to achieve a so important result, while the other 2 companies, Thai Cotton and Silk and Bam Khumsukkho met a different standard, “Natural Color with Organic Fiber”, suitable for community based groups producers of handicrafts.

- **The Expansion Phase**

The Thai government has been aware of the important of green production in agriculture sector. In support of the government's green growth agenda, the QueenSirikit Department of the Sericulture encourages the parallel development of organic sericulture in 2 areas.

1) Organic Standard Improvement

With the main mission of the QSDS that will strengthen integration of various activities of silk, mulberry and theirs products including their standards, the department has worked in collaboration withNational Bureau of Agricultural Commodity and Food Standards(ACFS) to develop organic sericulture standards in silk yarns and silk fabrics which expected to be legally enforced in 2016.

2) Extension and Development of Eco-friendly Production

In response to the government's green growth agenda, the Queen Sirikit Department of Sericulture promotes low carbon activities under the implementation of the Green Agriculture City project - a flagship project launched by the Ministry of Agriculture and Cooperatives, which aims to promote environmentally agriculture including promote carbon footprint labeling, zero waste management, certified Thai Good Agriculture Practices, organic agriculture, water and soil conservation, agro-tourism, as well as strengthen confidence on food and agricultural standards and research and development on policy, measures, and evaluation of the green agriculture development. The five-year plan of the project is as followed.

3.4 The Principle of Organic Sericulture Production in Thailand

(1) Organic Mulberry Planting

1.1 Land Selection

- History of land used need to be acknowledged, especially for agricultural use.
- A piece of cultivated land with adjoining space. High in soil nutrition.
- There need to be enough water resources of Mulberry and sample water need to be taken for laboratoryanalysis for contamination.
- Cultivated land has no history of long-term chemicals use and anysources of pollution and contamination. Sample of soil is required to be analyzed for contamination.
- Products can be sold as“organic product” only after thecompletion of conversion period for thefarm. Conversion periods of farms is three years on basis of recognized international or national standards (IFOAM family of standards, EEC 834/2007, USDA NOP).

1.2 Variety of Mulberry

- Plant propagation shall befrom organic agriculture.

- Using genetically engineered organismsand products thereof is prohibited in sericulture organic production and processing.

- Inputs, additives, processing aids andall ingredients in organic mulberry planting shallbe traced back one step of theproduction process in order to verifythat they are not be derived from genetic engineering, bothdirect and indirect ways.

1.3 Soil Improvement

- The use of artificial fertilizer is prohibited.
- There shall be an organic fertilizationplan of the use of integrated organicfertilizers. The organic fertilizer shall beused as necessary and in appropriateamount with consideration of nutrientbalance in the soil and the need ofnutrient of that crop.

1.4 Prevention and Control of Disease, Insect and Weed

- The use of chemical pesticides andherbicides on the farm is prohibited.
- Use of good cultural practices to controlweed such as plowing, rotation, mixedcrop, mulching crop, and mulchingfrom natural materials.

1.5 Protection of Contamination

- When mulberry field could becontaminated with chemicals fromadjoining conventional field and anysources of pollution and contamination,the producer shall set up buffer area toprevent chemical contamination. Thebuffer area shall has at least 1 meterwidth.

1.6 Packaging and Transportation

- Organic mulberry leaves/fruits must be storedseparately from conventional or non-certified mulberry leaves/fruits, except they are packed inpackaging with different color or clearlabeling.
- Packing materials for finished productsshall be clean, never used for packing anyother food or materials, except glass container.
- Transportation of mulberry leaves/fruits shallnot have the contamination or comminglingwith conventional products. If it cannot do so,the organic products shall have a clear labelingand are packed in container, which can preventcontamination. The producer/operator shalltake responsible of organic products during thetransportation.

(2) Organic Silkworm Rearing

2.1 Rearing house

- The rearing house shall be located in areas which is far away from chemical or toxic contamination.
- The rearing house should be located separately from conventional rearing sheds
- The rearing house should have a good length of height and breadth with good number of windows, proper ventilation, and light.
- Only clean water and quick lime shall be used for cleaning the rearing house.
- All synthetic chemical inputs areprohibited in the rearing house.

2.2 Silkworm Rearing

- The equipment and materials used in the rearing house shall be clean and hygienic. Silkworm eggs shall be laid on clean paper.
- Only hormone and other substances listed in the international organic standards are allowed.
- Only organic mulberry leaves that are produced and certified in accordance with the international organic standard shall be used for silkworm feeding.

2.3 Prevention and Control of Disease and Insect

- Use resistant or tolerant silkworm varieties. Genetically modified organisms (GMOs) as well as transgene varieties are notallowed.
- The equipment and materials used in silkworm rearing shall be clean frequently with clean towel or paper.
- Infected silkworm shall be destroy immediately. Landfill or burning is allowed to control serious disease and infection.

(3) Silk Cocoon and Silk Reeling

3.1 Silk Cocoon Management

- Organic silk cocoons shall be kept separately from conventional or non-certified silk cocoons, except they are packed inpackaging with different color or clearlabeling.
- Styrofoam is not allowed to use aspackaging.

3.2 Process of Silk Reeling

- All synthetic chemical inputs areprohibited in the degumming process.
- Organic silk yarns shall be stored separately from conventional or non-certified silk yarns, except they are packed inpackaging with different color or clearlabeling.

(4) Silk Fabrics

4.1 Silk Bleaching, Dyeing, and Printing

- Only dyeing silk fabrics with materials coloring from plants.
- Only substances listed in Material Safety Data Sheet (MSDS) are allowed for bleaching, dyeing, and printing.
- The waste involved in bleaching, dyeing, and printing shall be destroyedin environmentally friendly way.

(5) Other Key Criteria of Silk Production

5.1 Environmental Criteria

- At all stages through the processing organic fiber products must be separated from conventional fiber products and must to be clearly identified
- All chemical inputs (e.g. dyes, auxiliaries and process chemicals) must be evaluated and meeting basic requirements on toxicity and biodegradability/eliminability
- Prohibition of critical inputs such as toxic heavy metals, formaldehyde, aromatic solvents, functional nano particles, genetically modified organisms (GMO) and their enzymes
- The use of synthetic sizing agents is restricted; knitting and weaving oils must not contain heavy metals
- Bleaches must be based on oxygen (no chlorine bleaching)
- Azo dyes that release carcinogenic amine compounds are prohibited
- Discharge printing methods using aromatic solvents and plastisol printing methods using phthalates and PVC are prohibited
- Restrictions for accessories (e.g. no PVC, nickel or chrome permitted)
- All operators must have an environmental policy including target goals and procedures to minimize waste and discharges
- Wet processing units must keep full records of the use of chemicals, energy, water consumption and waste water treatment, including the disposal of sludge. The waste water from all wet processing units must be treated in a functional waste water treatment plant.
- Packaging material must not contain PVC. Paper or cardboard used in packaging material, hang tags, swing tags etc. must be recycled or certified according to FSC or PEFC

5.2 Technical Quality and Human Toxicity Criteria

- Technical quality parameters must be met (s.a. rubbing, perspiration, light and washing fastness and shrinkage values)
- Raw materials, intermediates, final textile products as well as accessories must meet stringent limits regarding unwanted residues

5.3 Minimum Social Criteria

- Employment is freely chosen
- Freedom of association and the right to collective bargaining are respected
- Working conditions are safe and hygienic
- Child labour must not be used
- Living wages
- Working hours are not excessive
- No discrimination is practised
- Regular employment is provided
- Harsh or inhumane treatment is prohibited

3.5 The Current Situation of Organic Sericulture in Thailand

Organic sericulture in Thailand was seriously implemented in last 5 years ago. The main organization that take responsibility in terms of promotion standard development and certification through the separation of individual section independently according to the international system. The results of organic and associated standards are shown in table 2.

Table 2: Organic Sericulture in Thailand between 2014 and 2015

Organic Sericulture Certification	2014	2015
Good Agricultural Practices (GAP)	120 Rai	140 Rai
Organic Mulberry Farm	251 Rai	442Rai
Organic Silk Cocoon	138 Kg.	200 Kg.
Organic Silk Yarns	1.9 tons	4.6 tons
GOTS: Organic Textile	4 companies	4 companies
Eco Label: Carbon footprint	5 companies	10 companies

3.5.1 Expected Outputs

1) Increasing the acquisition of knowledge in organic sericulture production as well as raising the awareness of environmental responsibility.

2) Improving the standard of mulberry and silk products in accordance with the international organic standard.

3) Advancing the popularity of mulberry and silk products both in domestic and international markets.

4) Adding value to mulberry and silk products and increasing competitiveness in the green market.

3.5.2 Obstacles

(1) Majority of farmers are afraid to convert to organic production due to the fear of higher production cost and lower yield. Moreover, organic production requires a complex management and process.

(2) According to the higher cost in organic production which leads to higher prices, only some consumers can afford organic products, keeping green market small in Thailand.

3.5.2 Policy Supports

1. The green agriculture city project has been launched by the Ministry of Agriculture and Cooperatives as a flagship project for the 2014 fiscal year to support green growth development. The six pilot sites include Chiang Mai in the North, NongKhai and Si SaKet in the Northeast, Chanthaburi in the East, Phatthalung in the South, and Ratchaburi in the central region. The project covers the development of all farm sectors – crops, livestock, and fisheries. It is in response to the current 11th National Economic and Social Development Plan, 2012-2016. The plan focuses on efforts to move toward a greener world, with the management of natural resources and the environment toward sustainability.

2. The Government implemented agricultural assistance programs to improve standard ease high cost in production such as organic soil bank, GAP certification promotion, etc.

3. Organic Agriculture is set to be a country strategy that expected to be implemented in 2015-2021, with the main objectives to securethe improvement of farm production, as well as farmers' quality of life.

4. Future Direction

In order to develop and enhance organic sericultural products in Thailand, QSDS has set the policy followed as ;

4.1 Develop local standards that related to organic to promote and certify to small farmers in order to decreased cost of certification.

4.2 Expanding the area of organic project to be cover high potential area.

4.3 Awareness building to the public through providing organic product information to them.

4.4 Cooperation with concerning party in order to set up sericulture organic network both national and international level.

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Carbon Footprint of Thai Silk Products

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I.Introduction

Industrial Thai Silk and Silk product is a major industry that is important to the economy in Thailand. It is also an industry that is labor intensive which produced most of the characteristics of household or industrial SMEs, thus, causing employment and additional income for the family farmer. However, the current global silk market worth is 300,000-400,000 million Baht. We found that, Thai silk has a relatively small market share or less than 1 percent of the value of exports of silk in the world market.Regarding to an increasing concern of global climate change and carbon emissions, the term carbon footprint has appeared to raise awareness of the environmental impact on consumer behavior around the world. In response to the need for transparency in the greenhouse gas (GHG) emissions of products and support green growth development, the Queen Sirikit Department of Sericulture promotes low carbon activities under the implementation of *the Green Agriculture City project* - a flagship project launched by the Ministry of Agriculture and Cooperatives, which aims to promote environmentally agriculture including promote carbon footprint labeling, zero waste management, certified Thai Good Agriculture Practices, organic agriculture, water and soil conservation, agro-tourism, as well as strengthen confidence on food and agricultural standards and research and development on policy, measures, and evaluation of the green agriculture development.One of activities under the Green Agriculture City project implemented by the Queen Sirikit Department of Sericulture is Carbon Footprint program which have main objectives to promote green economy and zero waste agriculture, to support decision making and supply chain management, and to encourage differentiation of Thai silk products on the market and trade advantages.

Objectives

1) To assess and register Carbon Footprint of Thai silk products
2) To develop procedures to reduce costs and greenhouse gas emission of silk products.

Scope of Practice

1. Invisible Training Workshop on the Assessment Guidelines carbon footprint
2. Selecting Thai silk products which will be registered as carbon footprint
3. Preliminary technical guidance
4.Following the implementation and evaluation
5. Carbon verification and filing of Silk products
6. Guidelines and outlines the using of resources, resulting in reduced costs and reduce greenhouse gas emissions
7. Conclusion

Expected Outputs

The operator can determine and analyze greenhouse gas emissions and prepare documents for the registration of Carbon Footprint of the product.

II.Products and Scope of Research

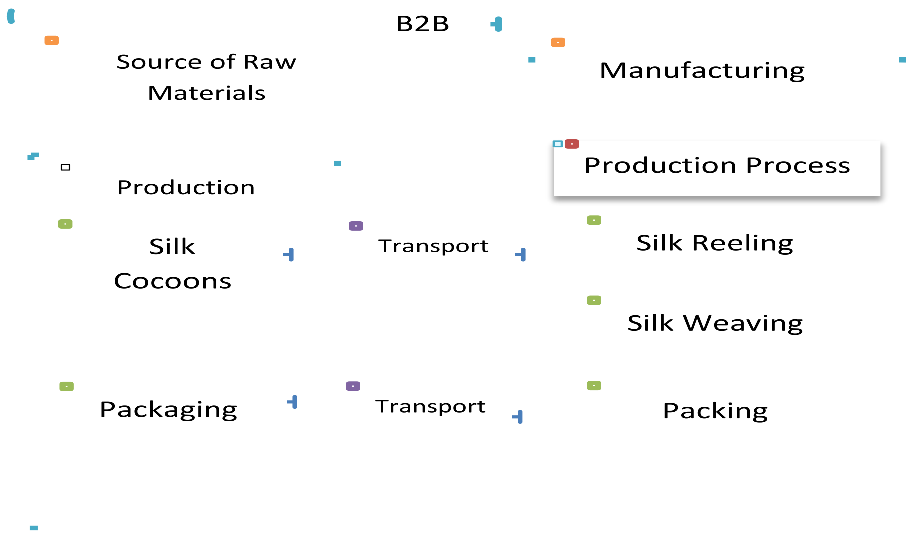
❖ **Natural Color, Hand Woven Silk Fabric**

Product Detail

- Natural colored silk fabric: width 1 meter
- Used mixing outer and inner layer of Thai native variety silk for weft and warp yarns
- Weaved by traditional looms
- Certified with Silver Royal Peacock

Scope

The scope of Business-to-Business (B2B) carbon footprint covers raw material acquisition, manufacture, and distribution up to the factory gate or distribution to another business organization depending on the specific product PCR.



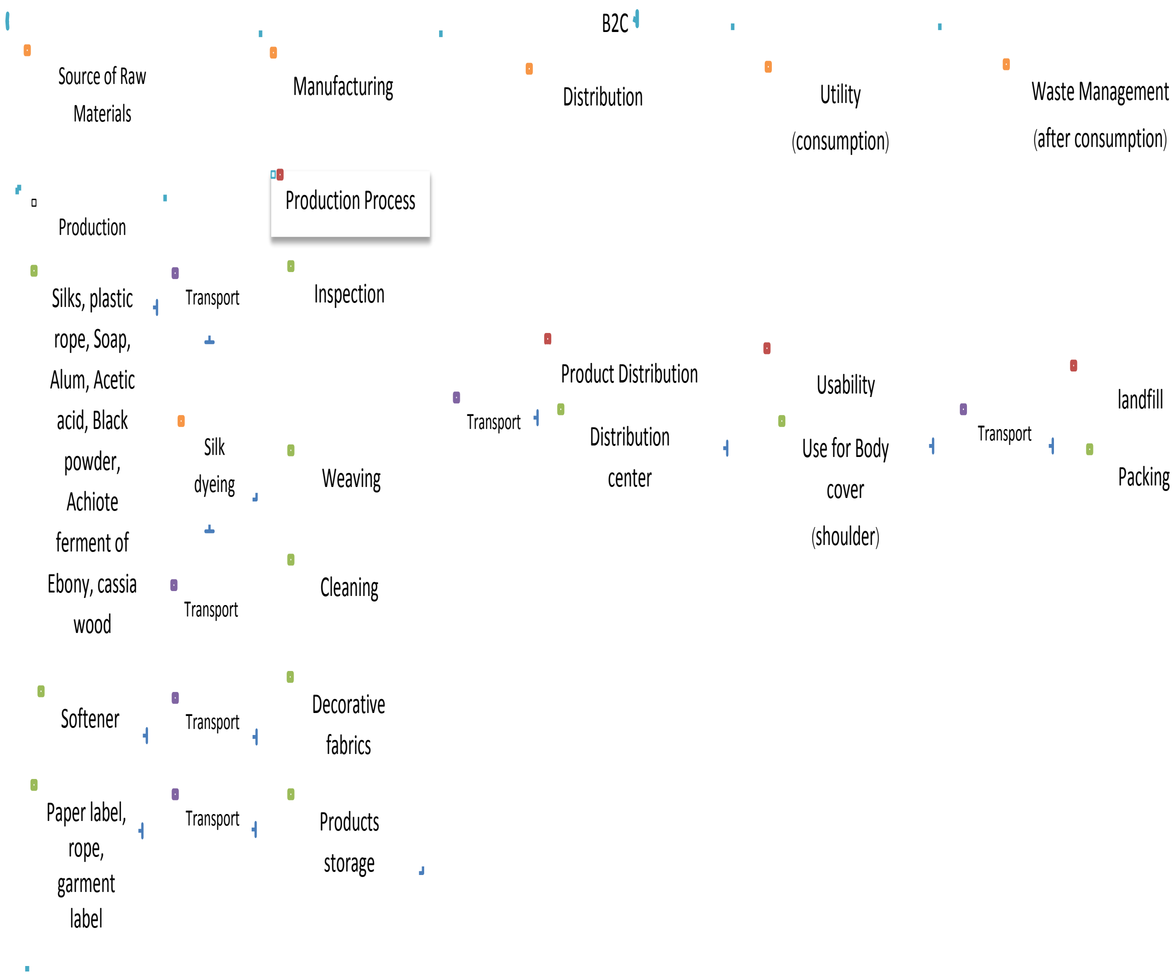
❖ **Natural Dyed Silk Shawl**

Product Detail

- Size 40 inches x 200 cm.
- Mud-mee (Ikate) fabric
- Used industrial Thai silk for weft and warp yarns
- Used natural dyed weft and chemical dyed warp yarns
- Weaved by hand loom

Scope

The scope of Business-to-Consumer (B2C) carbon footprint covers raw material acquisition, manufacture, use and final waste disposal including related transport in all stages.



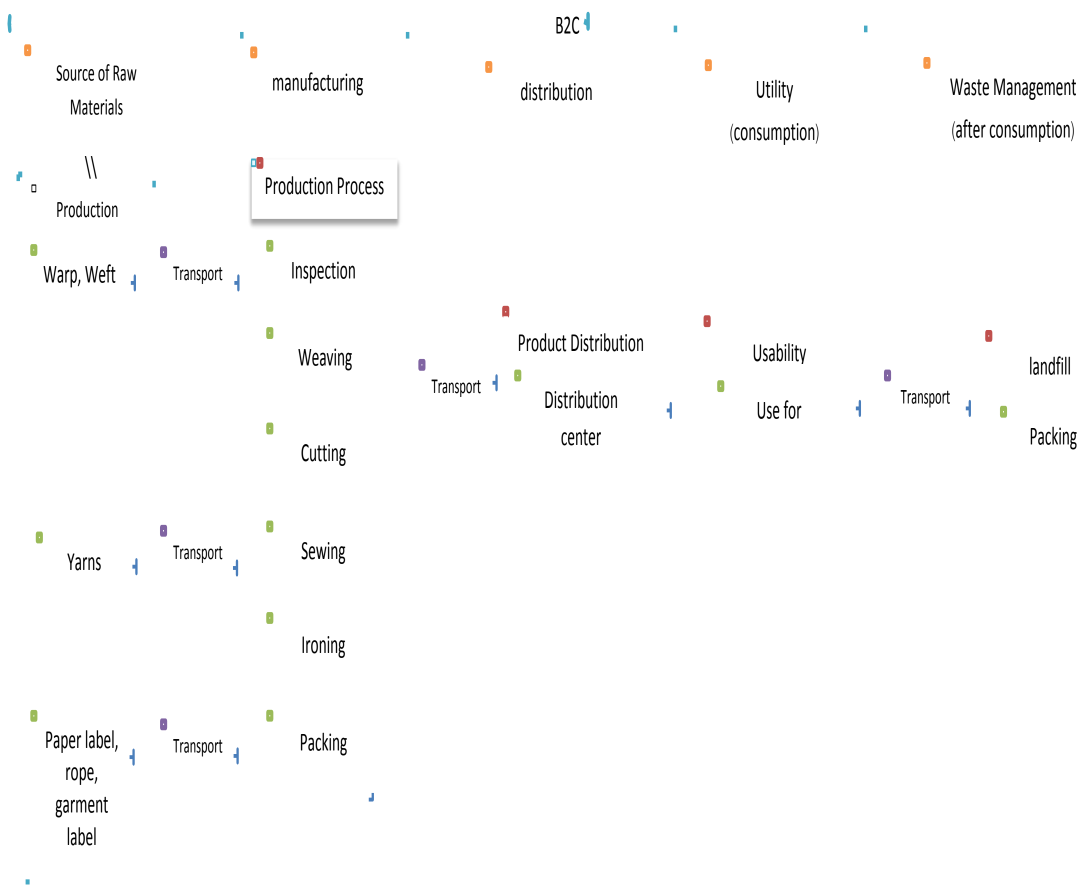
❖ **Silk Pocket Square**

Product Detail

- Size 30 cm. x 30 cm.
- White color (no bleach & no dyes)
- Using industrial Thai silk for weft and warp yarn
- Weaved by power loom

Scope

The scope of Business-to-Consumer (B2C) carbon footprint covers raw material acquisition, manufacture, use and final waste disposal including related transport in all stages.



III.Data

The data required for carbon footprint consist of

- Primary data - All direct activities under control of the organizationimplementing carbon footprint including energy and raw material use, transport of raw materials, etc.
- Secondary data - National LCI database for packaging, waste, electricity, etc.

IV.Methods of Analysis

- Life Cycle Assessment

Life Cycle Assessment (LCA) is a quantitative analytical method used to evaluate the total environmental impact arising from production, use, and end of life phases of a product or service (5). A carbon footprint on the other hand, is a subset of LCA methodology with analysis limited to emissions that have an effect on climate change. A carbon footprint of a product refers to the total set of GHG emissions (CO_2, CH_4, N_2O, PFCs, etc) associated with the product in its life cycle – i.e. raw materials, manufacturing, transportation, product use and disposal. Figure 1 shows an overview of various stages in the life cycle of a semiconductor product.

V.Results

❖ **Natural Color, Hand Woven Silk Fabric**

The summary of the carbon footprint of Hand Woven Silk Fabric with natural color is shown in Figure 1

Life Cycle	GHG Emission of collecting and utilizing inputs,	GHG Emission of transporting inputs, energy	Total GHG Emission ($gCO_2 \cdot eq.$)	Proportion

	energy and resources (gCO_2·eq.)	and resources (gCO_2·eq.)		
Resources collection	642	0.47	643	78.53
Manufacturing	176	0.00	176	21.47
Distribution	0	0	0	0.00
Utilization	0	0	0	0.00
Disposal	0	0	0	0.00
Land use change	-	-	0	0.00
Total	818	0.47	819	100.0

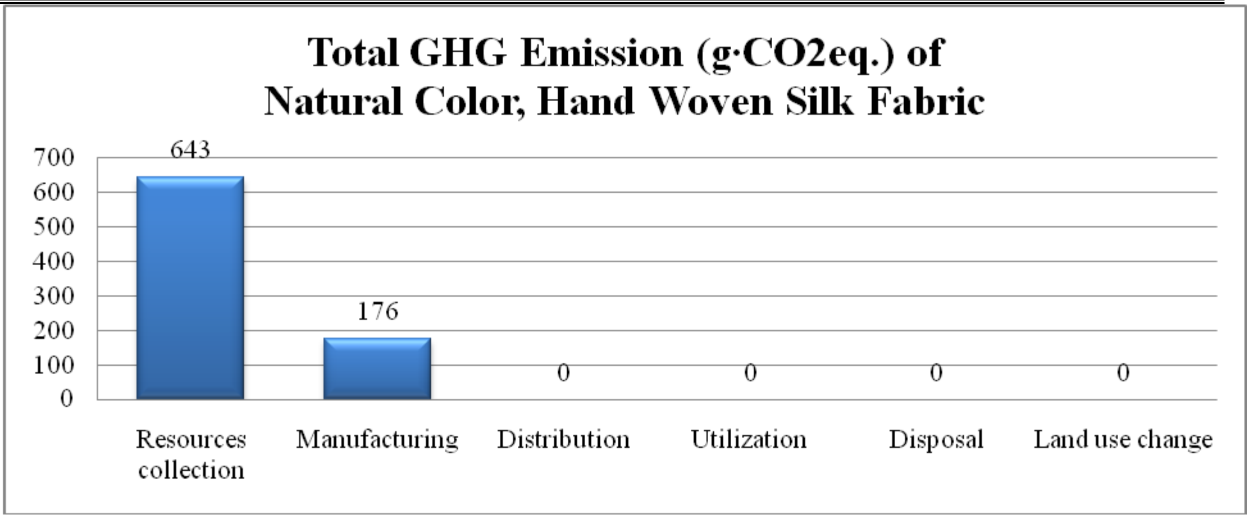


Figure 1 Shown the summary of the carbon footprint of Hand Woven Silk Fabric with natural color

- **Natural Dyed Silk Shawl**

The summary of the carbon footprint of Natural Dyed Silk Shawl is shown in Figure 2

Life Cycle	GHG Emission of collecting and utilizing inputs, energy and resources ($kgCO_2$·eq.)	GHG Emission of transporting inputs, energy and resources ($kgCO_2$·eq.)	Total GHG Emission k(gCO_2·eq.)	Proportion
Resources collection	2.06	0.00	2.06	64.38
Manufacturing	0.13	0.00	0.14	4.28
Distribution	0.00	0.00	0.00	0.00
Utilization	0.72	0.00	0.72	22.58
Disposal	0.28	0.00	0.28	8.76
Land use change	-	-	0.00	0.00
Total	3.19	0.00	3.20	100.0

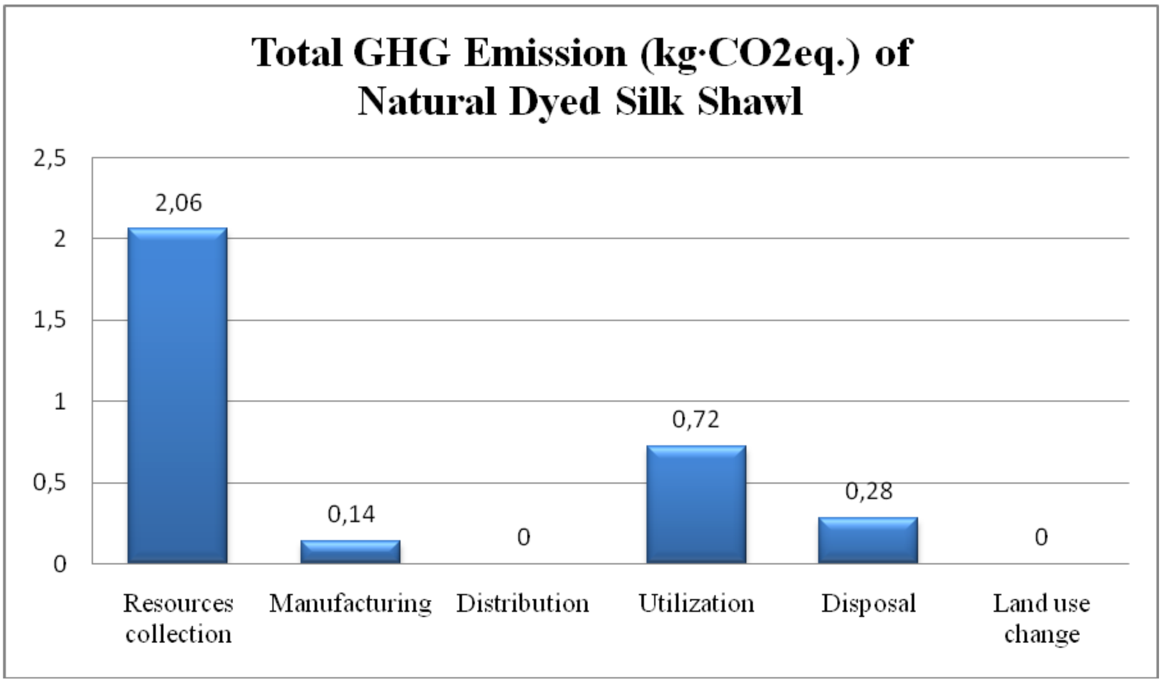


Figure 2 Shown the summary of carbon footprint of Natural Dyed Silk Shawl

- **Silk Pocket Square**

The summary of the carbon footprint of Silk Pocket Square is shown in Figure 3

Life Cycle	GHG Emission of collecting and utilizing inputs, energy and resources (gCO_2·eq.)	GHG Emission of transporting inputs, energy and resources (gCO_2·eq.)	Total GHG Emission (gCO_2·eq.)	Proportion
Resources collection	109	1.07	110	30.71
Manufacturing	114	0.01	114	31.73
Distribution	7.05	0.01	7.06	1.97
Utilization	59.4	0.00	59.4	16.54
Disposal	68.3	0.09	68.4	19.05
Land use change	-	-	0.00	0.00
Total	358	1.18	359	100.0

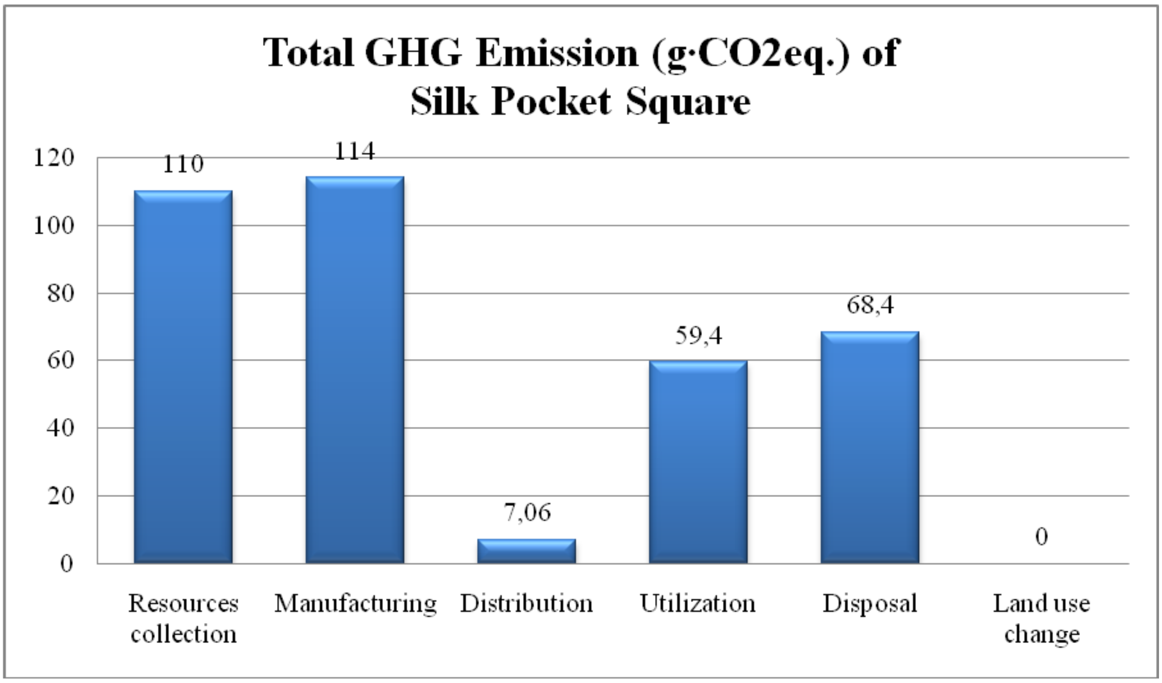


Figure 3 Shown the summary of the carbon footprint of Silk Pocket Square

VI.Conclusions

➢ Thai silk production needs to improve its environmental performance to be sustainable.

➢ The largest portion of the Carbon Footprint is different in each product.

➢ There are possibilities for GHG emissions in the process of

✓ Silkworm breeding

✓ Silk reeling

✓ Silk degumming

✓ Energy efficiency improvement.

Knowledge Extension Model of Good Chemical Fertilizer with Organic Fertilizer Application for Increase Sericulture Productivity

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Abstract

The study of Knowledge Extension Model of Good Chemical Fertilizer with Organic Fertilizer Application for Increase Sericulture Productivity aimed to study efficient fertilizer application and benefit for quality of mulberry and silk yarn, and to be a model of the best practice for fertilizer application to sericulture productivity increasing, as well as increasing of farmers' income. The study was conducted during 2013 – 2014, carrying out 2 mains activities; the first was studying on good chemical fertilizer with organic fertilizer application at Queen Sirikit Sericulture Centers in Roi-Et Province and Chaiyaphum Province. The experiment was design by randomized complete block design – RCBD and 4 replications consisting of 5 experimental formulas, which 0-0-0 , 30-15-15 kilogram per rai of N-P_2O_5-K_2O, and 30-15-15 kilogram per rai of N-P_2O_5-K_2O with organic fertilizer 1, 2 and 4 tons per rai, respectively. The test of soil in the both places before the experiment showed that most of the soil was infertile and found acidity in medium and low rate. After the experiments, it was found that application of chemical and organic fertilizer in all formulas helped considerably increasing leaves for Sakolnakorn mulberry variety. By feeding Nang Lai Silkworm variety with the experimental mulberry leaves found higher Nitrogen, Phosphorus, and Potassium in mulberry leaves for first and second stage silkworm than for fourth and fifth stage, applying 30-15-15 kilogram per rai of N-P_2O_5-K_2O with organic fertilizer in all formulas; nutrition in mulberry leaves, mulberry leaves products, cocoon, and silk yarn was increased and more fertile for planting. The second activity was the application of the formula 30-15-15 Kilogram per Rai of N-P_2O_5-K_2O with organic fertilizer 1 tons per rai in Yang Si Surat District, Mahasarakham Province, and Muang District, Chaiyaphum Province found that farmer obtained more yield of cocoon and silk yarn, and they were satisfied with knowledge extension of fertilizer application because it was practical and created more income.

Keywords: chemical fertilizer, organic fertilizer, mulberry, silk, product
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FOREWORD

Mulberry plantation by following technical steps and proper fertilizer application are the key success for increasing quantity and quality of mulberry leaf, and lessening capital cost for excessive use of fertilizer. Quantity and quality of mulberry leaf to feed is relevant with silk yarn quality. The mix of chemical and organic fertilizer application effects on quality of mulberry leaf.

The current problem is farmers keen to apply chemical fertilizer only, which changes soil structure. Long-term plantation of mulberry causes unfertile soil, low quality of mulberry leaf, low yield of leaf. If feeding silkworm with low quality leaf, cocoon and silk yarn production will be effected. To solve this problem, it needs teamwork. Famers have knowledge and understand mulberry plantation system, breeds selection, water and soil management, application of chemical and organic fertilizer, and appropriate technology using, which based on environmental friendly basis. Nowadays, there are various studies on soil fertilizing by conducting on the basis of soil characteristics, for example, physical, chemical, and biochemical, before conducting proper soil fertilizing. Growth and productivity both quantity and quality of mulberry depend on physical properties of soil which are relative to organic matter Such as Nitrogen, Phosphorus and Potassium (Shashidhar K. R. *et al,* 2009) including appropriate portion and ratio, soil pH, and soil moisturizing. Thus, chemical and organic fertilizer application becomes an important key in quality sericulture production. The fertilizering 15-7.5-7.5 kilogram per rai per year of N-P_2O_5-K_2O with organic fertilizer 3 ton per rai per year to increase the quatity and quality production of mulberry leaves.(Molthon.et.el, 2544) These shows the relevance between growth of silkworm, productivity, and quality of silk yarn, and fertilizer application. Comparison between mulberry leaf without and with fertilizer found that mulberry with fertilizer provided higher Nitrogen, Potassium than one without fertilizer. The knowledge extension of good fertilizer application greatly and practically responses to farmers’ needs.

Tools and Methods

Tools

1 Sakhon Nakorn mulberry variety
2 Nang Lai silkworm variety
3 chemical fertilizer 15-15-15 and Urea fertilizer 46-0-0
4 organic fertilizer
5 soil collecting kit
6 silk rearing room and silk rearing tools such as silk tray, basket, multage, net, and other necessaries
7 hand reel equipment

Methods

1. Select area of 2-year mulberry plantation in Queen Sirikit Sericulture Centers in Roi-Et Province and Chaiyaphum Province, 1 Rai per Center
2. Divide the area into 5 blocks for 5 treatments with 4 replications
3. Randomized complete block design – RCBD consists of 5 treatments with 4 replications;
   1) control 0-0-0
   2) chemical fertilizer 30-15-15 kg. per Rai of N-P_2O_5-K_2O
   3) chemical fertilizer 30-15-15 kg. per Rai of N-P_2O_5-K_2O + organic fertilizer 1 ton/Rai/year
   4) chemical fertilizer 30-15-15 kg. per Rai of N-P_2O_5-K_2O + organic fertilizer 2 tons/Rai/year
   5) chemical fertilizer 30-15-15 kg. per Rai of N-P_2O_5-K_2O + organic fertilizer 4 tons/Rai/year
4. The study of Knowledge Extension Model of Good Chemical Fertilizer with Organic Fertilizer Application for Increase Sericulture consisted of 2 activities, as the following;

4.1 <u>Activity 1</u> The study of Knowledge Extension Model of Good Chemical Fertilizer with Organic Fertilizer Application in Queen Sirikit Sericulture Centers in Roi-Et Province and Chaiyaphum Province, conducted the following processes;

4.1.1 randomly collected soil from both Queen Sirikit Sericulture Centers in Roi-Et Province and Chaiyaphum Province before and after experiments in the Year 2013 and 2014 to analyze soil characteristics

4.1.2 applied the fertilizer according to the experimental methods by applying chemical fertilizer 2 times and organic fertilizer 1 time before the first chemical fertilizer application

4.1.3 reared 2 crops of silkworm in Queen Sirikit Sericulture Centers in Roi-Et Province and Chaiyaphum Province by feeding the worm with experimental mulberry leaf. The rearing was 5 treatments with 4 replications. One replication used 0.4 gram of silkworm egg. RCBD was applied as well as for the fertilizer experiment. Some of mulberry leaf was brought to identify nutrition.

4.1.4 recorded the data as followings

1) physical data: soil, rain quantity, humidity, temperature, etc.
2) agriculture data
   (1) mulberry data: leaf productivity
   (2) silk data: silk weight at each stage (1^{st} -5^{th}, cocooning percentage, percentage of pupa, percentage of good cocoon, cocoon and silk yarn production

4.1.5 analyzed data

4.2 <u>Activity 2</u> The study of Knowledge Extension Model of Good Chemical Fertilizer with Organic Fertilizer at farm level

4.2.1 selected farmers in Roi-Et Province and Chaiyaphum Province

4.2.2 examine the farmer about Model of Good Chemical Fertilizer with Organic Fertilizer Application (30-15-15 Kg./Rai of N-P_2O_5-K_2O + organic fertilizer 1 ton/Rai/year)

4.2.3 collected and analyzed information and data from the farm

4.2.4 evaluated farmer's satisfactory

4.3 concluded the experiments and provided suggestions

Experimental sites

1. Queen Sirikit Sericulture Centers in Roi-Et Province and Chaiyaphum Province
2. Farms in Muang District, Chaiyaphum Province, and Payakphum Pisai District, Mahasarakham Province

Experimental duration

2 years (October 2012 – September 2014)

Result and suggestion

Result

1. biochemical analysis of the manure used in the experiments found that manure used in each Centers had different biochemical characteristics, for example electrical conductivity, Potassium of manure for Roi-Et Center was 5.15 dS/m, 2.27 milligrams per kilogram, higher than manure for Chaiyaphum Center 3.30 dS/m,1.87 milligram per kilogram, total Nitrogen and total Phosphorus for Chaiyaphum Center were higher than for Roi-Et Center at 1.19 milligrams per kilogram, 1.15 milligrams per kilogram, and 1.09 milligrams per kilogram, 0.73 milligrams per kilogram, consecutively (table no.1).

2 . mulberry block analysis in both Centers before experiment found that soil was infertile; soil pH of Roi-Et Center was 5.87, electrical conductivity was 0.023 dS/m, only 0.05 percent of organic matter, low Phosphorus (6.15 milligrams per kilogram), and exchangeable Potassium was 32 milligrams per kilogram. Soil pH of Chaiyaphum was 6.16, electrical conductivity was 0.51 dS/m, 0.86 percent of organic matter, medium Phosphorus (6.15 milligram per kilogram, and exchangeable Potassium was 32 milligrams per kilogram. (Table No. 2).

3 . result of chemical and organic fertilizer application per plant nutrition (nitrogen, phosphorus, potassium) in mulberry leaf and productivity of mulberry and silkworm

3 .1 plant nutrition in mulberry leaf, total Nitrogen, total Phosphorus, and total Potassium, collected from all experiments in Roi-Et Center to feed silkworm in first, second and third stages, contained 2.49 – 2.6 percent of total nitrogen, 0.86-0.96 percent of total phosphorus, and 2.7-2.75 percent of total potassium, tended to higher than leaf for silkworm in fourth – fifth stage. Leaf for silkworm in fourth and fifth stage contained 2.05 - 2.22 percent of total Nitrogen, 0.72-0.74 percent of total phosphorus, and 2.48-2.52 percent of total potassium (figure no. 1). For Chaiyaphum Center, plant nutrition in mulberry leaf for silkworm in first to third stage was likely high, 3.92 – 4.5 percent of total nitrogen, 1.33-1.5 percent of total phosphorus, and 2.94-3.35 percent of total potassium. Whereas leaf for silkworm in fourth to fifth stage had lower nutrition, 3.07 -4.32 percent of total nitrogen, 0.8-1.08 percent of total phosphorus, and 1.02-2.45 percent of total potassium, percentage of chemical fertilizer was 30-15-15 kilogram of N-P_2O_5-K_2O (figure No. 2).

3 .2 productivity of mulberry and silkworm, in Roi-Et Center found that average weight of mulberry leaf in experimental blocks for 30-15-15 kilogram of N-P_2O_5-K_2O and 1, 2 and 4 tons per rai in the first year, was 79567, 807.70, 797.58 grams per tree, in the second year was 744.43 ,779.12, and 719.45 grams per plant. For the first year of Chaiyaphum Center, the weight was 430.48, 430.75, 305.45 grams/tree, and the second year

was 550.58, 537.92 และ 548.67 grams per plant, consecutively. There was non significant differces (table no. 3). The result of cocoon and silk yarn productivity was in the same development; all experiments showed non-significant differce (table no. 5 and 6). However, for Roi-Et Center, the duration of rearing silkworm in the first stage of the first year provided quite low yield, as well as the first stage of the second year in Chaiyaphum Center, because of the weather and humidity during February – April was not appropriate (table no. 4, figure no. 4, figure no.6).

4. Result of soil analysis after chemical and organic fertilizer application in both Centers found that all formulas of fertilizer application did not influence on soil pH, or organic matter. Plant nutrition (nitrogen, phosphorus, potassium) had significant difference. For Roi-Et Center, soil pH was 5.86-6.96, organic matter was 0.61-0.75 percent, Phosphorus was 15.10-28.85 milligrams per kilogram, and exchangeable potassium was 62.00-78.50 milligrams/kilogram. In Chaiyaphum Center, soil pH was 6.70-7.45, organic matter was 0.88-1.22 percent, phosphorus was 38.95-42.35 milligrams per kilogram, and exchangeable potassium was 74.50-85.00 milligrams per kilogram (table no. 8,9)

5. result of knowledge extension of good chemical and organic fertilizer application, 30-15-15 kilogram per rai of $N\text{-}P_2O_5\text{-}K_2O$ + organic fertilizer 1 ton per Rai per year, to farmers was that farmers accepted the principle to action and could decrease their capital cost because organic fertilizer application provided non-significant effect, and helped developed soil in the northeastern area which was sandy loam and contained low organic matter, approximately 2 percent, increased water and nutrition absorbance. According to Nantarat Sukumneud, organic fertilizer could improve water and nutrients absorbance of soil in the northeast of Thailand which had low organic materials and sandy texture.

6. The satisfactory of famers toward Model of Good Chemical Fertilizer with Organic Fertilizer Application was good and appropriate for increasing sericulture productivity in farmer level (Table No.7).

6.1 The satisfactory toward farmers toward technology of mulberry plantation management, fertilizer application according to the model in Roi-Et and Chaiyaphum

Data collected by using questionnaire indicated that farmers was satisfied in high level, at the average level of 3.83

6.2 The satisfactory of farmers toward silkworm rearing with fertilizer application according to the model in Roi-Et and Chaiyaphum

Data collected by using questionnaire indicated that farmers was satisfied in high level, at the average level of 3.41

Suggestion

1. The analysis of organic fertilizer found that there was low of nutrients, different sources provided different substances. Soil in both Centers was infertile which might not show significant differences between productivity from chemical and organic fertilizer application, and non-fertilizer, or only chemical fertilizer application
2. Silkworm rearing during the experiment indicated that weather greatly influenced on cocoon and silk yarn productivity, especially for Roi-Et Center in March – April 2013, and in February – March 2014, as well as for Chaiyaphum Center in February – March 2014, where the temperature was higher than 30 degree celsius, low humidity. This condition caused lower percentage of survivor than the standard, and slightly influenced on the research.

Conclusion and discussions

Conclusions

1. Young stage silkworm (1st – 2nd and 3rd instars larvae) needs young mulberry leaf which had higher Nitrogen, Phosphorus and Potassium than that which feed to growth stage silkworm (4th or 5th instars larvae). These nutrition affected on silkworm growth, silkworm survival rate and silk yarn production. The nutrition contents analysis of mulberry leave showed that young leaves had higher nutrition than old leaves which in agreement with Shafiq and Haq (1993) and Laiw and Shaikata (1980) who reported that the growth of young stage silkworm which took soft leave and had higher Nitrogen content in young mulberry leaves were higher than growth stage silkworm. Javaid (1991) showed that supplement of 0.3K + 0.2%N to mulberry leave resulted in high growth of silkworm. Ashfagh et al. (1996) reported that the mulberry leave supplement with 0.1%N + 0.1%P resulted in higher consumption rate than that with 0.1%N. Moreover, young stage silkworm feed with supplemented mulberry leave resulted in higher yield because the production of good quality and quantity of silk depends on larval nutrition, healthiness of larva, with were partially influenced by the nutrition value of mulberry leaves (Ito, 1978). Moisture and protein contents of young mulberry leaves were important for young stage silkworm growing, whereas higher contents in carbohydrate of old mulberry leaves were suitable for 4th and 5th instars larvae (Watchapong, 2012). Not only Nitrogenous compounds but Phosphate also important for the metabolism of the silkworm (Etebari et. al., 2007).

2. The adding of chemical fertilizer (30 – 15 – 15 : N – P_2O_5 – K_2O) combined with organic fertilizer gave the higher yield of cocoon and silk yarn. No significant differences were found in soil from Roi-ET and Chiyaphum Queen Sirikit Sericulture Center. These results were similar with Sannappa et al. (2005) and Gowda, R. (1996) who reported that Nitrogen and Phosphorus played an essential role in quality and quantity of mulberry leaf and cocoon yield. Application of chemical fertilizer (30 – 15 – 15 : N – P_2O_5 – K_2O) combined with organic fertilizer (1 Ton per year per unit) with 4 pilot farms (each 2 farms from Roi-ET and Chiyaphum province) got the high satisfaction from farmer.

3. The nutritional analysis of soil from Roi-ET and Chiyaphum Queen Sirikit Sericulture Center showed that enrichment of chemical and organic fertilizers can improve soil fertility. The soil added with chemical fertilizer (30 – 15 – 15 : N – P_2O_5 – K_2O) combined with organic fertilizer trend to have lower amount of phosphorus and potassium than that the using of only manure. This may be due to the texture of soils which had sandy, loam and big particle size, good to retain adequate water. So, the mulberry root can easy absorb nutrition for normal crop growth. Organic fertilizer improves both the physical and chemical properties of the soil, soil structure, soil texture, cat-ion exchange capacity, water holding capacity, crumb formation, and hence plant growth and yield (Isiaq et al., 2010). The integrated nutrient management is the best approach to restore/ maintain soil fertility and productivity on sustainable basis. Application of organic manure in combination with reduced rate of chemical fertilizers had significant effect on the yield parameters and yield of vegetable crops (Islam et al., 2011).

Discussion

1. The nutrition of farm manure and soil from different place were different. According to encourage of chemical and organic fertilizer using, it should be analyze soil abundance before implement on farmer.

2. To improve quality of soil with chemical or organic fertilizers, the water are important for releasing the nutrient ions readily available for plant absorption. Therefore, it should have adequate of **water from natural and irrigation.**

3. From this investigate showed that the quality of mulberry leaf is essential for silkworm rearing. Effort to improve its productivity of mulberry should emphasize. Among improvement possibilities, the nutrition requirements play a major role. Nitrogen, Phosphorus and Potassium are major essential elements required for physiological mechanisms of mulberry growth. It is necessary to add chemical and/or organic fertilizer in order to have

good continuous mulberry yields. Both of them are the most common fertilizer applied in agricultural management to improve crop productivity.

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Table 1 The chemical analysis of the manure.

qualification	Sericulture Center Roiet	Sericulture Center Chaiyaphum
pH (1:10)	8.30	7.71
conductivity (dS/m)	5.15	3.30
Total Nitrogen (%)	1.09	1.19

Total Phosphorus (% P_2O_5)	0.73	1.15
Total Potassium (% K_2O)	2.27	1.87
Total Calcium (% Ca)	0.83	1.21
Total Magnesium (% Mg)	0.36	0.41
Total Sulfur (% S)	0.19	0.13

Table 2 The chemical analysis of soil before planting (Sericulture Center Roiet and Sericulture Center Chaiyaphum)

Qualification	Sericulture Center Roiet	Sericulture Center Chaiyaphum
pH (1:1)	5.87 Moderately acid	6.16 Slightly acid
conductivity (dS/m) (1:5)	0.023 Not salty	0.51 Not salty
Organic matter (%)	0.05 Very low	0.86 Low level
Avail. P_2O_5 (mg.kg.)	6.15 Low level	11.6 Medium level
Potassium (K_2O) (mg.kg.)	32 Low level	48 Low level
Soil characteristics	Sandy loam	Sandy loam

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Table 3 Effects of fertilizer with manure per weight of mulberry year 1 (2013) and year 2 (2014) of Sericulture Center Roiet and Sericulture Center Chaiyaphum

Treatment	Sericulture Center Roiet		Sericulture Center Chaiyaphum	
	Year 1	Year 2	Year 1	Year 2
0-0-0	635.90b	508.52b	166.09b	305.75b
30-15-15 kg. (N-P_2O_5-K_2O)	724.58ab	809.75a	534.01a	594.58a
30-15-15 kg. (N-P_2O_5-K_2O) + manure 1 ton/0.4 acre	795.67ab	744.43ab	430.475a	550.58a
30-15-15 kg. (N-P_2O_5-K_2O) + manure 2 ton/0.4 acre	807.70a	779.12a	430.75a	537.92ab
30-15-15 kg. (N-P_2O_5-K_2O) + manure 4 ton/0.4 acre	797.58ab	719.45a	305.45ab	548.67ab
F-test	*	*	*	*
%CV	31.47	29.54	51.74	44.27

Note ns Not statistically different at the 95 percent confidence level.
* Different statistical confidence level of 95 percent by DMRT

Table 4 Period of silkworm rearing 4 time of Sericulture Center Roiet and Sericulture Center Chaiyaphum

Location	Year	1 Time		2 Times	
		Date/Month	Number of the day	Date/Month	Number of the day
Sericulture Center Roiet	2013	March 18-April 10	24	July 20-August 9	21
	2014	February 20-March 11	20	July 26-August 14	20
Sericulture Center Chaiyaphum	2013	May 29-June 17	20	September 22-October 10	19
	2014	February 21-March 10	18	July 18-August 4	18

Table 5 Cocoon yield and silk production (per 0.4 g eggs silkworm) Sericulture Center Roiet

Treatment	Cocoon yield (g)				Silk production (g)			
	Year 1		Year 2		Year 1		Year 2	
	1 time	2 times	3rd	4 th	1 time	2 times	3rd	4 th
0-0-0	164.28a	345.50	185.44	237.29b	9.49b	31.41	16.19	20.72b
30-15-15 kg. (N-P_2O_5-K_2O)	132.60ab	382.75	213.90	298.00b	11.51ab	34.80	18.68	26.03a
30-15-15 kg. (N-P_2O_5-K_2O) + manure 1 ton/0.4 acre	143.33ab	374.50	243.71	248.13a	12.48ab	34.05	21.28	21.67a
30-15-15 kg. (N-P_2O_5-K_2O) + manure 2 ton/0.4 acre	131.43ab	370.50	204.04	260.13b	11.40ab	33.68	17.82	22.72a
30-15-15 kg. (N-P_2O_5-K_2O) + manure 4 ton/0.4 acre	110.35b	358.50	223.13	251.76b	14.39a	32.59	19.49	21.99ab
F-test	*	ns	ns	ns	*	ns	ns	*
%CV	22.06	6.57	21.50	11.38	23.07	6.57	21.51	11.38

Note ns Not statistically different at the 95 percent confidence level.
* Different statistical confidence level of 95 percent by DMRT

Table 6 Cocoon yield and silk production (per 0.4 g eggs silkworm) Sericulture Center Chaiyaphum

Treatment	Cocoon yield (g)				Silk production (g)			
	Year 1		Year 2		Year 1		Year 2	
	1 time	2 times	3rd	4 th	1 time	2 times	3rd	4 th
0-0-0	252.30	246.85b	199.88	240.01b	22.25a	21.80	16.17b	19.42b
30-15-15 kg. (N-P_2O_5-K_2O)	252.05	244.00b	294.22	267.65a	20.89b	22.85	23.80a	21.65a
30-15-15 kg. (N-P_2O_5-K_2O) + manure 1 ton/0.4 acre	253.63	248.60ab	231.51	251.12a	22.29a	22.93	18.73ab	20.32ab
30-15-15 kg. (N-P_2O_5-K_2O) + manure 2 ton/0.4 acre	251.68	249.58ab	228.24	261.57a	22.33a	22.65	18.47ab	21.16ab
30-15-15 kg. (N-P_2O_5-K_2O) + manure 4 ton/0.4 acre	251.20	254.33a	236.97	256.19a	22.29a	23.40	19.17ab	20.73ab
F-test	ns	*	ns	**	*	ns	*	*
%CV	11.4	19.2	20.76	6.35	4.32	5.17	20.76	6.35

Note ns Not statistically different at the 95 percent confidence level.
* Different statistical confidence level of 95 percent by DMRT

Table 7 The mean and standard deviation. Satisfaction levels of silk to master knowledge of farmers Chaiyaphum and Roiet

Complacency	$\bar{x}$	SD	Interpretation
Knowledge of fertilizer	3.83	0.751	Very satisfied
Silkworm rearing	3.41	0.605	Very satisfied
Total	3.62	0.678	Very satisfied

Table 8 The chemical analysis of the soil after application (Sericulture Center Roiet)

Treatment	pH	O.M (%)	Avail.P_2O_5 (mg.kg.)	K_2O (mg.kg.)
30-15-15 kg. (N-P_2O_5-K_2O)	6.13	0.66	22.80	78.50
30-15-15 kg. (N-P_2O_5-K_2O) + manure 1 ton/0.4 acre	6.96	0.64	28.85	71.50
30-15-15 kg. (N-P_2O_5-K_2O) + manure 2 ton/0.4 acre	5.92	0.64	15.60	62.00
30-15-15 kg. (N-P_2O_5-K_2O) + manure 4 ton/0.4 acre	6.95	0.75	17.45	73.00
F-test	ns	ns	ns	ns
%CV	2.66	15.57	59.44	20.29

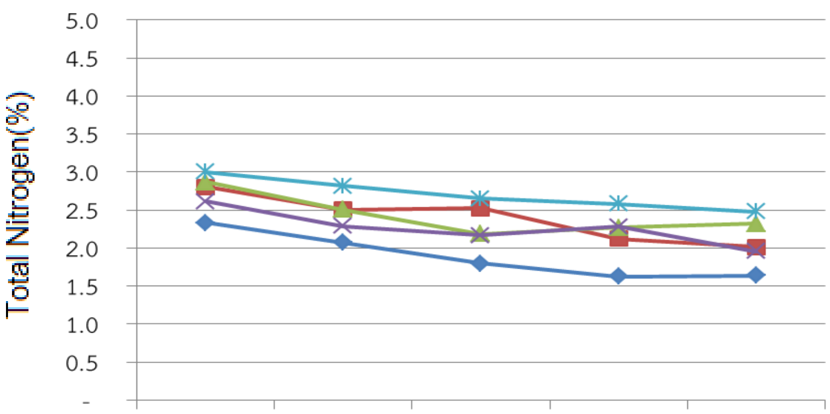
Note ns Not statistically different at the 95 percent confidence level.

Table 9 The chemical analysis of the soil after application (Sericulture Center Chaiyaphum)

Treatment	pH	O.M (%)	Avail.P_2O_5 (mg.kg.)	K_2O (mg.kg.)
30-15-15 kg. (N-P_2O_5-K_2O)	7.28	0.88	39.85	82.50
30-15-15 kg. (N-P_2O_5-K_2O) + manure 1 ton/0.4 acre	6.96	1.04	42.35	81.00
30-15-15 kg. (N-P_2O_5-K_2O) + manure 2 ton/0.4 acre	7.07	1.21	39.10	74.50
30-15-15 kg. (N-P_2O_5-K_2O) + manure 4 ton/0.4 acre	7.45	1.19	40.10	75.00
F-test	ns	ns	ns	ns
%CV	5.61	23.81	23.98	16.88

Note ns Not statistically different at the 95 percent confidence level

Figure 1 Nutrient content in mulberry leaves (Nitrogen, Phosphorus, Potassium) are used for silkworms rearing ages 1 to 5. (Sericulture Center Roiet)



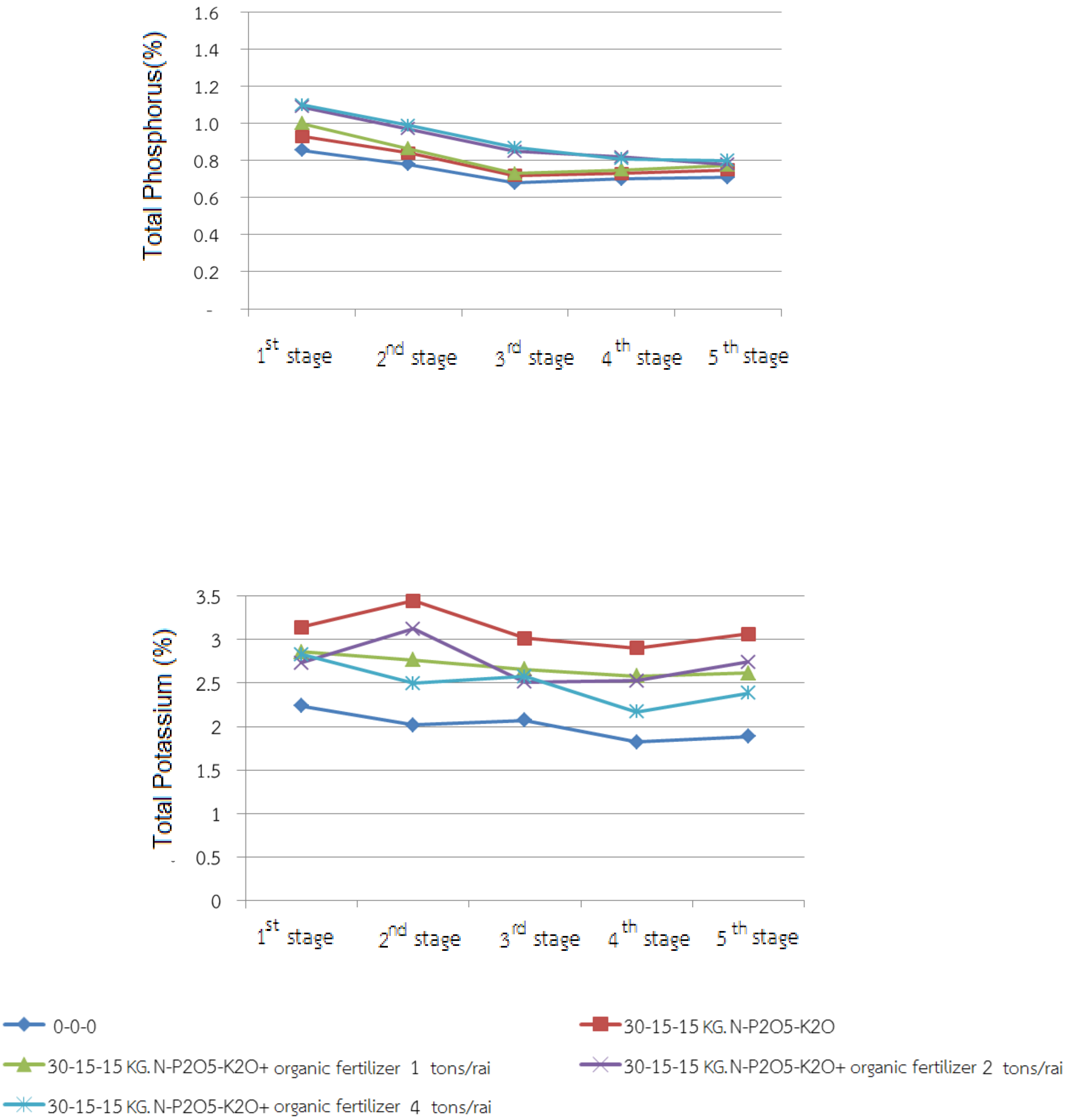
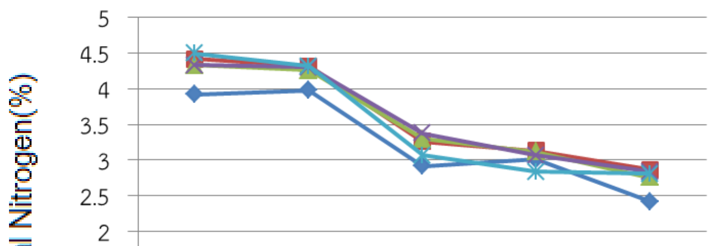


Figure 2 Nutrient content in mulberry leaves (Nitrogen, Phosphorus, Potassium) are used for silkworms rearing ages 1 to 5. (Sericulture Center Chaiyaphum)



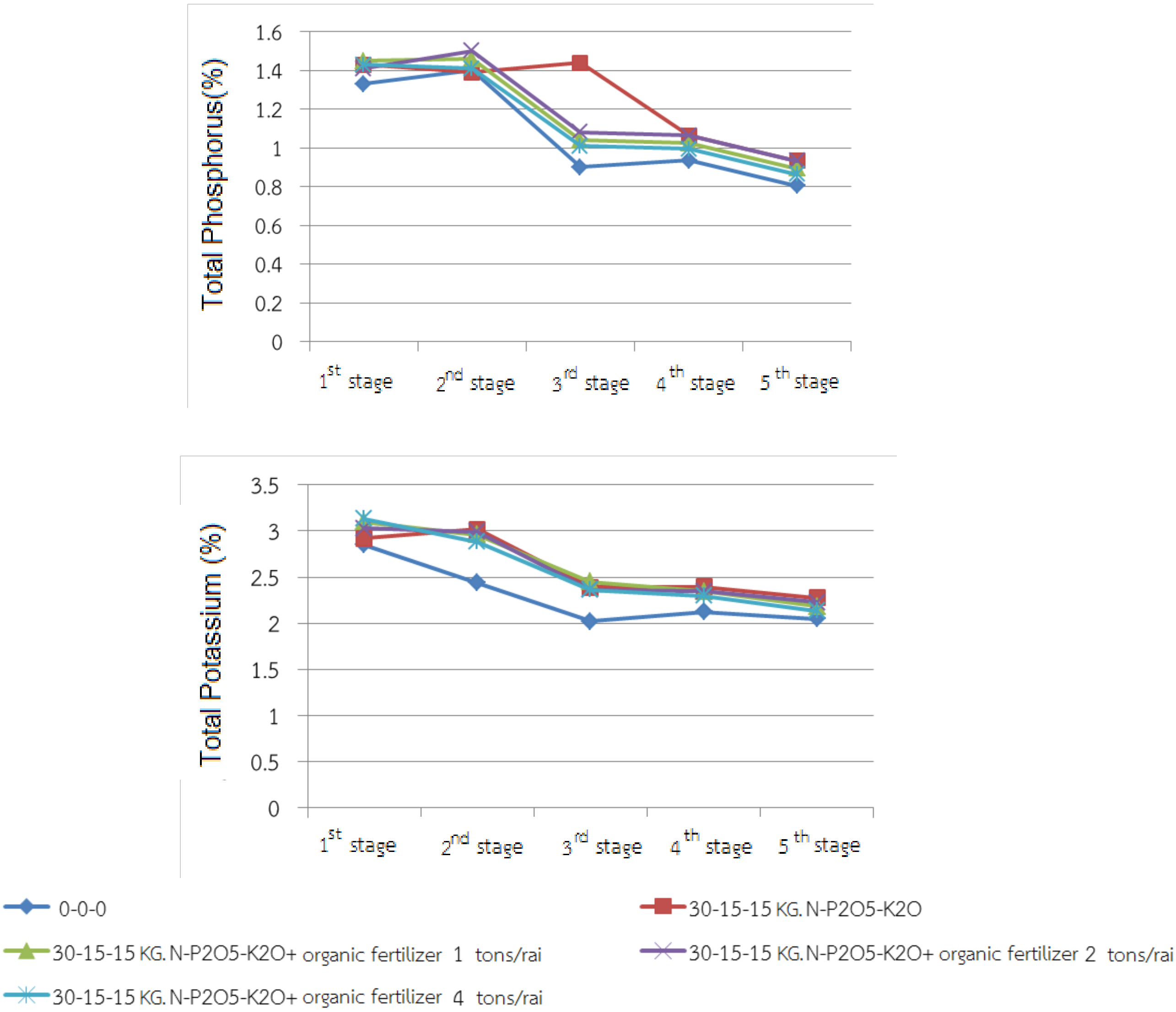


Figure 3 Rainfall accumulation of Roiet. (2013 and 2014)

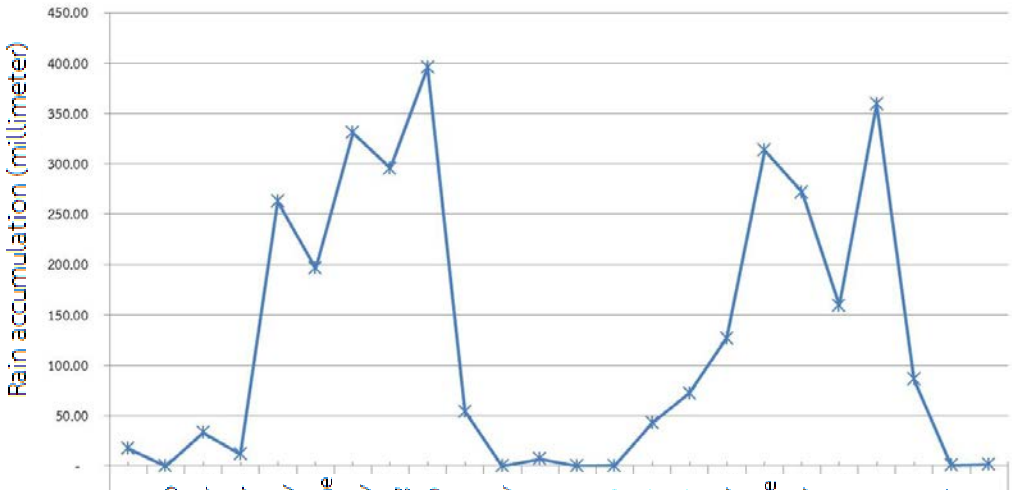


Figure 4 Average temperature and humidity of Roiet. (2013 and 2014)

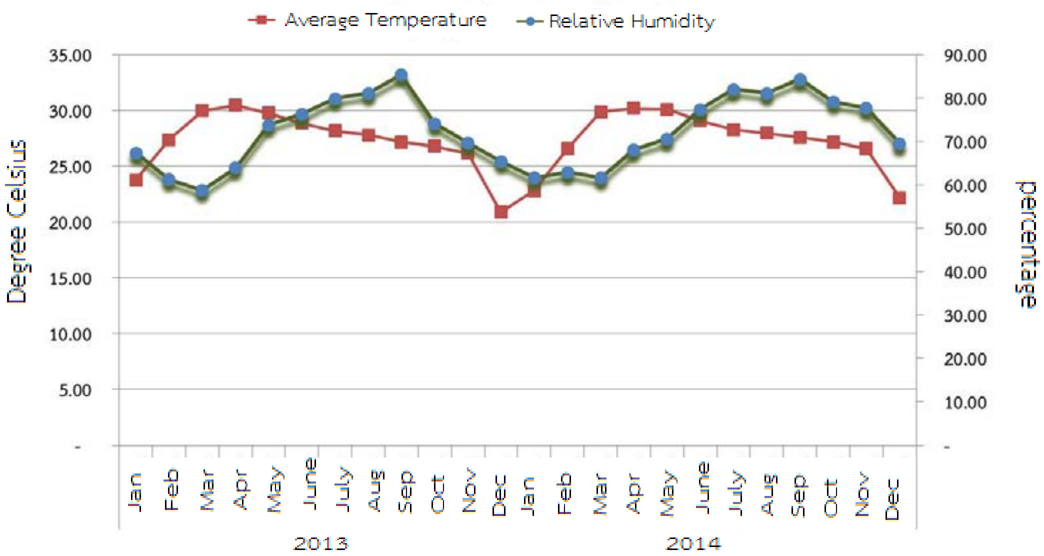


Figure 5 Rainfall accumulation of Chaiyaphum. (2013 and 2014)

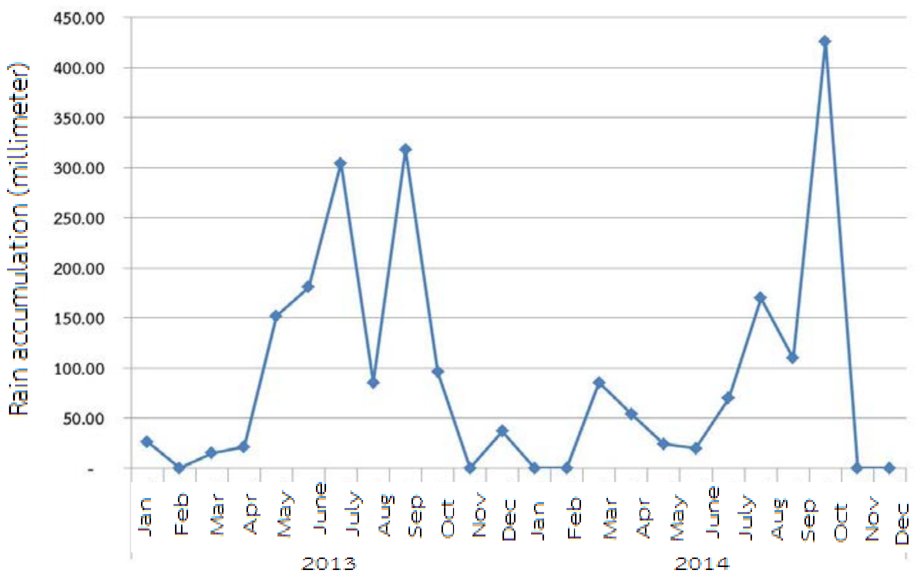
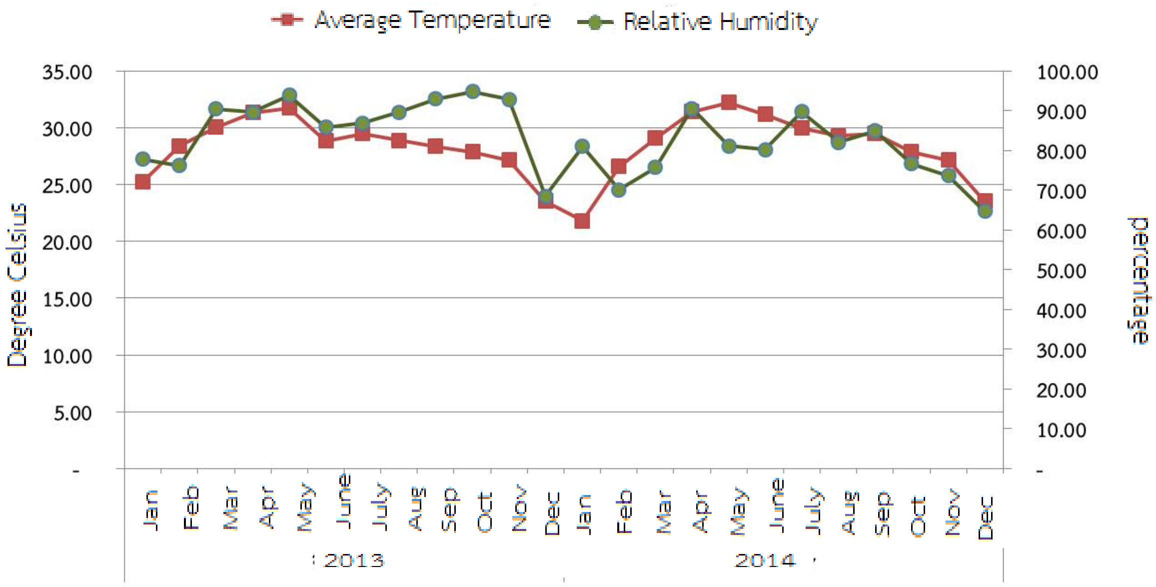


Figure 6



Organic mulberry plantations

By

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Abstract: In practical terms organic production means: not using mineral fertilizers at the expense of farm-produced natural fertilizers (compost, green manure and mulches; not using herbicides and pesticides, but instead mechanical companion, crop control and cover crop management.

Mulberry plantations which are immediately suitable for organic production exist only in the form of old low-density orchards, without any fertilization or plant protection measures. It is necessary to pass through conversion period, since the use of artificial aids is restricted, and attention must be paid to create an ecological balance, professional training of the grower and minimizing economic losses from temporary crop decrease.

Mulberry tree exploitation continues for decades and mistakes in plantation establishment, e.g. choosing the site and varieties, initial soil preparation, crown forming of young trees and cares in their juvenile period cannot be ignored easy and losses for the growers will be great. This is especially very important for organic production of mulberry leaves.

This article analyzes the main points that should be kept in mind and activities to be undertaken in the establishment and operation of plantations for organic production of mulberry leaves, namely:

Criteria for assessment of a site (all the factors associated with climate, location and soil); proper soil preparation which is one of the most important prerequisites for successful organic production; choice of the cultivar and the quality of the planting stock ; proper planting density and planting systems; protection of the soil when using machinery; soil testing in two ways - assessment of the soil on site, and secondly, analysis of soil samples in

the laboratory; organic preparation of the soil by green manuring, fallow systems and wild-flower strip mixtures; weed control; disease and pest control.

Keywords: organic farming, mulberry, plantation establishment, moriculture

1. General principles of organic farming

In practical terms organic farming, including moriculture means:

● Not using soluble mineral fertilizers, and careful use of farm-produced natural fertilizers (compost, aerated slurry), green manure, mulches, crop rotations and careful tilling of the soil;

● Not using herbicides, but instead mechanical or thermal companion crop control and cover crop management;

● Not using synthetic chemical pesticides, but instead increasing soil health, choosing resistant varieties, using natural active agents.

Integrated production of mulberry leaves can be regarded as an intermediate stage towards organic moriculture. According to the technical definition, 'integrated plant protection' describes as program, which incorporates all possible methods of plant protection, including chemical methods. Chemical measures are only applied if the economic damage threshold is exceeded.

Mulberry plantations which still have an intact ecological balance and are suitable for organic production exist only in the form of old low-density orchards, without any fertilization or plant protection measures, which are prevalent in Bulgaria. It is essential, therefore, to run thought integrated production and the conversion phase into organically farming. This process must be carried out in stages, and attention must be paid to the following points:

● Improving the ecological balance in the farm;

● A positive commitment of farmers to the organic production method;

● Professional training of the farmers;

● Minimizing economic losses.

Complete conversion takes 3-4 years.

2. Planning and setting up an organic sericulture and mulberry leaf production farm

2.1. Choice of site - ecological principles.

The term site encompasses all the factors associated with climate, location and soil. These three factors are closely related to each other. This interaction produces the living conditions for the trees.

The economics of organic moriculture is largely dependent on the site. Since in organic production it is only possible to make very limited use of chemicals, the choice of site is of critical importance. To achieve economic success, the site conditions must match the site requirements of mulberry as closely as possible. The most important prerequisite is to choose varieties that are right for the location. Before setting up an organic farm, it is essential to consult the local advisory services, which knows the special characteristics of the area. In this way errors in planning can be avoided.

2.2. Climate

Climate is of fundamental importance in determining whether a particular variety can be grown in a particular area. The general climate is shaped by the following factors:

● Temperature. In order to assess the suitability of a particular area for mulberry growing, apart from the mean annual temperature it is important to know the mean temperature during the months from April to November (growing season or vegetation season). The mean annual temperature is not the best indicator of suitability for mulberry leaves production. A better indicator is the length of the growing season, the number of days with a mean diurnal temperature higher than +5°C (physiological zero). The length of the growing season in a particular area is determined by the number of days of growth, and for successful organic moriculture it should be more than 200 days.

● Winter frost. Severe winters with low extreme temperatures over long periods, without snow cover, can lead to frost damage (winter frost damage). The damage caused by low winter temperatures is often underestimated. It occurs mainly at the start and towards the end of the winter. Mild periods with temperatures above zero followed by a sharp temperature drop (down to -15°C) are the most dangerous.

Sudden changes in temperature of this type cause severe damage to the wood and buds of sensitive mulberry varieties. Therefore sunny slopes, hollows and sites with a high groundwater level (moist, cold soil) are most at risk in this respect.

● Rainfall. The water requirements of mulberry are primarily supplied by precipitation in the form of rain and snow. The most reliable water supply can be obtained on deep soils with a high water capacity and with good rainfall distribution during the growing season. In dry soils, the usable groundwater level is also important, provided that it is not deeper than 1 m on light soils and not deeper than 2.5 m on heavy soils.

Lack of water causes a reduction in assimilation. There are symptoms which characterize the critical phase of water supply and indicate that the tree needs to be watered. Young trees and newly planted trees are more sensitive to drought and need to be watered in critical phases. In order to reduce drought stress, it is also very important to keep the planting area weed-free or cover it with organic materials.

● Light. The production of quality mulberry leaves requires between 1400 and 1600 hours of sunshine per annum. Light warms up the soil, increases assimilation (nutrient content of the leaves, maturity of the wood), accumulation of chlorophyll and development of strong buds.

● Wind conditions. Wind strength and frequency are also important. Frequent strong winds have the following negative effects: the soil dries out; vegetative and generative performance is reduced, broken branches and fallen trees.

Effective protection can be provided by planting a hedge as a wind-break. A windbreak which is properly set up at the right time significant improves the microclimate.

2.3. Location

Location means the way the climatic conditions are affected by mountains, hills, towns and villages, forests, altitude and orientation around plantation. The main types of locations can be classed as open, closed or sheltered:

● Open locations. Open locations are exposed in all directions and are therefore very affected by wind. The advantage that they offer is the low incidence of disease and pests due to better and faster drying. It also leads to increased wind damage.

● Closed locations. Closed locations are enclosed on all sides by woods, houses or hills. The lack of air movement leads to an increased incidence of disease and pests. These locations are also subject to a risk of frost.

● Sheltered locations. Sheltered locations are the best type of location for mulberry. They are protected on the north-east side (by woods, buildings, etc.) and are open towards the south-west. This provides the possibility of air flow in the latter direction and reduces the risk of frost.

Criteria for assessment of a site for mulberry plantation:

● Frost risk (early and late frost). Sites prone to frost reduce the reliability of the yield. Late frosts in spring can delay vegetation. Early frosts in autumn shorten the growing season. Sites which trap cold air, because of woods, valleys, buildings should be avoided. The nature of the terrain must therefore be taken into account. Wind is an important factor in this respect. Moderate air movement is beneficial, cold air which is moving seldom leads to frost damage.

● Closed Insolation. Only sites which receive good, prolonged insolation should be considered for organic growing. In sloping and hilly sites, even slight differences in the direction can significantly change the length of insolation. North-facing slopes in most cases are unfavorable. South-facing slopes can be considered optimal, except that there is often a risk of drought in summer. South-facing sites get about twice as much light as north-east-facing slopes. Apart from the orientation, the gradient of the slope is also a key factor for insolation. If the gradient is 25% or more, profitable production is impossible. Gentle slopes with a gradient of 10% or less are the optimum from the point of view of microclimate and labor costs.

2.4. Soil

The soil is the underground living space of mulberry tree and one of the most important factors for sustainable production. A well-aerated, retentive soil of sufficient depth, with good root penetration and many soil organisms, is essential for ensuring that plant growth is healthy. Permanent crops such as mulberry are especially dependent on a deep root volume. In many cases, cultivated soils suffer from compaction, which can seriously impair tree growth. A healthy soil structure can also be destroyed by insufficient soil cultivation. Proper soil preparation is one of the most important prerequisites for successful organic production.

A healthy soil should have the following composition and properties: 50% solid constituents (organic - humus, inorganic - minerals), 50% pore space (half filled with water and half with air), intact soil life (biological activity of the soil). Soil porosity is optimal when about half of the soil volume consists of pores.

Soil organisms have very important role, as followed: Mineralization of organic matter; humification (conversion of organic matter to stable humic substances); improvement of nutrient mobilization and uptake by plants (especially through mycorrhiza); nitrogen fixation from the atmosphere by root nodule bacteria; protection of the plant from soil pathogens.

Organic matter in soil has the following important functions: storage of water and nutrients in the root penetration zone; loosens heavy soils and increases crumb formation; light soils become more retentive; provides food for soil organisms; supplies nutrients; acts as a buffer against drought, temperature changes, etc.

3. Soil preparation

First at all soil must be tested. Soil testing is done in two ways: firstly, assessment of the soil on site, and secondly, analysis of soil samples in the laboratory.

The soil sample is usually tested for the following parameters:

● pH (soil reaction, pH in $CaCl_2$): optimal values 5.5-6.0;

● Humus content. Minimum humus content for light soils 1.5%; moderately heavy soils 2.0%; heavy soils 2.5%;

● Nutrient analysis. In order to determine the fertilization needed for production, it is important to test the soil for nutrients before planting. This provides information about nutrient deficiencies or excessive levels of certain nutrients in the soil. The soil sample should be tested for the following nutrients before a new orchard is set up: phosphate; potassium; lime (exchangeable calcium); magnesium; boron; other trace elements: manganese, zinc, copper, iron.

The nutrient content of the soil is adequate if the following quantities are contained in 100 g of soil: phosphate (P_2O_5) 11-25 mg/100 g; potassium (K_2O) 11-32 mg/100 g (depending on how heavy the soil is); magnesium (MgO) 7-13 mg/100 g (depending on how heavy the soil is); exchangeable calcium 250-300 mg/100 g; boron (B) 0.8 ppm; manganese (Mn) 70 ppm; zinc (Zn) 8 ppm; copper (Cu) 8 ppm; iron (Fe) 100 ppm.

Basal dressing is advisable if the results of the soil test indicate that there is an inadequate supply of nutrients in the soil. Only products specified in Annex II of EU Regulation 2092/91 should be considered for use as fertilizers and soil conditioners. If the pH is too low, the soil should be limed with up to 200-300 kg of calcium carbonate/daa per year (0.2-0.3 kg/m^2), or with dolomitic lime if there is also magnesium deficiency. If there is not enough humus, it is advisable to enrich the soil with organic matter.

Loosening the soil (mechanical soil preparation). In many cases cultivated soils have compacted areas which can impair tree growth. Compaction in soil may be due to soil formation factors, or by mechanical pressure from machinery. If the soil is compacted it is essential to loosen the subsoil by trenching or deep cultivation before planting. The use of soil tillage equipment before planting depends on the results of the soil tests. The soil needs to be loosened and then enriched with green manure. The depth of tillage should be only slightly below the compaction horizon. Soils which are naturally compact (clay soils) can only be mechanically loosened.

4. Planning and setting up an organic mulberry plantation

Under the EU guidelines for organic production, only planting stock obtained by the organic production method may be used in future (except for transitional periods). This also presupposes that nurseries must adapt accordingly and plan their production to conform to the guidelines for organic production; i.e. mulberry saplings have to be grown in organic nurseries.

4.1. Quality of planting stock

One of the most important factors for the success of new plantation is the quality of the planting stock. In addition to basic requirements, the planting stock must be of satisfactory internal and external quality. In organic moriculture, it is essential to use only saplings of the highest quality, since it is not possible to use chemical aids to improve tree development.

Minimum requirements for the planting stock are as followed:

● Healthy. Free of diseases and pests, virus-free if possible, free of mechanical damage and damage due to weather (hail, frost);

● Vigorous. With adequate strength and length;

● Uniform. Same age and uniform quality;

● True to variety. All the trees correspond to the variety stated on the label;

4.2. Planting systems in organic mulberry leaves production

The planting density of mulberry plantations has increased in recent years. In organic production with more extensive orchards, the yields are often lower and the manual labor requirements are higher, because of lower planting densities and the high tree forms. Significant improvements in absolute and relative productivity (yield per unit of area and costs per kilogram of leaves) can be expected from modern planting systems which are not incompatible with the aims of organic agriculture. Orchards with more than 300-400 trees/daa have very high establishment costs and increase the production risk. In many cases they do not achieve economically viable yields. With small-crown tree forms, the aims in organic production are as followed: early commencement of cropping; regular yields; improvement in leaves quality through optimum light exposure; reduction in manual labor requirements; efficient mechanization (mulching, plant protection, soil management); reduction in production costs.

The following aspects should be borne in mind in choosing planting distances:

● The shorter the planting distances, the smaller is the useful tree volume per tree and the greater the sensitivity of plantation to water and nutrients shortages.

● The management of the soil is important in choosing the planting schemes. If the distances between the trees are too short (<2.00 m), mechanized work on the row in the first few years after planting is difficult, as is also the mulching of rows with ground cover.

● Particular attention should be paid in organic production for preventive control of diseases and pests, so loose plantings are advantageous.

● The direction of the rows and the planting systems should be planned to achieve the optimum insolation (north-south direction).

The best density for organic mulberry plantation is 3.0-4.0/1.0-2.0 and the optimum tree height = distance between rows/2 + 1.0 m).

4.2. Choice of the variety

Choice of the variety is of particular importance in organic production. The choice of variety is greatly influenced by the site and by farmer inclinations. There is as yet little experience of the use of modern varieties in organic moriculture; also there are some regional differences in the performance of cultivars to climate, diseases and pests. To optimize the choice of cultivars it is very important to obtain regional information on specific cultivar properties testing. It is important to grow more than two varieties. It is also important for every plantation to have a spectrum of varieties appropriate for feeding the silkworms at different instars.

4.3. Fertilizers

Application of fertilizers is based on soil analysis. Soil analyses with information mainly about nitrogen levels, should be carried out at least once every 5 years.

● Nitrogen (N) supply. Only organic fertilizers can be used in organic farming. To make sure that the nitrogen is available to the plants at the time of greatest need, it is important to take into account the time needed to convert the nitrogen to available to plant form (speed of action). Speed of action depends on fertilizer, soil conditions and weather. Only about 10% of the total nitrogen in compost and about 50% of that in cattle manure can be included in the nutrient balance in the first year. In the case of other nutrients, 100% is included. Blood and horn meal or fast-acting commercial preparations can be used if additional nitrogen fertilizers are needed (see Permitted fertilizers and soil conditioners (Annex II to EU Regulation 2092/91) in the Appendix). Excessive amounts of nitrogen encourage harmful organisms, reduce yield and pollute groundwater.

● Phosphorus, potassium and magnesium supply. Sufficient quantities of phosphorus (P), potassium (K) and magnesium (Mg) are usually added to the soil along with organic material (compost or manure). The deliberate addition of these minerals is only advisable if there is some evidence of deficiency.

5. Cultural measures in organic mulberry plantations

5.1. Protection of the soil when using machinery

In organic moriculture, particular care should be taken to use machinery which does not damage the soil. The larger pores in the soil are responsible for aeration and water storage and also serve as habitats for soil organisms. The larger pores are reduced in size by pressure on the soil. Soil conservation is affected by the tractor type, tractor tires, and the number of times vehicles are driven through plantation.

5.2. Tractor design

The degree of damage to the soil by a tractor depends on the weight, which is distributed over the area covered by the tires. Heavier tractor (even if it has bigger tires) will exert greater pressure on the soil. The basic rule is: drive into the orchard as little as possible, and with as light a tractor as possible. Only a light tractor weighing less than 2000 kg, and with broad tires (at least 35 cm), conserves the larger pores of the soil. It is possible to use wheeled or tracked tractors, which take place in viticulture and horticulture. For slopes and habitats with heavy, soggy soil tracked tractors are preferably.

5.3. Care of the soil

Objectives of soil care in organic moriculture are to support the vegetative performance of the tree and to maintain a healthy soil structure and activity. Trees planted with low stem and with closely spaced planting have a small root system, mostly near the surface, which is correspondingly sensitive to competition for water and nutrients. Since herbicides and soluble synthetic fertilizers are not allowed, control of competition from companion plants must be achieved by other methods. Apart from hoeing, which is the most widely used method of soil care; the rows of trees can also be covered with organic materials such as bark mulches or straw.

Basic rules for organic care of the soil are:

● Optimum protection of the soil is guaranteed if the soil is protected by a ground cover crop. The competition to the mulberry tree from the ground cover crop is highly dependent on vegetation and varies depending on climate, soil and tree form.

● The removal of the ground cover in the row of trees depends on the degree of competition at the time.

Nitrogen requirements are highest for the tree in the spring after first leaves phenological phases. This time the competition from a green cover crop is high. The same is true of summer drought and especially after tree pruning for leaves harvesting. Here, too, the roots of the grasses can compete better than the tree roots. For this reason the planting strip often needs to be kept free of weeds in these periods which are critical for mulberry development. In autumn - a period with low nitrogen requirements, a ground cover crop on the planting strip has not negative effect on mulberry trees.

Equipment for under tree soil care: tree row mulcher. Any fast-response mulcher can be used; inter-row sweeper. For sweeping out the leaves and shredding them; mechanical tree row equipment. Three types of machines are available for controlling grass growth; hydraulically driven flat-shares, which cut down vegetation just below the soil surface and shred it with an additional rotor; rotary cutters sometimes give very good results for weed control; disc harrows till the soil either in the direction away from the tree or in the direction towards the tree. This causes considerable displacement of the soil. Disc harrows are more suitable for light soils.

The are some alternative methods of soil care in organic moriculture.

● Ground cover in rows. Ground cover is beneficial for soil structure and prevents erosion and nutrient losses. Sown ground cover is very labor-intensive and does not last long enough, so a natural ground cover is recommended. The row can be tilled mechanically in the spring, when the trees have high nitrogen requirements, or in summer, if there is drought, so that the competition from weeds is temporarily eliminated.

● Mechanical weed control. Good work is possible only if there is little weed infestation. Conserves soil moisture effectively, weeds are left near the trunk.

● Covering with bark. Good suppression of weeds propagated by seed, effect lasts 3–4 years. Helps humus production and prevents drying out and extreme temperature fluctuations in the soil. Only put bark on drained soil. Layer thickness 10 cm.

● Covering with rapeseed straw. Effect on weeds only lasts 1–2 years. Straw can be put down simply by hand or with a machine. Beneficial effects on soil similar to those of bark, but little increase in humus. Covering once provides about 100 kg of potassium/ha per annum. Layer thickness 15–25 cm, 20 bales per 100 m.

● Covering with water-permeable mulch film. 100% effect against weeds, lying can be mechanized. Increases soil moisture content. Films present disposal problems, relatively high costs.

6. Fertilizer application

Under the organic guidelines, commercial fertilizers and fertilizers produced by the grower can only be used. Only after soil analysis is possible to calculate the amount required of permitted fertilizers. Well-balanced fertilizer application enables the soil to make nutrients available to the trees in adequate amounts and helps to keep the trees in physiological balance.

Nutrient requirements of mulberry. One daa of mulberry plantations annually extracted from soil 15-20 kg N, 8-11 kg K, and 3-4 kg P

6.1. Soil testing

Soil testing is a widely used for finding out the specific properties and nutrient content of a soil and monitoring them. The availability of nutrients in the soil depends on the water regime, the type of soil, the proportion of stones and the biological activity. Soil analyses can be divided into two groups. The first group gives a general impression of the soil: type of soil (clay content), humus content and pH. The second group determines the nutrient status of the soil: the water-soluble nutrients that are available to the plants, phosphorus (P), potassium (K), magnesium (Mg) and calcium (Ca), and the reserves of P, K, Ca and Mg. The results of both analyses are used to calculate the fertilizers needed.

6.2. Application of fertilizers in organic farming

All measures available must be made for improving soil fertility in organic farming, including careful soil preparation, avoidance of damage to the soil in tilling, optimization of humus levels and application of farm-produced fertilizers. Optimum soil fertility ensures that mulberry has an adequate supply of nutrients. Readily soluble N, P, K and Ca fertilizers are not allowed in organic production. The commercial fertilizers suitable for organic use are under EC Regulation 2092/91 and can be used only if there is a proven deficiency.

The annual nitrogen requirements of trees are relatively high - about 20 kg N/da. There is an inadequate supply of N in the critical phases of trees. Conversely, even a slight excess of N can lead to the risk of physiological disorders. The incidence of pests and diseases is also increased by excessive application of nitrogen. The N requirements of mulberry vary within the growing season and are essentially limited to the months April to September, with a peak in June. Half of the N requirements in spring are met from the tree’s own reserves.

Only a few N fertilizers, which are mineralized relatively quickly, are permitted in organic farming. This is why the application of N fertilizers needs to be very precisely. Any competition from companion plants in the row of trees must be controlled in time by mechanical tilling. The N supply should be optimized by N analyses. Depending on the humus content, 200-1000 kg of pure N/daa is organically bound in the soil. On average, mineralization releases 7-14 kg/daa of pure nitrogen (N) annually and makes it available to the crops. 1% humus can provide about 3-4 kg of nitrogen/daa annually.

6.3. Organic fertilizers for soil conditioning

Organic fertilizers produced in situ are mainly soil fertilizers and because of their organic matter content - precursors for humus production. If soil analysis reveals that humus levels are too low, application of organic fertilizer is highly advisable. Use of organic fertilizers produced in situ is the best approach of efficient recycling of resources.

Humus containing fertilizers produced in situ are:

● Farmyard manure. Apply well-rotted farmyard manure in late autumn, winter; about 2-3 t/daa. For young trees, covering the planting strip with farmyard manure has been found to give good results.

● Compost. It has followed advantages: ideal source of humus built up by organic matter; rich in nutrients and soil organisms; increases the biological activity in the soil; slow release of nutrients; reduction of nutrient leaching; mineral fertilizers used less or not used at all. After earth-moving work it is advisable to ‘inoculate’ the whole area with farmyard manure or compost (3-4 m^3/daa, 2-3 kg/m^2). When planting, use 10-20 kg (l) per hole.

6.4. Organic fertilizers for supplying nutrients

The main fertilizers available are those derived from animal waste. Recently, because of a shortage of animal waste, use has also been made of plant residues, especially from fruits containing oil - oilseed residues (rapeseed, sunflower, castor beans, grape pips, olives, groundnuts, etc.). Marine algae are also becoming increasingly important because of their high proportion of trace elements and their amino acid content.

● Castor oil meal. This is the residue left after pressing the seeds of the castor oil plant. Castor oil meal is mainly used as a nitrogen fertilizer and soil activator. The amounts used range from 80 to 150 kg/daa.

● Rapeseed, groundnut, sunflower oil meal. These oil meals all still have a high oil content even after pressing; the bulk fibre component is subsequently converted to humus. All these fertilizers are considered to be rich in nitrogen.

● Limes, rock meals and clay. These substances are also used as organic fertilizers. They are used mainly for soil conditioning and to improve composts in a natural way.

6.5. Fertilizers derived from animal waste

● Meat meals and blood meals. Meals and blood meals are available in finely powdered form and are both fairly fast-acting high-quality organic nitrogen fertilizers with 9 and 12% N, respectively. Any fertilizer spreaders which can precisely distribute fertilizers in powder form are suitable for applying them.

● Horn meals. These are obtained from ground animal horns and hooves and are fast-acting. The most finely ground meals are very fast-acting (within 10–14 days), while the meals with coarsest particles in about 8–10 weeks.

● Bone meals. These are particularly suitable for supplying phosphorus and lime to the soil. Before grinding they are treated with hot steam and the fat is removed.

6.6. Foliar fertilizers in organic fruit growing

● Animal proteins in liquid form. Amino foliar fertilizers contain 55% amino acids and peptides and 9% organically bound nitrogen, as well as the nutrients and trace elements naturally contained in animal protein.

● Vinasse liquid fertilizer. Vinasse is an organic liquid fertilizer which is obtained as a byproduct in sugar beet processing. It contains 3-5% nitrogen, 0.14-2.0% phosphate and 5.0-7.5% potassium, together with trace elements, vitamins and enzymes.

The following foliar fertilizers can also be used if there is demonstrable deficiency:

● Calcium chloride in cases of calcium deficiency, against physiological disorders, etc.

● Magnesium sulphate in cases of magnesium deficiency

● Trace elements: boron, zinc, iron, copper, manganese and molybdenum in the form of sulphates and chelates.

7. Plant protection

7.1Principles and aims of organic plant protection

On a piece of land that is farmed (agricultural ecosystem), the living community is highly simplified and often consists of only one or two varieties, and which because of its presence in very large quantities provides favorable conditions for its predators: phytophagous (plant-eating) and phytopathogenic (disease-causing) organisms. These can spread unchecked because they almost have no natural enemies. In agricultural ecosystem some organisms have a ‘disturbing’ effect and man has to eliminate or control by protective measures.

7.2. Human intervention by various methods of plant protection

In organic production, greater importance is attached to preventive methods of plant protection. Since the choice of pesticides is very restricted and they are often less effective, the best possible use must be made of all methods of plant protection in order to achieve efficient results.

Biological pest control takes advantage of the countless antagonistic in order to control the population of harmful organisms. This is achieved in two ways: by control of the environment, with the aim of enhancing the effect of the existing natural antagonists and by propagation and introduction of natural antagonists.

7.3. Pesticides

National guidelines and conditions have been disregarded in listing the pesticides, as they change very rapidly. The organic pesticides are natural substances that have little toxicity.

7.4. Fungicides

● Copper. Mode of action - preventive, kills the germinating spores. Advantages - highly resistant to rain, has very good redistribution on the tree, highly effective against scab. Disadvantages - causes phytotoxic damage on the leaves. Copper is toxic to earthworms. Amount used - not exceed 0.15 kg of pure copper/da perannum, i.e. about 0.25-0.3 kg of the final product.

● Sulphur. Areas of application - mildew, scab, rust mites, pear pox mites. Mode of action - Preventive against fungi, kills the germinating spores. Advantages - sulphur also has an acaricidal effect. Control of mildew in spring also controls rust mites Highly effective against mildew. Disadvantages - temperature-dependent (at least 15-18°C). At higher dosages (over 0.3 kg/daa) and higher temperatures sulphur is harmful to predatory mites. Very poor effect against scab. Amount used - not more than 0.3 kg/daa or 0.7 kg/daa against the pear pox mite

● Calcium polysulphide. Areas of application - against overwintering stages of scale insects on the tree in dormancy, and against scab. Mode of action - corrosive action against overwintering stages, preventive action against scab – inhibits the germinating spores. Amount used - 15-20% as a winter spray (in absolute winter dormancy) 1-2 kg/daa against scab

Conclusions

The main points that should be kept in mind in the establishment and operation of plantations for organic production of mulberry leaves are discussed in detail, as followed:

Criteria for assessment of a site (all the factors associated with climate, location and soil); proper soil preparation which is one of the most important prerequisites for successful organic production; choice of the cultivar and the quality of the saplings; proper planting density and schemes; protection of the soil when using machinery; soil testing; organic preparation of the soil by green manuring, fallow systems and wild-flower strip mixtures; organic fertilization, weed control; disease and pest control.

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Some aspects of organic moriculture in Bulgaria

By

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Abstract: This paper compares the organic and conventional moriculture systems in Bulgarian conditions. Organic agriculture is an alternative production system that avoids the use of synthetic pesticides and fertilizers, and relies on biological pest control and on crop rotation, green manure and composts to maintain soil fertility. The results obtained highlight that organic mulberry plantations would be able to achieve substantial global cost savings if they reached the maximum level of efficiency that their technological restrictions permit. Limitations imposed on organic moriculture by regulatory and technological determinants have a significant impact on the relative efficiency of mulberry leaves production.

As a summary it can be safely said that mulberry is one of the crops can best fit conducting organic and sustainable agricultural production in Bulgaria. The most important evidences for this statement are the following facts: high receptivity against manure, compost and other organic fertilization; annual production of a significant amount of biomass, suitable for re-use in the plantations in the form of compost; limited disease and enemy’s occurrence; full use of mulberry by-products.

Keywords: organic, moriculture, mulberry

Organic agriculture is an alternative production system that avoids the use of synthetic pesticides and fertilizers, and relies on biological pest control, crop rotation, green manure and composts to maintain soil fertility. Since 1991, Organic farming in the EU has been governed by the Regulation (EEC) 2092/91 setting out the rules for labelling a food product as ‘organic’ or the equivalent terms ‘biological’ or ‘ecological’ in other languages. Niggli (2000) studied the ethical values of organic farming and summarised them as follows: respecting and enhancing production processes in closed cycles; stimulating and enhancing self-regulatory processes through system or habitat diversity; using strictly naturally derived compounds, renewable resources and physical methods for direct interventions and control. Besides increased food security and profits for some of the farmers, intensification resulted in environmental impacts as ground water depletion, soil degradation (Giller et al., 1997; Goh, 2011; Gomiero et al., 2011), loss of crop genetics diversity (Thrupp, 2000; Tilman et al., 2002) and increased pesticide concentration in products. Also, according to (Bengtsson et al., 2005; Altieri, 2002), advantages of organic agriculture range from conserving soil to production of quality products with less environmental pollution. On the other hand, the disadvantages of organic agriculture are labour intensive, abundance of natural input materials, and often yield reductions in transition periods (usually 2-3 years) (Prasad, 2005; Tuomisto et all, 2012).

Mulberry (Morus spp.) is a perennial and high biomass producing plant. Also mulberry is the only one forage crop in sericulture for feeding silkworms. The silkworm, Bombyx mori L. as monophagous insect, derives almost all the nutrients for growth and development from mulberry leaves. It has been estimated that, nearly 70% of the silk proteins are derived from mulberry leaves.

In Bulgaria mulberry is ubiquitous and grows well in areas with an altitude till 1000 m. Cultivation of mulberry includes a number of practices and mulberry leaves production is essential for proper development of sericulture. For the production of 50-60 kg of fresh cocoons 1 t mulberry leaves are necessary. The continuous exploitation of mulberry plantations for a long time results in gradual reduction in leaf yield and quality.

As other agricultural production moriculture has undergone significant changes due to new technologies and intensive mechanization and application of chemical fertilizers. However, this proved negative effects on the environment and human health, mainly because of the large areas with mulberry as monoculture and the constant increase of used fertilizers, chemicals and energy in production.

The leaf yield and quality of mulberry depends on the soil type, plant variety and agro-ecological conditions, which reflects on the quality of cocoon production. In Bulgaria, mulberry is cultivated for leaf production and contributes more than 35% for successful cocoon production. Only suitable climatic conditions are not sufficient for the development of sericulture. The determining factor is country economy, the state policy, the development of Sericultural science and introduction of scientific products and invention into practice. Unfortunately at the moment in Bulgaria real sericulture farms are absent. For this reason, it can be argued that the production of mulberry leaves is an extensive organic, but non sustainable production. In the absence of typical silkworm farms and small cocoon production (a family grown once 1 to 4 boxes of silkworm eggs per year) moriculture fully meet the modern definition of organic farming. This sounds good, but in practice in mulberry plantations there is no agrotechnics, except pruning and mowing the grass between the rows.

Therefore extremely low economic efficiency is achieved. On the one hand the production costs of food for the silkworms are extremely low. On the other hand, yields of mulberry leaves are very low and revenue per unit of arable land is very low also. While at normal exploitation 1 daa of mulberry plantation could provide food for three or more boxes of silkworm eggs, now 1 da plantation cannot satisfy the needs of even 1 box of eggs. Mulberry trees do not watered and fertilized except sporadic use of certain quantities of farmyard manure. They are still alive only because of the biological and physiological characteristics of the mulberry tree, which develops strong root system, whose dimensions are larger than the size of the tree crown. In these conditions only the tall trees could existed, while dwarf and bushy die quickly.

It is therefore necessary to shift toward organization of sustainable or organic mulberry and silkworm production. This will become by establishment of new farms, where sericulture will be one of the main activities.

Essential precondition for that transformation are unique characteristics of mulberry and features of moriculture, the most important of which are the following.

1. Low use of energy and resources.

A relatively simple system of agrotechnics can be applied in mulberry plantations, including an autumn ploughing and several surface treatments through vegetation between the rows and in rows strips according to the technical equipment of farms and even with small-scale agricultural machinery.

Soil and plant cover management (tillage) represents the main weakness of organic mulberry farming with regards to its conventional counterpart. Organic farms cannot make use of chemical control to manage plant cover; therefore they have higher labor expenditures that could be reduced by resorting to mechanisation. The absolute predominance of dense tree plantation schemes represents a structural obstacle that must be surmounted in order to improve the chances of successful mechanisation. Mulberry plantations could be established in areas where farmland is less expensive and new plantations can be designed from the beginning to overcome every sort of structural problems.

Mulberry is highly responsive to watering and during its growing season average daily water consumption is about 3 mm. The main source of water is natural rainfall, which are usually insufficient and unevenly distributed. It was found that the conduct of 1-2 irrigations with about 30 m^3 /daa during the summer led to 19-32% increase of leaf yield, and with repeated watering, consistent with the physiological state of the plants the reported excess in yields reached 29-8%. Especially appropriate for mulberry is drip and groundwater irrigation, thus achieving the most efficient use of irrigation water, the optimum ratio between the final production and investments made by possible return on investment dropping to build an irrigation system for 3-5 years.

2. System stability

The self-regulating ability of organic agro-ecosystems can be defined as the capacity to resist the effects of small and large perturbations. Such system stability is important for risk reduction and yield increase, but also for reducing the population densities of harmful organisms and increasing the densities of beneficial organisms. The challenge for an organic farmer is to manage and support all these interactions at different levels of the production system in such a way that his farm can utilize ecosystem functions, such as biological pest control, nutrient cycling and water and soil conservation, to increase output, output stability and resource-use efficiency.

3. Soil management

One daa mulberry plantations annually extracted from soil 15-20 kg N, 8-11 kg K, and 3-4 kg P, as well as certain amounts of S, Ca, Mg, Fe, Mn, Zn, Pb, B, Mo and Cl. Those nutrients are essential for the proper growth and productivity of mulberry.

Under organic management soil loss is greatly reduced and soil organic matter (SOM) content increases. Soil biochemical and ecological characteristics appear also improved:

● Organically managed soils have a much higher water holding capacity than conventionally managed soils, resulting in much larger yields compared to conventional farming, under conditions of water scarcity (Krishna and Bongale, 2001; Rao et al., 2011).

● Soil organic matter has a positive impact on many other soil quality aspects, such as structure, erosion control, water retention and long term productivity (Shepherd et al., 2002). SOM was 7% higher in organic farms compared to conventional farms (King et al., 2004).

● Nitrogen leaching causes contamination of groundwater and indirectly increases nitrous oxide emissions. Nitrogen leaching occurs when more nitrate is available in the soil than plants can use when water from rain, irrigation or snowmelt moves through the soil into the groundwater. (Shepherd et al., 2003). And per unit of area was 31% lower from organic farming compared to conventional farming and 49% higher per unit of product because of the lower levels of nitrogen inputs applied.

● Phosphorus losses contribute to eutrophication of waterways. Many soils have large reserves of phosphorus, but often only one percent is available to crops).

In organic agriculture the basis is the care for building-up soil fertility, which is based on three interrelated components of soil management: the physical (water-holding capacity, structure, etc.), chemical (nutrient dynamics, pH), and biological (soil biota) component. Soil fertility in organic farming could be descripted as well managed soil organic matter, good soil structure, rich soil biota, and a high nutrient and water-holding capacity by using compost and stable manure (Koopmans and Bokhorst, 2000). According to Verma et al. (2012) soil organic carbon is the key component of soil organic matter and includes materials ranging from highly decomposable to very recalcitrant - labile and stabilized fractions. The losses of organic matter in tilled soils occur due to aggregate disruption and microbial action that enhances decomposition rates (Haynes, 2005). Mulberry leaf productivity is dependent on plant nutrients like NPK and is known to respond well to the addition of organic manures. (Shashidhar et al., 2009).

Study of Tzenov et al. (1994) showed that compost from silkworm rearing wastes - mulberry twigs, silkworm faeces and leaf residues contains 77.77%, 12.20% and 20.57% crude protein, could be used in mulberry plantations.

The role of Vesicular Arbuscular Mycorrhiza (VAM) in the nutrition of agricultural crops has received much attention (Tinker, 1978; Baqual et al., 2005). The available information on the combined of mycorrhiza, nitrogen fixing bacteria, phosphate solubilizing bacteria and fungi have indicated their use as enhancement in soil fertility (Subba Rao, 1998). Mulberry plants, whose leaf is exclusively used for rearing silkworms for cocoon production, have indicated their positive response towards application of biofertilizers. The beneficial effect of inoculation of mulberry plants with Azotobacter bio-fertilizer and have been well documented by Das et al. (1994) and Baqual et al. (2005).

4. Plant health; pest, disease and weeds management in mulberry organic farming

Mulberry is attacked by certain pests and diseases, but they rarely inflicted more serious damages. The nature of moriculture - production of leaves, and mode of operation through annual cutting of all vegetative wood helps for prophylactic combat against pests and diseases. Therefore, the use of chemical pesticides is economically inefficient.

Weeds are mentioned as the most significant problem in organic mulberry farming because no herbicides are allowed. This requires knowledge about the population dynamics of weeds and their seed setting. Weed control in organic farming is based on knowledge about how weeds and crops interact, under different weather and soil conditions and different management and control methods (Smith and Gross, 2006). Due to the occurrence of some uncontrolled factors, the farmer must be able to adapt management if field situations so require.

The losses due to pests and diseases in organic farming systems differ, depending on climate, region and farm structure. Growth of the organic sector can be supported if yield stability can be raised by better control of pests and diseases. Like with weed management, pest and disease management depends with the farming system and use of agro-ecological knowledge. It aims at increasing the self-regulating capacity and tolerance to pests and diseases instead of regulation with chemical protectants. The central concept of plant health in organic farming is: good growing conditions and avoiding stress will enhance the natural tolerance of plants to plant competitors.

5. Maintain constant yield stability, Net profit and conservation of natural resources.

In respect of varietal structure in moriculture currently in Bulgaria it can be said that a number of high productive and well adapted to local conditions varieties are distributed into practice. Product of the Bulgarian selection are varieties № 3, № 24, № 26, № 59, № 106, Vratsa 1, Vratsa 18 and Veslets. There are some promising varieties from Japan, as Kinriu and Kokusso 20, 21 and 27.

The reliability of an organic farming system depends not only on yield levels with low inputs but also on yield stability. Although organic farmers may gain relatively more system stability after their conversion period and several years of good farming practices, they still have little external inputs to quickly correct farm conditions during the growing season against undesired environmental stress. The fact that yields in organic agriculture fluctuate much more than in conventional systems has become one of the most important factors that limit the growth of the organic producers.

There is no direct net profit from moriculture due to the nature of the proceedings in sericulture farms. Final product - mulberry leaves are used in sericulture for growing silkworms and producing cocoons. Therefore, we can talk about the artificial separation of the two proceedings, which are inextricably linked because moriculture is forage base of sericulture.

6. Reduced production costs and increased efficiency.

Organic farming requires 84% more land compared to conventional farming in Europe, including moriculture. This is mainly due to lower crop yields and land area requirement for fertility building crops. The average organic yields over all crops in the data were 75% of conventional yields. The main reason for lower organic yields identified in the studies was insufficient availability of nutrients (especially nitrogen) although some studies mentioned problems with weeds, diseases or pests.

The main way for reducing production costs is increasing and stabilizing the production of mulberry leaves. This can be achieved by providing all the necessary conditions and factors for the proper growth of mulberry trees. Therefore optimal levels of agrotechnics, fertilizing and watering must be provided for obtaining maximum yields of nutritious for silkworms mulberry leaves.

Further the efficiency in sericulture farms could be improved by carrying out not one, but several rearings per year with the leaves from the same plantation. It was found (Tzenov and Petkov, 1995) that by parceling of mulberry plantations it is possible to conduct five rearing during the mulberry vegetation. Better economic performance in moriculture can be done by implementation of the latest scientific achievements; proper planning at establishment of new farms and mulberry plantation, and annual planning of technological and cash flows.

Net profit of sericulture farms can be increased also by maximum utilization of mulberry by-products (Petkov, 1997). Its twigs and shoots except for composting can be used as a fence material and for firewood. Unused sericulture leaves can be fed to livestock, especially in the hilly areas of the country. Mulberry fruits are well known as a dessert fruit and can be processed to produce non-toxic drinks and are used in folk medicine.

Sustainability of a crop directly depends on its cost of production (Babu et al., 2011). Naturally, the requirement of nutrients and water increased to a great extent to tap the high yielding potentiality of the newly evolved mulberry varieties. Sericulture depends on two major factors, viz., cocoon price and cost of cocoon production. The NPK inputs recommended for mulberry ultimately makes the cost of cocoon production high. Since sericulture requires less investment than most of the agricultural crops and assures periodical return, it is very much attracted in the rural areas. Babu et al., 2011 and Patil et al., (2014) suggested that the cost of production can be reduced by educating the sericulturists about the optimum use of inputs such as fertilizers, pesticides and practicing Integrated Nutrient Management (INM) and Integrated Pest Management (IPM) approaches on mulberry cultivation. Thus integration of various available organic inputs can effectively curtail the production cost in mulberry.

Many changes are needed in Bulgaria to overcome the constraints and achieve its rich potential in organic agriculture. There are some major problem areas for the growth of organic moriculture nowadays in Bulgaria:

● Absence of proper organization of sericulture.

● Organic manure contains fewer amount of nutrient: The source of organic nutrient contain fewer amount of nutrient so huge quantity of biomass required for supply the optimum amount of nutrient to crops.

● Bio-fertilizers and bio-pesticides are yet not so popular in the country.

● High input costs: The costs of the organic inputs are higher than those of industrially produced chemical fertilizers and pesticides including other inputs used in the conventional farming system.

● Low yields during conversion period: Yield declines during initial two-three year of conversion from conventional to organic.

● Complex certification procedure. There is large number of formalities required to certification of the product and high cost involved is important constraint of organic farming.

In our view, the main challenge for organic farming systems to improve overall sustainability is to increase yields without causing harm to the environment. The main reasons for low yields in organic farms are soil nutrient deficiencies and problems with pests, diseases and weeds. Under carefully controlled management conditions organic moriculture has the potential to achieve yields comparable with those in conventional farming. Further research is needed to improve control strategies for weeds, pests and diseases in organic systems, especially when reduced tillage is used. There is also a need for breeding crops that are suitable for organic farming.

Conclusions

As a summary of everything mentioned here can be safely said that mulberry is one of the best suitable crops for conducting organic farming. The most important evidences for this statement are the following facts:

● The high responsiveness to organic fertilization.

● The annual production of a significant amount of biomass, suitable for re-use in the plantations in the form of compost.

● The lack or limited plant protection against diseases, pests and weeds.

● Full use of all mulberry by-products.

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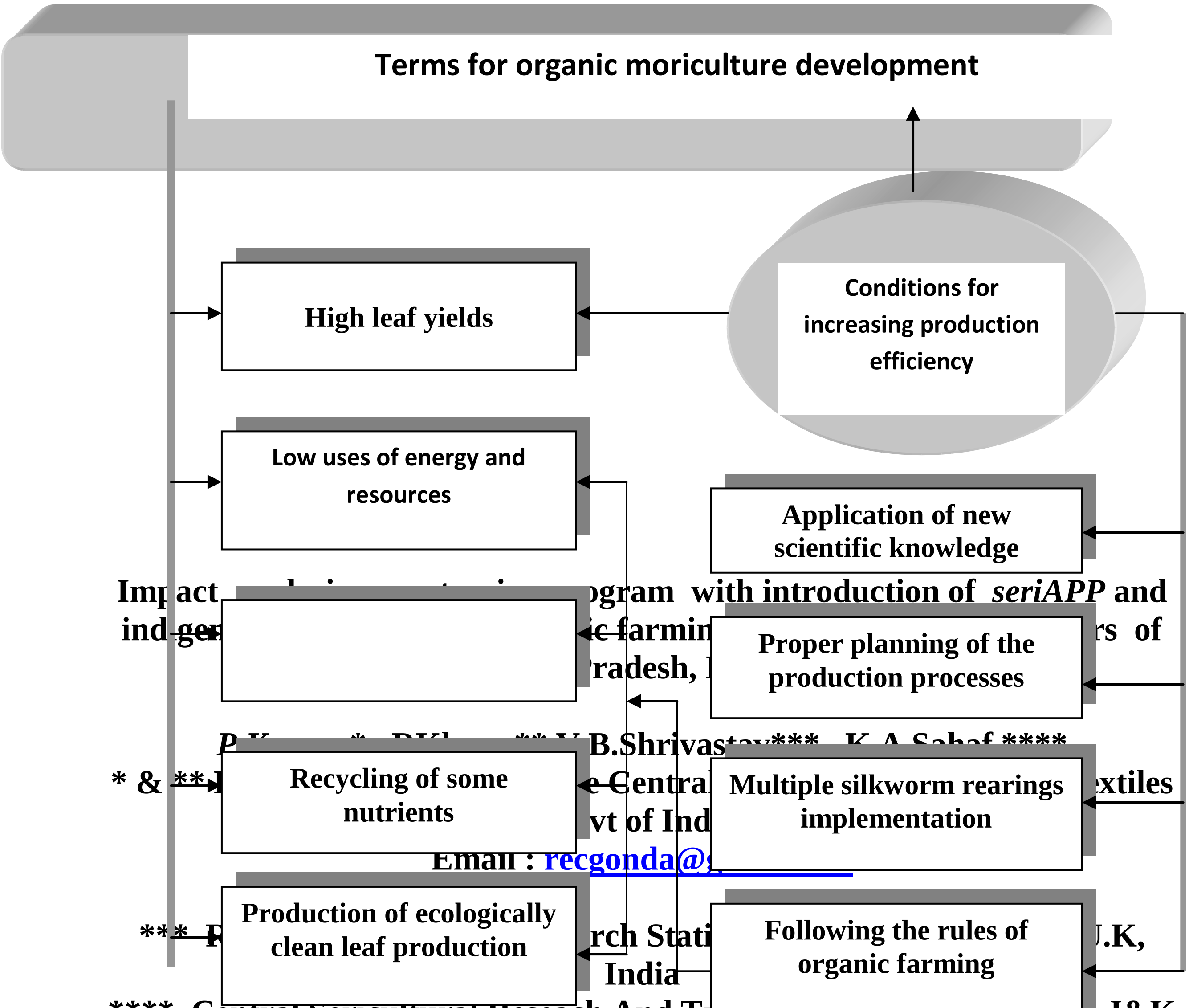

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ABSTRACT

Indigenous technologies such as mulberry plantation on bunds as bush and trees , the use of Inter crops like lentil and marigold and introduction of apiculture boxes in mulberry field as well as effective utilization of waste and unused mulberry twigs and waste cocoons in the preparation of organic handicrafts and use of waste and dried mulberry leaves as organic manure have shown significant acceptance level (≥ 50 %) amongst poor stakeholders with low INPUT of expenditure and high OUTPUT of income The role of *seriAPP* as an extension tool has also been discussed in transmitting the information of organic sericulture at grass root level.

KEY WORDS : Mulberry , Cocoons , organic sericulture , handicrafts and *seriAPP* .

INTRODUCTION

As the agriculture land of Uttar Pradesh India is fertile and the farmers are taking traditionally predominating main agriculture crops like sugar cane wheat paddy and pulses in routine basis as per recommended crop cycle . In the mean time the farmers have been plasticizing sericulture as main subsidiary crop.

Mulberry *(Morrus* sp .) sericulture in Eastern Uttar Pradesh is non- traditional and four crops of *Bombyx mori* L.are being reared with two crops of Bivoltine x Bivoltine and two crops are Mutivoltine x Bivoltine crops . Mulberry plantations have been made both bush and tree type. At Govt. Sericulture Farms economic and bush plantations of S146 mulberry variety at the spacing of 3’x3’ have been made for chawki rearing purpose and providing 100 % chawki reared worms as demonstration and training to the stakeholders. At the farmers level the mulberry plantations have been made at wider distance of 5’ to 6’ on bunds as the land is too fertile and famers can not spare their main land .On bunds both bush and tree mulberry plants are prevalent . Farmers generally take two major crops i.e. Spring and Autumn and two minor crops as in summer and monsoon season. Thus for the whole year they take four crops .

Considering the wide scope of sericulture as per the study made during geospatial survey, it is more liable to take the organic sericulture farming for creating more value addition to the poor stake holders by covering the following concepts:

1- Bush and tree plantation at bunds and its utilization in silkworm rearing.
2- Encouragement to utilize dried mulberry leaves and silkworm waste to prepare vermi compost.
3- Inter copping with Marigold and lentil and putting apiculture boxes in mulberry field.
4- Utilization of waste cocoons and unused mulberry twigs after two times pruning in the preparation of organic silk handicrafts like cocoon garlands, silk rakhi and basket of mulberry twigs.

Several studies have been made (Datta *et al* ; 1992 and Halimani *et al* ; 2001) in inter cropping with mulberry but no studies have been made on organic intercropping with marigold and lentil with mulberry in easten Uttar Pradesh . As regard Apps (Applications) on mobile development , lot of the Apps have been developed in agriculture sector but in sericulture area Apps developed by Munirajune , 2014 (KSSRDI INDIA) is only confined with sericulture calendar and further development by National Mobile Application Development Association and capacity building Program by Govt. of Sri Lanka in 2014 is also restricted to general sericulture . With increasing penetrations of smart phones in India and affordable prices (likely to go down further with the introduction of Android one by Google) it has been considered essential to create mobile Apps in sericulture. Android operating system has the largest share amongst the smart phones in India. Therefore , multiple Apps are being developed for Android and generally other operating system such as windows and IOS (International Operating System) will be worked up on.

In the present study the above concepts have been taken in to the study and the application of indigenous technologies such as mulberry plantation on bunds as bush and trees , use of inter crops like lentil and marigold , effective utilization of waste and unused mulberry twigs and waste cocoons in the preparation of organic handicrafts and also use of dried mulberry leaves and twigs as organic manure and development of *seriAPP* as an extension tool for propagating organic sericulture at farmers level have been studied in detail .

MATERIALS AND METHODS

At an experimental field of Research Extension Centre (Central Silk Board Govt of India) Subhagpur Gonda Uttar Pradesh, India , mulberry bushes of 10 years old (Vareity S146) from a plot of ½ acre of 2420 plant with spacing 6'+3'X2' was selected for the study ..
The mulberry bushes were maintained at the height of 3 feet from ground by doing regular pruning as per standard pruning methodology as mentioned in Fig 1.

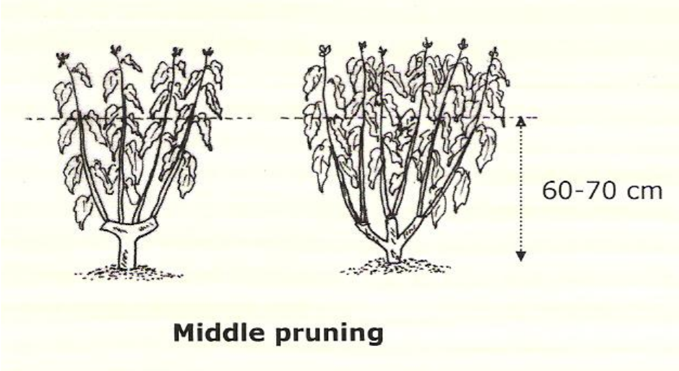

Fig 1. Standard pruning methodology of mulberry .

The 6 feet space between rows were utilized for sowing the lentil seeds during the month of September following the normal sowing methods . Two kilogram of seeds have been sown at the depth of 0.5 inch by broadcasting the seeds in uniform area . A week after light irrigation was provided followed by weeding in the month of November . The flowering starts during Nov- December and light irrigation was applied . Harvesting was done in the month of May by uprooting and after that sun dried following beating and winnowing and yield data were recorded.

Fig 3 Lentil (*Lens culinaris* L.) Seeds

Fig 4 Lentil with mulberry in 6'+3'X2'

In another set of experiment the marigold saplings were planted in the month September in between 3 feet x 3 feet mulberry plantation and marigold flowers were harvested in the month of March . Further two apiculture boxes were also placed in the mulberry fields with marigold as inter crop.
The dried mulberry leaves collected from mulberry fields and silkworm rearing wastage were collected and subjected to compost preparation by using earthworms .Thus harvesting of compost was recorded The flimsy cocoons, emerged cocoons and defective cocoons and floss collecting from de flossing the cocoons materials were utilized in the preparation of cocoon garlands and silk rakhi by following standard methods . The results of above experimentations have been discussed. Further the introduction of apiculture boxes in mulberry field will also

be one of the additional organic sericulture component wherein with the same input the poor stake holders can get additional organic honey of 1 kg from 0.5 acre of mulberry field .

Fig 5 Organic Handicrafts made up of waste cocoons and mulberry

Further *seriAPP* developed with a focus on sericulture and Organic sericulture. The full version designed for Android phones offer uses different tools such as up date market price of silk cocoon, Organic handicrafts, lentil, marigold flowers honey bee cost its procurement and methodology on mobile phones . seriAPP also offers opportunity of connecting “seriAPP WEB “ the online verion of seriAPP. Its applicability have been discussed in detail (Fig 7) The programming has been developed with JAVA IDE for Android (Fig 6)

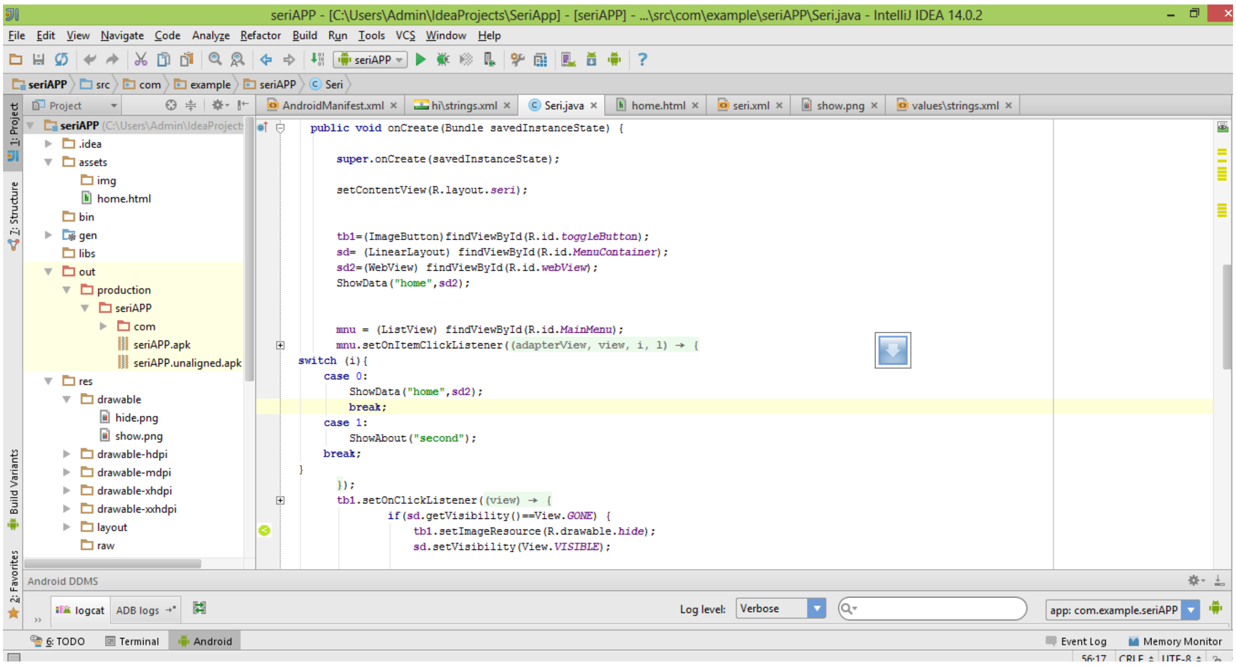

Fig 6 JAVA IDE for Android in the development of seriAPP.

Fig 7 . Main Screen of seriAPP developed for Android and Windows phones (Tablets)

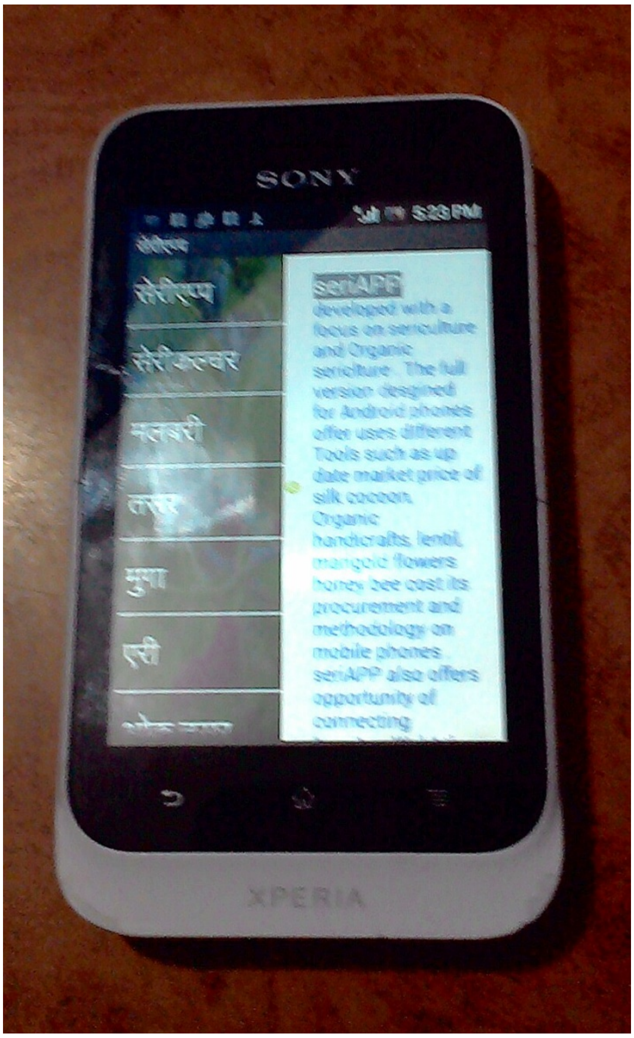

Figure 8: seriAPP on Mobile

RESULTS AND DISCUSSIONS

Out of seven cluster zones of Uttar Pradesh , in Gonda cluster the plantations have been made at the distance of 5feet and as a result with rich fertilser as inputs provided by the farmers to their traditional farming like paddy , the manures after bleaching in mansoon season due to heavy rain increases the leaf productivity of mulberry bush planted on the bunds and thus the mulberry do not require extra expenditure of manure on its growth (Fig 9) .

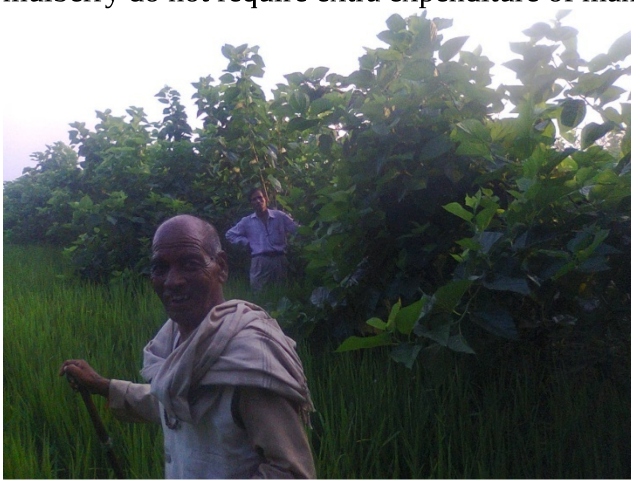

Fig 9 Mulberry on bunds of paddy crop

Table II . Yield of Inter crops

Spacing of Mulberry	Intercrop	Yield	Rate INR/kg
6’+3’X2’ 0.5 acre	Lentil (*Lens culanaris* L)	10 Kg	60
3’x3’ 0.5 acre	Marigold (*Taget* sp.)	20 Kg	30

Table III Organic Products in one crop.

Product	Quantity	Rate INR	Amount INR
Vermicompost	60 Kg	3.00	180.00
Silk rakhi	10	20.00	200.00
Cocoon garland	01	100.00	100.00
Mulberry basket	10	20.00	200.00

As per Table II , lentil planted in area of spacing of 6’+3x2’ in the experimental field resulted 15 Kg of lentil pulse with income of Rs 900 and plantation of marigold in 0.5 acre plantation of 3feet x 3 feet spacing resulted 20 kg of marigold flower @ Rs 30 per Kg in March . Thus ,a total of additional income of Rs 1500 in 0.5 acre reveal its scope in value addition to poor stake holders .In addition to the value addition the mulching of lentil roots in mulberry field also increased fertility of soil and marigold plantation reduced the mulberry pest infestation and no pest infestation was observed ,Marigold (*Tagets* sp) are typically grown for ornamental purposes as bedding plants .Studies have found that that marigold can be highly toxic to plant parasitic nematodes and are capable of suppressing a wide range of nematode including nematodes of mulberry (Wang and Ploeg ,2007). Marigold produces a substance called alpha terthienyl which can aid in reduction of root knot nematodes.
Further the preparation of vermi compost from dried mulberry leaves from the same plot was 60 Kg which returned benefit of Rs 180 . The waste twigs after pruning was utilized in the preparation of 10 baskets with total income of Rs 200 . Further after doing silkworm rearing average yield of 20 kg bi x bi cocoons in 2 crops@ 50 dfls/crop resulted Rs 5000 income . In addition to the silkworm rearing the waste, deformed and defective cocoons were selected and floss of cocoons after de flossing were utilzed in the preparation of 10 silk rakhi of Rs 200 and one cocoon garland of Rs 100 . Thus, a total income of Rs 7180 was generated while before it was Rs 5000 only and at an average of Rs 2180 was an additional income from 0.5 acre of mulberry plantation in one crop . The above economics table IV has been calculated on the basis that no additional input have been provided separately for the above practices except the subsidiary cost of mulberry plantation and silkworm rearing under cluster program.
Further, in order to get popularize this key issue amongst stakeholders in general public and civil society , the development of ***seriAPP*** with informations on organic sericulture will help to know the details like Sericulture , Productvity , Statistics , options for instant calculations , current market rate of cocoon and other like availability and cost of lentil , marigold , honey bee , silk cocoon and mulberry handicrafts associated with this study . The Apps developed are not only useful for for remote location whee desktop PC are not avalable and would also be available to farmers and other stakeholders for extracting information from the web . The mobile Apps will be of free of cost and do not having any royalty on Intellectual Proprty Right (IPR) issue.Description of App and download link is being made available on Google play store.It will also be available on Play Store for any user and seriAPP is having the facility with language option (Fig 8&9)..

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Scientific – technical reports session

Section Moriculture: selection, propagation and cultivation

Possibility of multi-purpose use of mulberry and economic efficiency in the mountain region of Adjara

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Abstract:
The mulberry (Morus) in Georgia is spread everywhere, up to the height of 1600 m above sea-level. It differs in specific variety. Specifics of its use changes according the different climatic conditions.

The leading branch of a mountain zone of Adjara is the animal husbandry. Because of shortages of arable lands the local population for additional forage of animals uses coarse leaves of different plants together with branches. Proceeding from research objectives nutritional value of a mulberry coarse leaves, possibility of their use in animal husbandry in the form of an additional forage and economic efficiency was studied.

It was established, that mulberry coarse leaves according reserve of nutrients for 22-29% exceeds hay of forest and field vegetation, and for 50-55% exceeds the corresponding indicator of deciduous plants. On each 100 kg of the coarse leaves of a mulberry, the exit of air - dry leaves makes 450 kg, i.e. 255 kg of nutritious units. The spent operational expenses make 90 USD, product cost makes 0, 35 USD, and profitability - 101%.

Keywords: Leaf, fruit, seed bud, prime cost, profitability

INTRODUCTION

The mulberry is the most ancient culture in Georgia. It differs in specific variety. Specifics of use of mulberry change according different climatic conditions. Its utilization is possible at the altitude up to 1000 m above sea level, in higher regions is expedient the use of only fruit varieties of mulberry and its polyploidy forms, which are plentifully fructifying, or hybrids with high vegetative weight.

Mulberry fruit has multilateral use for different purposes. Its fruit provide the population with various products, both the raw or dried fruits, with the use of waste-free technology.
Mulberry is distinguished with many useful properties as a fruit plant, it yields useful fruits for the human consumption, and leaves for silkworm feed, it is used for production of alcoholic and soft drinks, provides raw material rich with vitamin and antocians for canning

production, it possesses medicinal properties, it is used as a raw material for production of oil paints and also in textile production.

Mulberry tree is easily bent, the plant can be correspondingly formed and grown as decorative forms, which are used as shadow trees in squares and gardens, in strips plantings along the roads and rivers, along irrigation channels, in the form of wind-shelter and field-protecting live fences on personal plots, etc.

Mulberry tree is used for aforestation of gorges, slopes and for prevention of a soil erosion. In such cases, for soil conservation are used hybrids with powerful root structure.

Mulberry is characterized by rapid growth, its fruit forms are used for afforestation of slopes as the fallen fruits and leaves form a dead cover for the growth of new plants. Fruits in its turn attract birds and animals that cause accumulation of organic litter.

Mulberry timber is characterized by high physical and mechanical properties, resist dampness (up to 15%), it is considerably hard and easily bent, therefore it is convenient to use its timber for production of wood ware (jugs for storage of wine or water), it increases aroma of the wine, softens the water and improves its properties. For these purposes are used old, overripe and even dried trees.

Annual branches of mulberry contain tannins in large amount (up to 32%), from them are made baskets, and wattled ware. They are used for different purposes as a fence or props for plants. For this purpose mulberry branches are more effectively used in the mountain regions of Georgia. Expediency of utilization of mulberry timber was studied on the example of village Merisi of Keda region.

OBJECTIVES AND METHODS

The part of mountainous and highland Adjara is characterized by strong and average erosion, that often leads to the exclusion of territory from agricultural turn. The destroying influence of erosion is considerably decreased by elevated parts of vegetable cover – especially leaves, and root system. From this point of view mulberry plant plays significant role, as a broad-leaved, fruit plant with powerful root system and dense wood. Therefore it is natural, that interest of its use for economic purposes considerably increases.

In the mountainous region of Adjara, along with plant growing the leading branch is animal husbandry. Because of shortage of arable and cultivated areas the local population for cattle feed uses rough leaves of plants together with branches. In comparison with the rough leaves and branches of forest plants (beech, hornbeam, oak, etc.), use of rough leaves and branches of a mulberry is more effective owing to the following economic reasons:

1. Mulberry fruits can be used for production of various food by country population for family needs.
2. Young leaves of mulberry can be used for feeding of silkworm for replenishment of the family budget.
3. Rough leaves and branches of mulberry can be used more intensively, as mulberry better endures heavy cutting in comparison with the other perennial plants.
4. Fruits and leaves of mulberry are useful not only for livestock, but also for the other animals and birds. Mulberry produces large quantities of highly digestible forage, high in protein.

According to the scientists (G. Nikoleishvili, 2005) at the utilization of 40% of the leaves it is possible to receive 8000 kg of raw materials, which will promote providing animal husbandry with natural forage.

RESULTS AND ANALYSIS

Due to its high nutritive value, tree foliage is being increasing recognized as a potentially high Quality feed resource for ruminants, particularly to supply crude protein, which could then be used in the diets for mono-gastric animals. However, little information is available on the nutritional values of mulberry leaves as animal feed.

Purpose of our research was amplifying of animal feed source with raw materials, and in the next prospect - studying of nutrition value of mulberry leaves' flour - an additional cheap feed for animal husbandry. The present study was conducted to evaluate the nutritive value of mulberry leaves, which were sampled from different varieties at different stages of maturity. The chemical composition of the rough leaves of mulberry was studied. For the research were taken mulberry leaves of the varieties: Georgia, Tbilisuri,Hybrid-2 and Triploid-13. The fodder value of leaves in natural and dry matter was determined. Data is given in Table 1.(see Table 1.)

Table 1

Chemical composition of mulberry leaves of different varieties

12.05.2014.

№	Variety	condition of sample	composition %					
			water	ash	fat	fibres	protein	nonnitric extr subs
1	Tbilisuri	natural	75,19	3,07	1,24	3,60	4,59	12,31
2		dry	7,31	11,46	4,62	13,45	17,15	46,01
3		abs.dry	–	12,36	4,98	14,51	18,50	49,65
Nutritional value of leaves in natural condition –0,22 nutr.unit Dry–0,30 nutr.unit.								
4	Gruzia	natural	70,64	2,80	1,48	4,87	3,80	16,41
5		dry	7,86	8,78	4,63	15,27	11,93	51,53
6		abs.dry	–	9,53	5,02	16,57	12,95	55,93
Nutritional value of leaves in natural condition - 0,21 nutr.unit Dry –0,34 nutr.unit								
7	Hybrid–2	natural	71,34	3,47	1,37	4,97	5,83	13,02
8		dry	6,87	11,28	4,44	16,15	18,95	42,31
9		abs.dry	–	12,11	4,77	17,34	20,35	45,43
Nutritional value of leaves in natural condition - 0,24 nutr.unit Dry–0,37 nutr.unit								
1	Hybrid –2 roughage	natural	71,67	3,77	2,03	4,14	4,30	13,09
2		dry	5,38	13,05	7,01	14,32	14,87	45,37
3		abs.dry	–	13,80	7,41	15,14	15,72	47,93
	Nutritional value of roughage in natural condition – 0,48 nutr.unit dry–0,52 nutr.unit							
8	Triploid–13	natural	44,11	11,4	4,4	10,9	8,45	20,71
9		dry	9,1	18,6	7,1	17,8	13,8	33,7
10		abs.dry	–	20,4	7,85	19,6	15,1	37,0
	Nutritional value of leaves in natural condition -0,25 nutr.unit Dry–0,31 nutr.unit							

As it is shown in Table 1, the content of nutrients is higher in leaves of production varieties, also nutritional value of a leaf both in natural and dry matter is respectively higher. From this point of view are distinguished the leaves and branches of mulberry variety Hybrid-2.

In spite of the fact that nutritional value of leaves of the variety Triploid-13 is slightly lower, for the mountain region we consider more expedient the use of the variety Triploid-13 for several reasons:

1. The variety Triploid-13 plentifully fructifies, its fruits possess useful properties, both for the human and poultry.
2. Develops powerful root system thanks to which it is more effective for slopes aforestation and preservation of soils structure in erosion dangerous zones.
3. It is characterized by intense growth of branches, forms a large number of growing shoots that is in direct correlation dependence with leaf formation abundance.

As a result of analysis of the data given in Table 1, it is clear that mulberry leaf has quite rich nutrients balance. Nutritional value of rough leaves and branches of mulberry variety Hybrid-2 is optimal for animals (0,5 nutritive unit). It should be noted that the leaves before falling are full-fledged.

For comparison we provide data on a chemical composition of leaves of different plants. (see tab. 2).

Table 2

Chemical composition of leaves of different plants

№	Name	dry matter in 1 kg	1 kg dry matter					nutritiousness	
			crude protein	crude fat	crude fibre	non-nitric extract substance	ashes	nutr.unit	%
1	Leaf of a mulberry	855	139,5	29,0	249,5	427,7	115,5	0,48	100
2	Clover hay	830	151,8	31,3	294,0	437,1	84,0	0,54	112,5
3	Lucerne hay	850	177,7	28,2	301,1	393,0	100,0	0,50	104,2
4	Meadow grass	850	98,8	30,6	300,0	495,3	75,3	0,42	87,5
5	Mixture of grain and bean	850	143,5	28,2	310,6	429,4	88,2	0,44	91,7
6	Hay of deciduous plants foliage	840	101,2	30,9	286,9	501,2	79,8	0,46	95,8
7	Birch leaf	407	137,4	54,0	211,3	533,2	63,9	0,40	83,3
8	Maple leaf	890	49,4	68,7	238,2	529,1	113,5	0,27	56,2
9	Aspen leaf	320	53,1	68,8	225,0	565,6	31,5	0,26	54,2
10	Grass flour	880	136,4	26,1	283,0	446,5	102,2	0,51	106,2

As it is clear from data , mulberry leaf in nutritiousness exceeds the corresponding indicators of grain and bean mixture, and the leaves and flour of other deciduous plants. It slightly concedes only to indicators of hay and flour of Lucerne and clover grass mixture, difference within 4-12%. The forage received from 1 t of mulberry leaves contains dry matter - 855 kg, crude protein -139,5 kg, crude fat - 29,0 kg, crude fiber - 249,5 kg, carbohydrates -427,7 kg, mineral substances - 115 kg and other biological active elements -41 kg. Nutritional value equals 480 nutritious units. The forage produced from mulberry leaves can be used for animal feed. With the fodder produced from mulberry leaves it is possible to replace 30-35% of hay for livestock, in rabbits diet - 25-30%, for sheep and goats -50-60%, also it is possible to use it for growing fish in ponds and for domestic poultry with success.

According to our supervision, hay additive from mulberry leaves in winter feeding of animals resulted in good effect - milk yield increased.
Operational costs of production of flour from rough leaves of mulberry were studied and economic efficiency was defined. Results are presented in Table 3 (see Table 3)

Table 3
Operational expenses, prime cost and profitability of rough leaves, flour and branches of mulberry

№	Indices	quantity unit	amount, hectare	Price (Lari)	
				of a unit	total
1	The rough leaf of a mulberry in a natural condition	kg	1000	10,0	100
2	Dry matter of mulberry leaf	kg.	450	0,80	350
3	Nutritional value (Nutr.unit)	kg	255	1,50	380
4	Operational expenses: Cutting of branches, carrying to the road, delivery, drying, storing	resource/ day	2,0	10	20
5	Caring costs of mulberry plantings	resource/ day	15,0	10	150
6	General factor cost (4+5)	–	–	–	180
7	Prime cost of the production	Gel	–	–	0,7
8	Profit	Gel	–	–	200
9	Profitability	%	–	–	101

With the carried-out work it was confirmed that mulberry leaves hay in many respects surpasses hay of other broad-leaved plants in the content of nutrients and the hay from of the grain and bean mixture used in animal husbandry.
Nutritional value of mulberry leaf equals 0,48 fodder units, and according to the contents exceeds the corresponding indicator of meadow hay for 6,0% and hay from leaves of deciduous plants for 21,0 - 22,0%.
From the data provided in the table, it is visible that from 1000 kg of the roughen in the autumn mulberry leaves is possible to receive 450 kg of dry hay, which fodder value equals 255 kg fodder units. Operational costs of production equals 180 GEL (18 resource/day X 10), product cost makes 0,7 GEL, and profitability - 101%.

CONCLUSION

Therefore, per each hectare of mulberry plantation in mountain zone of distribution of silkworm breeding, total income from mulberry leaves exceeds a corresponding indicator of the areas occupied under hay in 2,5-3,0 times.
For the purpose of production of non-conventional additional forage for animal husbandry, utilization of the roughened in the autumn mulberry leaves (roughage, flour) is economically justified and is organizationally feasible.
Proceeding from the above-noted, farmer “homestead” silkworm breeding in mountain and lowland conditions has to develop taking into account requirements of the market economy.

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The mulberry (Morus) in Georgia is spread everywhere, up to the height of 1600 m above sea-level. It differs in specific variety. Specifics of its use changes according the different climatic conditions.

The leading branch of a mountain zone of Adjara is the animal husbandry. Because of shortages of arable lands the local population for additional forage of animals uses coarse leaves of different plants together with branches. Proceeding from research objectives nutritional value of a mulberry coarse leaves, possibility of their use in animal husbandry in the form of an additional forage and economic efficiency was studied.

It was established, that mulberry coarse leaves according reserve of nutrients for 22-29% exceeds hay of forest and field vegetation, and for 50-55% exceeds the corresponding indicator of deciduous plants. On each 100 kg of the coarse leaves of a mulberry, the exit of air - dry leaves makes 450 kg, i.e. 255 kg of nutritious units. The spent operational expenses make 90 USD, product cost makes 0, 35 USD, and profitability - 101%.

Physical-chemical Characteristics of Some Mulberry Species and Prospects of their Application

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Key words: species, anthocyans, cellulose, volatile acid, preserves, jam, sauce, syrup

Focused application of fruit is still urgent for obtaining high quality, natural, diverse food products for the provision of the country and for their export to international market. Therefore it is necessary to select objects, which contain potential quantity of urgent components and to develop technology for obtaining the products balanced by vital components which are necessary for human organism. The significant trend in a matter of satisfaction of demands in food products is application of less used and nontraditional local vegetable raw material.

With the view of modern medicine fruit is considered as necessary component to keep health, and this is closely associated with antioxidant properties of fruit [1,2,3,4]. These properties contribute to protection of organism from free radicals. It has been proved that it is namely a result of impact of free radicals that various diseases such as cardio-vascular, diabetes mellitus, cataract, cancer and others are developed. Specific attention to fruit is conditioned by composition of anthocyans. Lately pharmacologic interest to fruit has been increased greatly. With this in view specific interest is focused on mulberry, which is widely spread in Georgia and is practically not used in food industry. Mulberry is a phyto-nutrient of a body. It contains anthocyans in great quantity. Total anthocyans, such as cyanidine-3 glycoside equals to 147.68 – 272.46 mg/l [5,6]. Scientific studies have shown that mulberry fruit protects a body from malignant cancers, ageing, nervous diseases, various inflammation and bacterial infections and diabetes mellitus [10]. Mulberry fruit contains natural antioxidant –resveratrol, which protects human body from stroke. It changes molecular mechanism of vascular system and participates in their dilatation [7.8.9.17.18.19]. Mulberry contains in great quantity vitamin C, which is a natural antioxidant. It helps a human body to work out resistance to infections, it decreases inflammatory processes and protects from the effect of harmful free radicals. Mulberry is also rich in antioxidant flavanoids such as: beta-carotin, zeaxanthin and lutein, which significantly reduce a risk of malignant cancer of lung and pancreatic gland. Zeaxanthin is a dietary carotinoid, which protects eye retina from ultra-violet rays. Mulberry is rich in vitamins, mineral components. It contains great quantity of iron. Fe is a component of hemoglobin in erythrocytes and contributes to oxygen transportation [7.8.9.17.18.19].

We have selected mulberry varieties “Gruzia” “Khartuta” and “Ganjuri”, widely spread in Georgia. Phytochemical characteristics of fruit of these varieties are less studied with the view of obtaining modern brand products.

Research goal is evaluation of the above referred varieties according to their phytochemical properties.

Various form products have been prepared: mulberry jam, mulberry preserves, juice, sauce, sour fruit juice, treacle/syrup, mulberry wine and vinegar. Organoleptic and phytochemical analyses of the obtained products were performed.

Phytochemical data of leaves of mulberry varieties “Gruzia“ and “Hybrid 2” were studied.

Results and discussion. Research frame encompasses the issues connected with each other. According to the phytochemical data the above stated mulberry varieties differ greatly from each other. Substantial difference is observed in total content of anthocyanides and it equals to 1850– 917.7mg/kg. (Table 1.)

Table1

Phytochemical characteristics of mulberry varieties

Parameters				

Dry substance%		14.2	15.1	GOST28562-90
Total sugars g/dm^3	16.4	12.8	14.5	GOST8756.13-87(MA-E-AS311-01)
Ash, g/100g	0.60	0.51	0.78	N.2676/90EC(Euro regulations)
Sum of anthocyanes,mg/dm^3	801.5	-	749.11	OIVMA-E-AS315-11
pH	5.93	6.40	3.70	GOST8756.16-70
K,mg/100g	385.01	373.57	380.83	GOST30178-96,GOST26929-94, At-adsorb.spect.Analyst400.
Na,mg/100g	4.81	9.60	1.72	GOST30178-96,GOST26929-94, At-adsorb. spect.Analyst400
Fe,mg/100g	6.62	3.64	4.66	GOST30178-96,GOST26929-94, At-adsorb. spect.Analyst400
Ca,mg/100g	45.2	26.8	30.23	GOST30178-96,GOST26929-94, At-adsorb. spect.Analyst400
vitamin C, mg/%	35.0	11.8	34.3	By Tilman's reagent

Various form food products were prepared based on phytochemical characteristics . Procedures of their making were based on the demands of traditional technologies, but they contain innovative elements: inverted sugar syrup and dry wine yeast were used for initiation of alcoholic fermentation. While developing the technologies we have to consider recommendations of the World Health Organization (WHO,2003) and demands of EC regulations of (EC 1924/2006), according to which rate of application of saccharose is to be reduced markedly [15,16], while in jams – content of pectin. Mulberry contains pectin compounds in low quantity. Pectin compounds of mulberry fruit are characterized by low molecular weight, by not very high grade of etherification and high rate of purity (content of galacturonic acid). It is known that pectin compounds of such characteristics create rather weak jelly. White mulberry is characterized by formation of jelly, red mulberry too is characterized by this property while the black mulberry doesn't form jelly at all [11,12].

The research object is a source of very vital components, with the nutritive food and therapeutic point of view. Various type food products were prepared on its. These are: mulberry preserves, jam, juice, sauce, sour juice, syrup, mulberry wine and vinegar. Organoleptic and phytochemical analyses of the obtained products were performed. Characteristics are given in Table 2, which show that they meet the demands stipulated for such products.

Table 2.

Characteristics of products obtained from mulberry

Investigated specimens	Dry matter GOST8756.2 %	Total sugars GOST 8756.13-87 g/dm^3	Carbohydrates GOST 8756.13-87 %	Alcohol% GOST 13191- 73 %(vol)	Volatiles GOST 13193-73
preserve	49.2	60.2	23.4		
jam	42.0	19.3	18.4		
juice	10.5	13.0	12.8		
syrup	35.5	37.5	36.9		
sauce	32.2	-	20.0		
sour juice	40.5	-	-		
wine	-	-	-	9.6	1.4
vinegar	-	-	-	-	3.1

Studies have proved that nutritive value of mulberry leaves depends on mulberry varieties, agrotechnology and exposition, on nutritive value of definite nutrients (proteins, carbohydrates and fats) [13,14]. Thanks to its rich phytochemical composition, it is used in folk medicine as a means to reduce sugar in blood. Modern medicine has studied active material of mulberry leaves and the mechanism of its action. This compound is 1-deoxynoiirimicine (DNJ), which is characterized by a capacity to reduce sugar in blood [20,21,22].

Table 3.
Phytochemical characteristics of mulberry leaves

Specimens	Dry matter GOST8756.2	Total sugars GOST 8756.13-87	Proteins GOST13496.4-84	Carbohydrates GOST8756.13-87
1.“Gruzia”, leaflet	89.5	5.1	14.4	13.46
2. „Gruzia“	89.2	5.1	11.6	12.94
3.Hybrid 2 –leaflet	90.25	7.2	20.6	14.98
4.Hybrid 2	90.23	7.2	17.8	14.38

According to phytochemical indices of the leaves (Table 3) protein and carbohydrate compositions of leaflets of upper layer of both specimens exceed those of leaves of lower layer. Besides, indices of leaves of “Hybrid 2” are higher than those of “Gruzia”, which refers to high nutritive value and enables to use widely these leaves for making food admixes and for application in sericulture.

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STUDY ON THE MAJOR ECONOMIC CHARACTERISTICS OF MULBERRY FRUITS OF *MORUS ALBA* L. SPECIES

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ABSTRACT

In the current century man spent on more clean organic food. Particular attention is paid to more unpretentious to growing fruits , with similar characteristics as equal to or higher than those traditionally used by man.
The aim of the study is to examine the contents of the main indicators of the mulberry fruit ripening period , color , size of the fruit.

The study was conducted in Web of Agricultural University - Plovdiv in 2012-2014, to investigate three groups were composed of three versions with three repetitions.
Options 1 and 2 are selected from different parts of Bulgaria and grafted on the web. Option 3 is the variety Kinriu .
Investigated the length of leading shoot , number of buds , flowering period , period of maturation , percentage of first maturity , size, duration of zreene.Protsent sugars and acids
It was found that the mulberry fruits have different colors , sizes and simultaneity of ripening .
In mulberry fruits contained sugars and organic acids similar to those of grapes and apples .

Key words: Morus alba, fruits

INTRODUCTION

In the current century, looking for more clean organic food, people are paying more attention to fruit crops that are unpretentious to the growing conditions and have characteristics and nutritional qualities similar to or better than the traditionally consumed by humans.

Rearing mulberry silkworm is inherently an ecologically friendly organic production. Mulberry silkworm is a unique biological phenomenon, intolerable to pesticides applied in food. The presence of pollutants in the air, soil and water leads to physiological disorders, which have a negative impact later in rearing the silkworms. The food used – mulberry leaves, are free of any pollutants. Ecological cultivation of mulberry (*Morus alba* L.) is the basis for the development of organic sericulture. Man has long used mulberry fruit for food in a different form – fresh, processed or dried. Mulberry fruits are a real challenge for targeted use in human food. *Morus alba* L. species form catkins, which later develop into fruits of berry type. They are different is size. Ripe mulberry fruits come in different colors, mainly white, pink and black. Grown throughout the years, man found out the wonderful qualities of mulberry fruit species and started using them for food. (Jiang, Y., Nie, W.-J.) Analyzing black mulberry fruits, it was established that they have the richest content of total flavonoids and monomeric anthocyanins. Those results are quite useful in selecting mulberry species with an abundance of nutrients and phytochemicals. (Liang, L. , Wu, X. , Zhu, M. , Zhao, W. , Li, F. , Zou, Y. , Yang, L.)

Morus atropurpurea is characterized by a high nutritional value and antioxidant activity, which could be beneficial for the development of healthy food. (Liang, L. , Wu, X. , Zhu, M. , Zhao, W. , Li, F. , Zou, Y. , Yang, L.)

The total content of soluble solids in mulberry species varies between 15,9% (*M. rubra* L.) and 20,4% (*M. alba* L.), the acid content is from 0.25% (*M. Alba* L.) to 1.40% (*M. nigra* L.), pH is from 3.52 (*M. nigra*) to 5.60 (*M. alba*), ascorbic acid is between 19,4 mg/100 g (*M. rubra*) and 22.4 mg/100 g (*M. alba*), respectively. The mineral content in the mulberry species is 0.83% N, 235 mg/100 g P, 1141 mg/100 g K, 139 mg/100 g Ca, 109 mg/100 g Mg, 60 mg/100 g Na, 4.3 mg/100 g Fe, 0.4 mg/100 g Cu, 4.0 mg/100 g Mn and 3.1 mg/100 g Zn, respectively. (Ercisli, S., Orhan, E.)

The period of ripening of mulberry fruits, their coloration, acidity and fermentation are similar to grapes of different cultivars. Such investigations in grapes were carried out by (Ireneusz Ochmian, Piotr Chelpinski, Rafal Rozwarski, Agnieszka Dobrowolska, Ludmil Angelov, Bojan Stalev)

The aim of the present study was to investigate local new unbred selected samples and varieties introduced in Bulgaria. The following characteristics were studied: the annual shoot length, the number of buds, the period of flowering, the period of fruit ripening, the sugar and acid content of mulberry fruits.

MATERIAL AND METHODS

The study was carried out on the Training and Research Site of the Agricultural University – Plovdiv in the period 2012-2014. Three groups of three variants, numbered 1, 2, 3, were formed for the study, the trees being in the third year of vegetation.

Variants 1 and 2 were collected from different regions of Bulgaria and grafted on the Training and Research Site. Variant 3 was an introduced sample of the Japanese variety Kinriu.

Shoot length in cm, the number of buds, the period of flowering, the period of fruit ripening, the percentage of ripened fruits at the first ripening stage, major coloration of the fruits and the duration of the ripening period in days were studied, as well as the sugar and acid content of the mulberry fruits in mg/100 g.

RESULTS AND DISCUSSION

The investigation during the period of ripening showed that the fruits of the studied variants were coloured in pink, red or black. White and amber fruit coloration was also reported in breeding practice and in literature data. The major fruit colours of the studied samples are presented in figures 1, 2 and 3.

Figure 1

Figure 2

Figure 3

The measurements conducted after leaf fall showed that the mean length of the mature shoots of the two studied variants were 11.33 sm in Variant 1 and 26 sm in Variant 2, respectively, shorter than the shoot length in Variant 3 (Tabl. 1). The mean error in the studied variants is comparatively small, while in Variant 3 it is quite high. That trait corresponds to the results about the number of buds on the shoots, which are also presented in the same table. The largest number of buds were reported in Variant 3 – 31,66 buds in average for the period. In the two studied variants the number of buds is 24.66 in Var. 1 and 17.66 in Var. 2, respectively. The data in Table 1 shows that the variations of those characteristics are not great in the separate years of the study. The small differences are due to the precipitations during the separate years.

Table 1

Variant	Shoot length, cm					Number of buds				
	2012 x	2013 x	2014 x	x for the variant	S_x	2012 x	2013 x	2014 x	x for the variant	S_x
1.	142	128	135	135	4,04	25	20	29	24,66	3,68
2.	121	115	125	120,3	4,10	18	15	20	17,66	2,05
3.	138	145	156	146,33	7,40	28	32	35	31,66	2,86

The beginning of flowering is a trait indicating the beginning of the vegetation process. The three variants had different periods of flowering. Variant 3 was the earliest to flower and Variant 2 – the latest. That characteristic has a direct impact on the first ripening stage (Tabl. 2). Variant 3 was the earliest ripening, in average for the studied period. The earliest date of its ripening was reported in 2013 – on 18 May, and the latest date was in 2014 – on 24 May. The latest date of fruit ripening was reported for Variant 2 in 2012 – on 30 May.

The earliest ripening date for that Variant was on 25 May in 2013. Relatively constant period of ripening during the years of the study was established in Variant 1.

The results about the percentage of ripened fruits at the first ripening stage are presented in Tabl. 2. The highest percentage was reported for Variant 2 – 21.33%, and the lowest for Variant 3 – 17%.

Table 2

Variant	Date of flowering			Date of ripening			First ripening stage, %				
	2012 x	2013 x	2014 x	2012 x	2013 x	2014 x	2012 x	2013 x	2014 x	x for the variant	S_x
1.	29 April	5 May	2 May	22 May	24 May	23 May	15	18	13	15,33	1,45
2.	1 May	7 May	10 May	30 May	25 May	29 May	21	24	19	21,33	1,45
3.	25 May	22 May	29May	20 May	18 May	24 May	17	15	19	17	1,11

An important indicator showing the possibility of using mulberry fruits for fresh consumption is the duration of the period of ripening. The longest period of ripening was reported for Variant 1 – 67.66 days in average for the period of study and the shortest one was established for Variant 3 – 54.23 days.

The total sugar content per 100 g of fruit is presented in Tabl. 3. The highest content for the study period was established in Variant 1 (8.51 g/100 g in average) and the lowest – in Variant 2 (8.05 g/100 g).

Ascorbic acid is among the most important acids contributing to fruit taste (Tabl. 3).

Table 3

Variant	Duration of the period of ripening				Sugar content, g/100 g					Ascorbic acid content, mg/100 g				
	2012 x	2013 x	2014 x	x for the variant	2012 x	2013 x	2014 x	x for the variant	S_x	2012 x	2013 x	2014 x	x for the variant	S_x
1.	65	66	72	67,66	8,23	7,51	9,03	8,25	0,43	29,4	21,34	20,54	21,43	0,53
2.	52	54	57	54,33	8,56	7,14	8,45	8,05	0,45	21,63	20,96	21,49	21,36	0,20
3.	58	60	67	61,66	8,17	8,13	9,24	8,51	0,36	19,85	22,03	20,94	20,94	0,62

The highest content of ascorbic acid was reported in Variant 1 – 21.43 mg and the lowest – in Variant 3 – 20.94 mg.

CONCLUSIONS

Based on the observations, studies and the analysis made, the following conclusions can be made:

Mulberry fruits of the studied variants come in pink, red and black color. Mulberry trees have different lengths of the annual shoots, varying from 120,33 cm to 146,33 cm and different number of buds ranging from 17,66 to 31,66 in average. They ripen at the same time and they have a long period of ripening, varying from 54.33 to 64.66 days in average.

The content of sugars in the studied variants is from 8.05 g/100 g to 8.51 g/100 g and the content of ascorbic acid is from 20.84 mg/100 g to 21.43 mg/100 g.

Mulberry trees are suitable to be planted as a garden species, as well as in compact plantations for producing fresh fruits for a long period. The good sugar to acid ratio of the fruits makes them a healthy food for people.

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Section Silkworm genetics and breeding

Study on some silkworm, Bombyx mori L breeds susceptibility to artificial diet feeding

By

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ABSTRACT

The study has been carried out at the educational and experimental facility of the Silkworm breeding section of the Faculty of Agriculture at Thrakia University in Stara Zagora, Bulgaria. The studied 115 silkworm breeds originated from SAES-Vratsa and AF-TrU, and constituted a major part of the genetic bank of Bulgaria, were reared with artificial diet with 25% content of mulberry leaf powder.

In order to detect the susceptibility to artificial diet feeding of the breeds analyzed the larval viability in the 1st, 2nd and 3rd instars was determined.

The results obtained show that 84.35% of the breeds analyzed exhibit over 70% viability in the first instar. In the process of larval growing however the larval viability decreases so that 64.35 % of the breeds tested perform over 70% viability in the second instar while only 39.13% of them in the 3rd instar.

The highest larval viability in the whole three instars and the highest susceptibility to artificial diet feeding, respectively manifest the breeds "E-31", "Line 22", "Ukrainian 20", "Syria 1" and "Vratsa 38", which gives reason to believe that they are the most promising in this direction.

The comparatively high percentage of survival rate established in the majority of the breeds analyzed in the first instar is indicative for the presence of biological potential for rearing them on artificial diet.

Key words: breeds; Bombyx mori L.; silkworms; artificial diet; sericulture.

INTRODUCTION

The study of the food habits of *Bombyx mori* L. Is one of the main factors related to species productivity, increase of the number of yields per year and the distribution area.

The domesticated silkworm appears to be a considerable molecular genetic resource of important economic significance for solving a wide range of biological issues (J. Nagaraju, 2000).

Studies on raising silkworm on artificial diet feeding started as early as 1960. That made it possible for fresh mulberry leaves to be substituted by non-conventional food sources thus widening the opportunities for rearing and conducting studies with Bombyx mori under laboratory conditions (Ito, T. and Kobayashi, 1978).

In recent years in countries with developed sericulture intensive work is carried out for making recipes for artificial mixtures. According to their composition they contain chemical compounds or chemical compounds and mulberry leaf meal (Ito, 1961, 1965, 1966; Horie & Watanabe, 1969; Kim, 1979; Horie, 1981; Furuyama et al., 1985; Machida, 1987; Kato, 1988).

Silkworms can be fed with artificial food only during the first stage or during the entire larval development (Ito et al., 1974; Ito & Kobayashi, 1978; Maura, 1983; Iwanami, 1985; Matsubara et al., 1988a, 1988b).

Mulberry meal is used mainly due to its components irreplaceable for the silkworms without which they refuse to take in food. Soya meal, casein, egg albumin, gluten, sein, bovine albumin, gelatin, etc. are used as protein sources (Ito, 1978).

Depending on the type of protein added to the food, the content of free aminoacids in the structure of the hemolymph typical of Bombyx mori changes considerably (Yasuhiro Horie, Kijiro Watanabe, 1983).

Cappellozza et al. (2004) tested several replacers of soya meal in the artificial food for silkworms, such as flax meal, sunflower meal and rape meal and found that all three have significantly worse results compared to those of soya meal.

For the first time in Bulgaria in 2009 – 2010 at SAES, Vratsa, Tsenov and Georgiev (2010) developed artificial food suitable for silkworm nutrition during the entire larval period and cocoon production.

Genova (1991) found that during first stage positive results are obtained when feeding silkworms with artificial food containing 40 and 50% of mulberry meal. Better results are obtained with hybrids compared to the initial breeds.

As a result of long studies the need for selection of breeds and creation of hybrids susceptibility to artificial diet feeding was realized (Azizov and Gulamova, 1982).

According to Kanda (1992) the practical use of artificial food with low prime cost can be achieved by genetic changing of the eating habits of forms for industrial rearing.

In the area of application of artificial food for silkworms the issue of finding out the susceptibility to artificial diet feeding of *Bombyx mori* L. breeds and hybrids and the creation of forms adapted to raising with artificially prepared food can be pointed out as the main one, which focused our efforts to the objective of the present study.

MATERIAL AND METHODS

Our study has been carried out at the educational and experimental facility of the Sericulture section at the Department of Animal breeding – non-ruminants and other animals of the Faculty of Agriculture, Trakia University.

To achieve that goal and tasks we used biological material comprising 106 breeds from the genetic bank of SAES, Vratsa and 7 breeds from the genetic bank of Trakia University – Faculty of Agriculture, Sericulture section.

In conducting the experiment for feeding_silkworms breeds, we used artificial food with 25% content of mulberry leaf powder provided by SAES, Vratsa, prepared by methods recommended by the manufacturing company. The ready food was kept in a refrigerator at temperature 2-5^{o}C until the moment of its use for feeding.

Due to the great number of layings incubation and rearing of silkworms was in the following stages:

- I loading – 21.04 – 06.05;
- II loading – 09.05 – 25.05;
- III loading – 31.05 – 15.06;

In mid-March we made a preparation for incubation expressed in conducting thermal shock and disinfection on silkworm eggs and of the equipment. In any repetition of the studied breeds we placed by 30 normal eggs for incubation.

In order to prevent infection of hatched silkworms and development of diseases we used sterile petri dishes.

Incubation of silkworm eggs, breeding and rearing silkworms was conducted in petri dishes in thermostats prepared in advance with the relevant temperature and humidity conditions.

In order to establish the viability of the larvae of breeds object of this study, we made readings at Ist, IInd and IIIrd age.

At the end of each age, respectively after the first, second and third sleep, just before loading the food, we recorded the number of living specimens, incl. number of stripped, number in sleeping phase, number of specimens lagging in their development. Silkworm vitality at each age was determined as percentage by the following formula:

$$V = \frac{S_1}{S} \text{ x } 100(\%) \quad ,were$$

V– Vitality (%);

S_1– silkworms that had reached the next age (pcs.);

S – total number of silkworms;

For all studied traits we calculated the basic statistical characteristics of specimens of all breeds. The obtained data were systemized and processed with the respective modules of STATISTICA software of StatSoft and Microsoft Excel 2010.

RESULTS AND DISCUSSION

In recording the susceptibility to artificial diet feeding of silkworms, one of the basic traits is considered to be the number of specimens with normal development calculated as percentage of vitality. The analysis of the data has been made on the basis of the detected norms determining the degree of receptivity to artificial diet of larvae.

Criteria for assessing the degree of receptivity of silkworms to artificial food.

Degree of receptivity	**Vitality (%)**
Very high	Over 90
High	85 - 90
Normal	70 - 85
Low	60 - 70
Very low	Under 60

The mean values of the percentage of surviving specimens of different ages of breeds included in the study are presented in Table 1.

Table 1.Vitality of specimens from the analysed breeds during their age development(%)

The results presented in Table 1 show that the vitality of the analyzed breeds varies in wide ranges. There is also different dynamics in the change of vitality in the direction from first to third age.

In the first age very high degree of receptivity (over 90% viability) is typical of 34.78% of the breeds, high (85-90%) - 21.74%, and normal degree (70-85%) - 27 , 83% of the species included in the study. With low (60-70%) and very low (<60%) degree of receptivity are respectively 6.96% and 8.70% of the breeds. Detected percentage vitality of breeds analysed in the study, gives us reason to we believe that the majority of them (84.35%) demonstrated high affinity to artificial diets in the first age, and only 15.65% have low and very low receptivity. In the second age the ratio between breeds with high % of vitality to those with low % is approximately 2:1 and from a total of 115 tested breeds, 64.35% have very high, high and normal degree of receptivity, and those with low and very low degree constitute 35.65% of all breeds, which is 20% more than these in the first age.

With the advancement of age, there is a tendency to reduce the number of breeds with high degree of receptivity to artificial diet. The data in the table show that the breeds with low and very low degree of receptivity comprise a total of 60.87%, 3.48% of them have not reached the third age. Over 70% vitality is typical of a total of 39.13% of the breeds, 3.48% being with very high (> 90%), 6.96% - with high (85-90%) and 28.70% - with normal (70-85%) degree of receptivity.

Figure 1 graphically depicts the proportion percentage of breeds exhibiting affinity to artificial diets in the first three stages of larval development.

Figure 1. Breeds characterized by over 70% vitality during the first three stages of larval development.

Lower limit of survival in rearing with artificial food is over 70% vitality. The value for the first age stated in Figure 1 (84.35%) gives us reason to believe that despite the decrease in the next two ages of caterpillar stage, the analyzed breeds have high biological potential and can be improved by applying appropriate breeding methods.

The reason for this are the results by Nair et al. (2011), who through direct selection manage to increase the receptivity of silkworms to artificial diets to 85%. According to them, adapting to artificial food is much greater in hybrids bred for 12 generations.

Figure 2 presents data on breeds with the smallest and greatest dynamics of the trait in the first three stages of age development. Of the breeds with the least variation of vitality in various stages of rearing are presented five of those with the highest and lowest values.

Figure 2. Breeds with the lowest and highest dynamics of vitality during age development.

The results presented in Figure 2 show that the breeds "E- 31", "Line 22", "Ukrainian 20", "Syria 1", "Vratsa 38" retain high degree of receptivity in all three ages of their development, and therefore can be distinguished **/indicated/** as the most promising for rearing with artificial food. Breed "E-28" in the first age also shows higher receptivity to artificial diets (89.34%), but with advancement of age development sharp decrease of vitality is observed (29.86%), and specimens do not reach the third phase of moulting (0%). Nevertheless the serious dynamics in the survival rate of breed "E-28", it is characterized as a breed with high biological potential, in which after the purposeful individual selection, there are prerequisites for improving characteristics that breed.

It was found that the affinity to artificial diets of larvae is controlled by a single recessive allele and it is inherited as a dominant indicator, and their adaptation expressed by the growth and yield of cocoons varies depending on breeds and is probably controlled by many genes (Fujimori et al., 1982; Yamamoto & Shimizu, 1982; Yamamoto, 1983; Tanaka & Midorikowa, 1984).

According to some authors (Takuma, 1976; Azizov and Gulamova, 1982; Kouno & Ohdachi, 1985), Japanese breeds have better receptivity to artificial diet than those of Chinese origin.

To confirm this, the summarized analysis presented in Figure 1 shows that in the breeds with very high degree of receptivity to artificial diets in "Line 22", of Japanese type, the tendency persists through all three stages of the ages development, the percentage of vitality towards third age decreased by only 5.20% (100% → 94,80%). Breeds "E-31" and “Syria 1" of Japanese type, also exhibit high affinity to artificial mixtures, but with more significant decrease in the survival rate, from first to third age % vitality decreases, respectively in "E-31" by 18.3% (100% → 81,97%), and in "Syria 1" by 12,23% (98,85% → 86,62%).

With levels of the indicator vitality in all three ages have the breeds "№-6p" (30,52% → 0,95% → 0%), "PS-4B" (37,00% → 22,92% → 11,46%), which are Chinese type.

An exception of the link established by Takuma (1976) et al. between the geographical origin of breeds and receptivity to artificial diets are the breeds "Ukrainian 20", which belongs to the Chinese group of breeds, but demonstrates high affinity (97,77% → 92,40%) and "BV-2sh” belonging to the Japanese breed group but exhibits low receptivity (38,75% → 0%).

These differences in the established manifestations of food behavior in the breeds depending on their geographical origin can be explained by breed and individual specificity of the species.

CONCLUSIONS

- Feeding specimens of all breeds studied with artificial food by 25% content of mulberry leaf powder has a multifaceted effects on the survival rate during the observed stages of age development and varies in wide ranges (from 27.96% to 100% in the first age; from 0.95% to 100% in the second and from 0% to 94.80% in the third age).
- Breeds "E-31", "Line 22", "Ukrainian 20", "Syria 1", "Vratsa 38" show the lowest dynamics of the indicator vitality and retain high degree of receptivity in all three stages of their age development, and therefore can be identified as the most promising of all 115 breeds studied.
- In the first age the majority of breeds (84.35%) are characterized by a survival rate above 70%. Given that the results obtained from the original forms in which no selection in receptivity to artificial diets has been made, it can be considered that in conducting targeted intrabreed individual selection the vitality of breeds can be improved
- In general, the breeds belonging to the Japanese breed group demonstrate higher affinity to artificial food compared to those of Chinese origin.

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Table 1.Vitality of specimens from the analysed breeds during their age development

№	Breed	I stage X ± Sx	II stage X ± Sx	III stage X ± Sx
1	Vratsa 19	78,42 ± 12,05	77,14 ± 12,2	68,24 ± 8,36
2	Vratsa 37	90,99 ± 1,44	81,38 ± 6,83	67,96 ± 10,43
3	Veslec 1	93,14 ± 6,86	90,13 ± 8,35	83,99 ± 6,85
4	Ogosta 1	86,47 ± 4,29	84,38 ± 4,54	78,51 ± 7,55
5	Kom 1	89,33 ± 10,67	67,61 ± 11,21	46,28 ± 25,23
6	BV- 2sh	38,75 ± 19,41	16,67 ± 16,67	-
7	KS	92,98 ± 2,17	80,17 ± 5,37	61,88 ± 14,17
8	Valve 111	83,75 ± 7,61	77,80 ± 5,20	77,80 ± 5,20
9	Merefa 1	68,29 ± 12,73	63,35 ± 15,79	52,24 ± 21,43
10	Vratsa 55	96,39 ± 2,23	94,24 ± 1,28	92,02 ± 1,09
11	Vratsa 63	88,66 ± 6,52	84,45 ± 7,45	84,45 ± 7,45
12	Hebur 1/18	94,17 ± 1,05	94,17 ± 1,05	78,54 ± 15,87
13	VBAS	95,32 ± 3,32	95,32 ± 3,32	91,39 ± 4,43
14	SB- 1	91,61 ± 2,53	89,39 ± 0,33	79,19 ± 6,26
15	VB- 1	89,14 ± 6,32	84,90 ± 6,63	81,68 ± 5,14
16	Ogosta 1/20	75,21 ± 14,08	68,99 ± 12,46	58,36 ± 8,75
17	Belopol 1/18	83,13 ± 13,46	58,88 ± 20,07	39,29 ± 21,72
18	19	89,67 ± 1,99	81,87 ± 7,74	73,11 ± 10,56
19	1013	92,72 ± 3,64	87,17 ± 8,09	81,22 ± 9,39
20	Vratsa 16	82,80 ± 5,37	78,36 ± 1,31	53,73 ± 20,84
21	Vratsa 38	97,98 ± 2,02	93,08 ± 4,27	81,09 ± 10,82
22	Vratsa 64	27,96 ± 27,96	26,68 ± 26,68	25,81 ± 25,81
23	Vratsa 66	84,24 ± 7,71	81,94 ± 9,99	55,73 ± 27,03
24	Super 4	81,35 ± 10,99	71,03 ± 14,03	46,66 ± 26,88
25	157 K	88,44 ± 7,28	87,37 ± 7,22	82,74 ± 11,44
26	Ogosta 2	85,69 ± 11,33	75,63 ± 10,71	61,45 ± 21,77
27	Valve 222	79,50 ± 2,88	74,56 ± 7,71	56,66 ± 15,4
28	HB- 2	91,23 ± 8,77	83,29 ± 8,39	81,70 ± 9,17
29	HBShV	95,70 ± 4,30	92,57 ± 6,02	76,48 ± 13,25
30	BV- 3B	73,95 ± 10,62	71,93 ± 10,04	60,88 ± 13,11

31	SB- 1071- 1	54,97	±	27,89	36,61	±	23,80		-	
32	Hebur 2/1	73,82	±	10,13	63,61	±	12,17	44,89	±	21,20
33	Belopol 2/21	82,63	±	4,57	65,64	±	10,43	62,03	±	6,83
34	Ogosta 2/21	91,65	±	1,44	90,37	±	1,70	86,57	±	3,81
35	BTV- 2/64	89,21	±	7,7	59,70	±	22,71	26,67	±	26,67
36	Vratsa 2003	94,65	±	2,99	94,65	±	2,99	89,29	±	5,98
37	Vratsa 2006	90,39	±	8,14	89,38	±	7,59	89,38	±	7,59
38	Vratsa 2007	92,91	±	1,89	91,8	±	0,8	61,59	±	30,8
39	Almaz	82,56	±	8,44	67,72	±	19,86	47,81	±	27,94
40	Mayak 5	94,65	±	2,99	88,18	±	3,34	82,43	±	8,68
41	Mayak 6	92,77	±	4,55	87,56	±	3,19	83,40	±	6,39
42	Azeri	84,45	±	9,36	51,96	±	28,93	37,25	±	31,56
43	Vatan	93,55	±	6,45	88,24	±	8,82	85,20	±	7,64
44	Karabakh	84,90	±	8,41	66,27	±	23,77	55,08	±	27,98
45	Zafar	94,52	±	2,74	90,05	±	0,81	60,68	±	30,36
46	Sh – 3	93,83	±	3,21	93,83	±	3,21	88,63	±	0,85
47	Sh- 26-32	91,38	±	2,64	87,22	±	3,80	64,59	±	7,17
48	Mir 5	92,27	±	2,02	88,34	±	3,49	73,97	±	2,09
49	E- 1	57,78	±	29,9	42,22	±	21,11	31,11	±	15,67
50	E- 2	92,55	±	5,96	86,30	±	6,89	83,17	±	9,10
51	E- 3	69,52	±	14,76	55,63	±	24,74	37,19	±	24,64
52	E- 4a	74,89	±	11,33	65,42	±	11,61	58,27	±	17,93
53	E- 5a	48,51	±	27,97	45,38	±	25,31	22,35	±	17,23
54	E- 9	94,25	±	5,75	93,10	±	6,90	83,35	±	14,17
55	E- 13	91,22	±	2,56	87,65	±	3,67	76,90	±	8,12
56	E- 31	100,0	±	0,00	100,0	±	0,00	81,97	±	16,03
57	Mziuri 1	88,95	±	2,02	79,43	±	7,59	74,66	±	12,34
58	Nig 1	84,59	±	9,37	77,92	±	5,43	74,59	±	5,80
59	Nig 2	89,48	±	6,33	89,48	±	6,33	89,48	±	6,33
60	TV	86,13	±	3,96	78,15	±	5,36	72,90	±	3,83
61	110- S	91,41	±	4,82	85,07	±	1,42	63,37	±	17,74
62	Tahvon 106	65,53	±	10,48	56,94	±	12,35	36,51	±	18,84
63	Banyasa Alba	92,43	±	6,26	92,43	±	6,26	81,73	±	13,24
64	AlbCislau 29	63,17	±	22,34	55,56	±	29,4	42,42	±	29,85
65	Banyasa 1	96,36	±	2,23	83,81	±	11,18	72,31	±	12,26
66	Banyasa 21	80,06	±	7,19	75,19	±	6,28	49,78	±	19,97
67	Banyasa P	51,23	±	25,68	38,01	±	19,81	11,99	±	10,70
68	J- 90	88,05	±	4,20	70,19	±	13,67	55,90	±	27,95
69	Cislau Tokay	90,80	±	9,20	78,42	±	7,18	60,36	±	22,10
70	Banyasa 75П	67,21	±	15,68	47,61	±	23,85	40,20	±	20,68
71	№ - 6р	30,52	±	7,69	0,95	±	0,95		-	
72	P 4/T	77,64	±	1,87	76,60	±	0,90	67,92	±	4,35
73	SK 2 /F	88,28	±	1,90	76,80	±	10,21	45,83	±	22,99
74	BN/ 4	86,85	±	11,79	84,07	±	10,86	78,33	±	11,67
75	Rg- 90	62,50	±	8,27	62,50	±	8,27	57,64	±	5,78
76	VAR	92,55	±	3,18	91,04	±	2,83	89,52	±	3,24
77	Syria 1	98,85	±	1,15	95,82	±	2,65	86,62	±	9,21

78	Syria 2	94,65	±	4,07	80,29	±	5,23	63,09	±	14,36
79	Ukrainian 14	62,04	±	31,11	50,31	±	25,39	39,20	±	20,54
80	Ukrainian 15	77,51	±	9,60	77,51	±	9,6	65,20	±	4,21
81	Ukrainian 18	86,19	±	9,34	84,23	±	11,29	74,42	±	21,06
82	Ukrainian 20	97,77	±	1,18	95,06	±	3,16	92,40	±	3,82
83	Merefa 6	78,70	±	10,18	78,70	±	10,18	72,64	±	10,77
84	Merefa 7	85,27	±	7,35	85,27	±	7,35	82,72	±	8,44
85	Tashkenian 9	85,56	±	7,86	79,39	±	13,92	55,25	±	28,28
86	Tashkenian 16	70,22	±	18,48	34,70	±	24,19	14,58	±	14,58
87	Line 22	100,0	±	0,00	94,80	±	3,93	94,80	±	3,93
88	A-14	79,01	±	7,85	70,19	±	15,11	62,41	±	17,88
89	MNB	83,53	±	6,29	67,05	±	12,57	60,48	±	17,42
90	Almeria esp 1	90,48	±	9,52	89,33	±	9,00	82,43	±	8,88
91	Almeria esp	94,25	±	1,15	87,36	±	3,04	68,97	±	20,79
92	Sierra Morena	89,47	±	10,53	68,74	±	21,61	49,62	±	28,06
93	Bagdad	86,64	±	9,50	56,89	±	7,61	36,45	±	15,22
94	371	90,62	±	2,47	83,71	±	6,34	68,81	±	14,4
95	PS- 5sh	54,66	±	8,38	41,81	±	15,74	36,56	±	18,39
96	PS- 4B	37,00	±	19,60	22,92	±	22,92	11,46	±	11,46
97	1A- 1	79,36	±	10,72	71,87	±	5,04	61,26	±	4,14
98	1A- 2- I	81,88	±	7,20	52,13	±	17,74	41,33	±	20,93
99	PS- pure	70,11	±	13,46	44,67	±	24,39	36,19	±	23,41
100	Shandon	88,51	±	6,08	34,71	±	22,84	26,67	±	26,67
101	Daizo	60,32	±	30,24	30,48	±	30,48	7,62	±	7,62
102	China	73,09	±	23,66	35,75	±	13,37	18,39	±	18,39
103	Jena	97,91	±	1,08	88,67	±	8,76	52,09	±	28,10
104	Tg	88,97	±	6,68	84,63	±	6,23	43,43	±	28,44
105	E- 26	83,84	±	5,30	77,18	±	11,94	60,71	±	14,88
106	E- 27	55,82	±	28,07	34,92	±	24,98	21,30	±	21,30
107	E- 28	89,34	±	1,84	29,86	±	21,19		-	
108	E- 29	88,96	±	4,27	68,64	±	11,47	47,55	±	8,66
109	1v	93,69	±	6,31	92,46	±	5,79	76,41	±	15,15
110	1w	87,83	±	6,5	80,56	±	10,02	73,41	±	13,82
111	20	93,14	±	6,86	87,18	±	6,46	81,86	±	9,16
112	1014	82,20	±	8,90	56,41	±	29,57	53,85	±	29,12
113	Zebri v/w	75,13	±	19,75	72,75	±	19,03	61,85	±	16,39
114	Zebri v	88,24	±	6,45	59,59	±	30,05	49,78	±	26,13
115	Zebri w	75,81	±	12,95	57,56	±	28,78	51,21	±	26,27

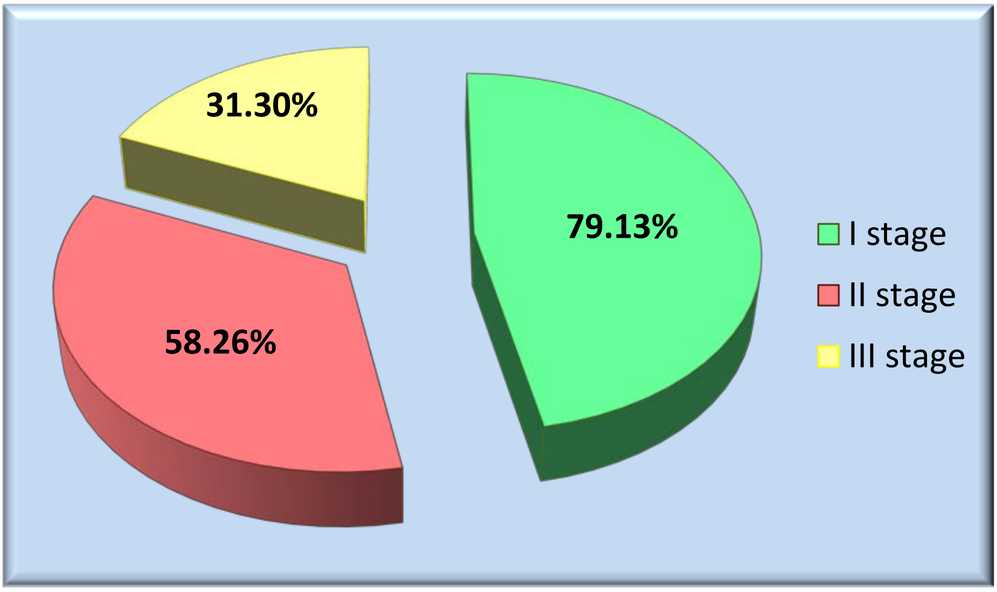

Figure 1. Breeds characterized by over 70% vitality during the first three stages of larval development.

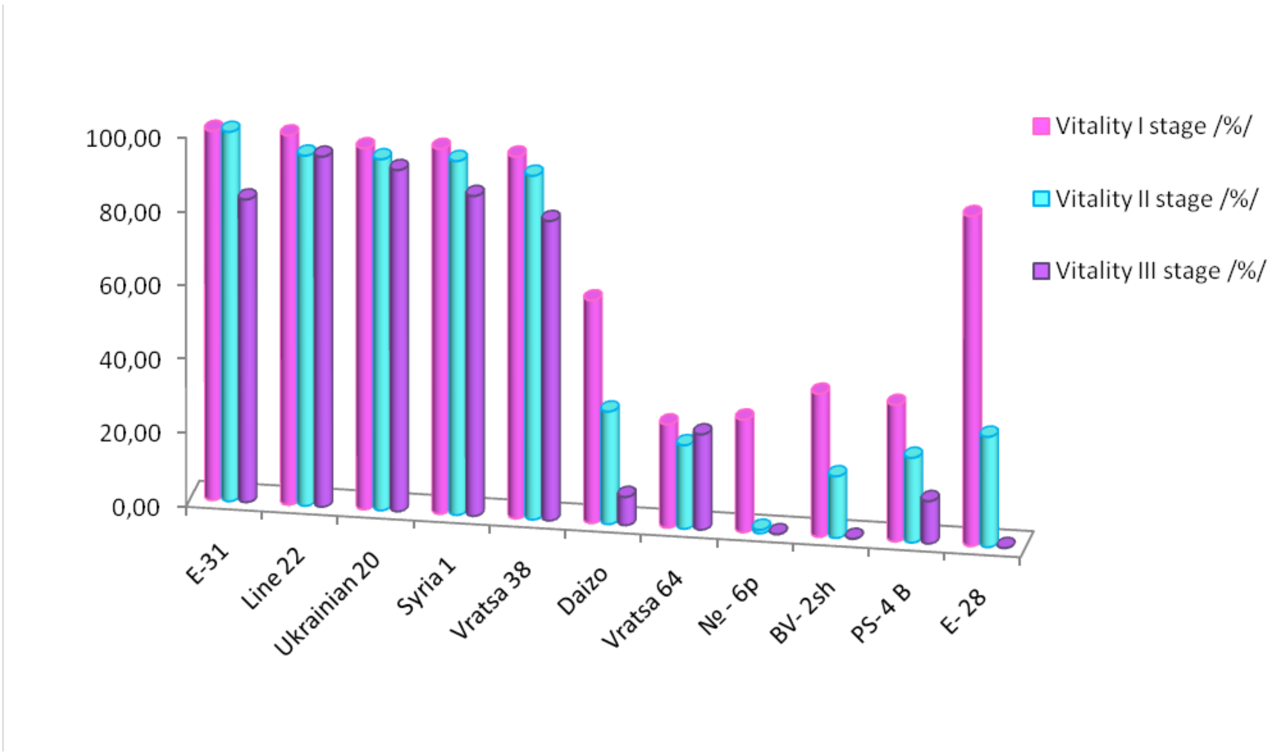

Figure 2.Breeds with the lowest and highest dynamics of vitality during age development.

Testing and Evaluation of New Bulgarian Silkworm, *Bombyx mori L.* Non Sex-Limited and Sex-Limited Commercial F1 Hybrids

By

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ABSTRACT

The study has been conducted during the period 2012 – 2014 at the Thracian University, Stara Zagora, Sericulture and Agriculture Experiment Station, Vratsa and Agricultural university, Plovdiv, Bulgaria. The following F1 silkworm hybrids between Bulgarian pure breeds 19, 1013, Magi 2 and Lea 2 were created and tested simultaneously: 19 x Magi 2, Magi 2 x 19 (sex-limited for larval markings), 1013 x Magi 2, Magi 2 x 1013 (sex-limited for larval markings), 19 x Lea 2, Lea 2 x 19 (sex-limited for cocoon color), 1013 x Lea 2, Lea 2 x 1013(sex-limited for cocoon color). It was detected that the main qualitative characters some of the new hybrids differ from the control and other hybrids were larval body color during the 5th instar, larval markings and cocoon color. The new silkworm hybrids demonstrated comparatively high hatchability, normal 5th instar and larval period duration, significantly higher than the control pupation rate and near or higher than the control fresh cocoon yield by one box of silkworm eggs. The mean fresh cocoon weight and silk shell weight in 4 of the new hybrids (19 x Magi 2, 19 x Lea 2, 1013 x Magi 2 and 1013 x Lea 2) were near to the control, while all the rest performed a significantly lower than the control cocoon and shell weight. In most of the new silkworm hybrids the silk shell percentage was higher of near to the control. In the non sex-limited F1 silkworm hybrids tested the silk shell weight in the females was higher than the males, while in the sex-limited for larval markings and cocoon color hybrids the males had higher silk shell weight than the females. The non sex-limited hybrids performed a bit higher mean silk shell weight values than the sex-limited ones. The dry cocoon weight in most of the new hybrids was near and lower than the control. The filament length was significantly longer than the control in the hybrids 19 x Magi 2, Magi 2 x 19 and 1013 x Magi 2, it was near to the control in 19 x Lea 2 and it was significantly lower than the control in all the rest hybrids. Similar were the results, obtained for the silk filament weight. The differences between the silkworm hybrids tested concerning reelability were insignificant, but the raw silk percentage in the new hybrids was significantly higher or near to the control. The results obtained from the present testing of new F1 silkworm hybrids allow us to suggest them for state examination, authorization and certificates protection respectively.

Key words: silkworm, Bombyx mori L., F1 hybrids, sex-limited, productivity

INTRODUCTION

Since silk is the ultimate product required for commercial purpose in textile industry many scientists have paid special attention on methods for evaluation of silkworm hybrids based on silk productivity (Udupa and Gowda, 1988; Singh et al., 1994; Bhargava et al., 1993, 1996; Ramesh Babu et al., 2001; Rajhavendra Rao et al., 2004). According to many scientists during the last 15 – 20 years studies on selection of F_1 silkworm hybrids, having a high heterosis expression have been accelerated to such a degree, that in sericulturally developed countries almost all cocoon production is based on industrial manner of organization (Osawa and Harada, 1994; Petkov, 1995; Bharagava et al., 1996; Datta et al., 2000). Heterosis and combining ability contribute the choice of parents and do have an important impact for improving of production traits in silkworm breeding (Petkov and Nacheva, 1996; Nacheva et al., 1990).

Production of F_1 hybrid silkworm eggs for industrial cocoon production with participation of ordinary genetically non sex-limited races and lines is technologically complex and difficult process. Difficulties proceed from the necessity of preliminary sex discrimination of *Bombyx mori* L. cocoons (pupae or moths after the emergence) before mating of moths for avoiding crossing inside the breed.

Used till now methods and manners for mechanized cutting of cocoons and dividing of pupae manually or mechanized trough apparatus working on the basis of existed biologically dependent differences between weight in two sexes are also expensive and inaccurately (Zakirova, 1978; Strunnikov, 1986; Petkov at al., 2000).

Because of this a lot of resources are invested during the last years in silkworm sex regulation in sericulturally advanced countries.

On the other hand according to Tzenov (2014) in the sex-limited for cocoon color Bulgarian F1 hybrids Lim 1 x Lea 2 and L1xI1 x L2xN2 the filament length and weight were higher in the males than in the females which might be explained with the genetic depression due to the translocation of Y allele on the W chromosome. Therefore the using of silkworm F1 hybrids, having both of parents sex limited breeds may be reconsidered with using only one sex-limited parent for example.

The present study aims to investigate the performance of several F_1 silkworm hybrids, obtained between non-sex-limited and sex-limited Bulgarian pure breeds.

MATERIALS AND METHODS

The study has been conducted during the period 2012 – 2014 at the Thracian University, Stara Zagora, Sericulture and Agriculture Experiment Station, Vratsa and Agricultural university, Plovdiv, Bulgaria. The following silkworm pure breeds were used as parents of the F1 hybrids:

19 – Japanese type, non sex-limited silkworm breed, having larvae with markings and white cocoons with peanut shape. The breed was created in the Thracian University, Stara Zagora.

1013 - Japanese type, non sex-limited silkworm breed, having larvae with markings and white cocoons with peanut shape. The breed was created in the Thracian University, Stara Zagora.

Magi 2 – sex-limited for larval markings silkworm breed, the female larvae are zebras and the males are plain. The cocoons are white and oval. The breed was created in the Sericulture and Agriculture Experiment Station, Vratsa.

Lea 2 – sex-limited for cocoon color silkworm breed. The larvae are plain, the female cocoons are yellow, the male cocoons are white and the cocoon shape is oval. The breed was created in the Sericulture and Agriculture Experiment Station, Vratsa.

The following F1 silkworm hybrids were created and tested simultaneously:
19 x Magi 2
Magi 2 x 19 (sex-limited for larval markings)
1013 x Magi 2
Magi 2 x 1013 (sex-limited for larval markings)
19 x Lea 2
Lea 2 x 19 (sex-limited for cocoon color)
1013 x Lea 2
Lea 2 x 1013(sex-limited for cocoon color)

As a control, the widely adopted Bulgarian F1 commercial hybrid Super 1 x Hesa 2 was used. 2 g of eggs of each silkworm hybrid were incubated and larvae reared together until the end of 2nd instar. At the 3rd instar beginning 4 replicates, consisted of 200 larvae each were counted from each hybrid and further reared until the cocoon spinning.

The silkworm larvae were reared following the standard method for spring rearing in Bulgaria (Panayotov and Ovesenska, 2002), and fed “ad libitum” with mulberry leaves of №24 Bulgarian variety. The mulberry plantation was rain fed only, without any irrigation during the spring season. The data obtained were processed statistically (Lidanski, 1988).

RESULTS AND DISCUSSION

It is evident from table 1 that at the larval stage the main qualitative characters the new hybrids differ from the control are the larval body color in the 5th instar (the hybrids Lea 2 x 19 and Lea 2 x 1013 have male larvae with bluish - white body color and female ones with yellowish – white color while in the other hybrids and the control all the larvae are with bluish white color) and the larval markings (in the hybrids Magi 2 x 19 and Magi 2 x 1013 the female larvae are zebras and the male larvae are plain while in all the other hybrids and control the larvae are with normal markings.

In table 2 the cocoon qualitative characters are presented. It is displayed that all the new F1 hybrids and control do not differ as for the cocoon shape, size and nature of grains characters – in all of them the cocoons have oblong shape, medium size and medium nature of grains. The hybrids Lea 2 x 19 and Lea 2 x 1013 however have yellow cocoon color females and white cocoon color males.

In all the F1 hybrids tested the hatchability (table 3) is comparatively high (from 97.73 % to 99.94 %). The hybrids Magi 2 x 19, Lea 2 x 19 and Magi 2 x 1013 manifested significantly shorter 5th instar and larval duration than the control and the rest hybrids. In almost all the new hybrids the pupation rate is significantly higher than the control. The fresh cocoon yield by one box of silkworm eggs in most of the new hybrids is near or higher than the control, except for the hybrids Lea 2 x 19, Magi 2 x 1013 and Lea 2 x 1013 which performed a lower than the control cocoon yield.

The fresh cocoon technological characters values are presented in table 4. It is evident that in the non sex-limited F1 silkworm hybrids like Super 1 x Hesa 2, 19 x Magi 2, 1013 x Magi 2, 19 x Lea 2 and 1013 x Lea 2 the silk shell weight in the females is higher than the males, while in the sex-limited for larval markings and cocoon color hybrids Magi 2 x 19, Magi 2 x 1013, Lea 2 x 19 and Lea 2 x 1013 the males have higher silk shell weight than the females. This lower silk shell weight in the females of sex-limited hybrids reflects even on the average silk shell weight of each hybrid, so the non sex-limited hybrids perform a bit higher silk shell weight values than the sex-limited ones. The mean fresh cocoon weight and silk shell weight in 4 of the new hybrids (19 x Magi 2, 19 x Lea 2, 1013 x Magi 2 and 1013 x Lea 2) are near to the control, while all the rest perform a significantly lower than the control cocoon and shell weight. In most of the new silkworm hybrids the silk shell percentage is higher of near to the control.

Regarding the silk filament technological characters, presented in table 5, the dry cocoon weight in most of the new hybrids is near and lower than the control. The filament length is significantly longer than the control in the hybrids 19 x Magi 2, Magi 2 x 19 and 1013 x Magi 2, it is near to the control in 19 x Lea 2and it is significantly lower than the control in all the rest hybrids. Similar are the results, obtained for the silk filament weight. As regards the silk filament thickness it is manifested that the hybrids Magi 2 x 1013, 1013 x Lea 2 and Lea 2 x 1013 perform a significantly thicker filament that the control and rest hybrids.

The differences between the silkworm hybrids tested concerning reelability are insignificant, but the raw silk percentage in the new hybrids is significantly higher or near to the control.

CONCLUSIONS

- The main qualitative characters some of the new hybrids differ from the control and other hybrids were larval body color during the 5^{th} instar, larval markings and cocoon color.

- The new silkworm hybrids demonstrated comparatively high hatchability, normal 5^{th} instar and larval period duration, significantly higher than the control pupation rate and near or higher than the control fresh cocoon yield by one box of silkworm eggs. In most of the new silkworm hybrids the silk shell percentage is higher of near to the control.

- In the non sex-limited F1 silkworm hybrids tested the silk shell weight in the females was higher than the males, while in the sex-limited for larval markings and cocoon color hybrids the males had higher silk shell weight than the females. The non sex-limited hybrids performed a bit higher mean silk shell weight values than the sex-limited ones.

- The differences between the silkworm hybrids tested concerning reelability were insignificant, but the raw silk percentage in the new hybrids was significantly higher or near to the control.

- The results obtained from the new F1 silkworm hybrids testing allow us to suggest them for state examination, authorization and certificates protection respectively.

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Table 1. Qualitative characters of the silkworm eggs and larvae in F1 hybrids.

Hybrids	Egg chorion color	Egg shell color	Larvae body color in the 5th instar	Larval markings
Super 1 x Hesa 2 (control)	gray	white	bluish-white	with normal markings
19 x Magi 2	gray	white	bluish-white	with normal markings
Magi 2 x 19	gray green	yellow	bluish-white	♀zebra, ♂ with normal markings
19 x Lea 2	gray	white	bluish-white	with normal markings
Lea 2 x 19	green	yellow	♂bluish-white and ♀yellowish-white	with normal markings
1013 x Magi 2	gray	white	bluish-white	with normal markings
Magi 2 x 1013	green	yellow	bluish-white	♀zebra, ♂ with normal markings
1013 x Lea 2	gray	white	bluish-white	with normal markings
Lea 2 x 1013	green	yellow	♂bluish-white and ♀yellowish-white	with normal markings

Table 2. Cocoon qualitative characters in F1 silkworm hybrids.

Hybrids	Cocoon shape	Cocoon color	Cocoon size	Cocoon nature of grains
Super 1 x Hesa 2 (control)	oblong	white	medium	medium
19 x Magi 2	oblong	white	medium	medium
Magi 2 x 19	oblong	white	medium	medium
19 x Lea 2	oblong	white	medium	medium
Lea 2 x 19	oblong	♀yellow; ♂white	medium	medium
1013 x Magi 2	oblong	white	medium	medium
Magi 2 x 1013	oblong	white	medium	medium
1013 x Lea 2	oblong	white	medium	medium
Lea 2 x 1013	oblong	♀yellow; ♂white	medium	medium

Table 3. Biological quantitative characters values in F1 silkworm hybrids.

Hybrids	Hatchability (%)	5th instar duration (h)	Larval period duration (h)	Pupation rate (%)	Fresh cocoon yield by one box of eggs (kg)
Super 1 x Hesa 2 (control)	98.83	214	724	95.50	36.67
19 x Magi 2	99.27	212	698	96.50	36.93
Magi 2 x 19	99.94	186***	642***	99.50**	35.19
19 x Lea 2	99.16	212	698	99.00**	37.88**
Lea 2 x 19	97.73	186***	642***	98.50*	33.03**
1013 x Magi 2	98.58	212	698	99.00*	36.77
Magi 2 x 1013	97.53	186***	642***	98.50*	31.50***
1013 x Lea 2	98.74	214	700	99.50**	37.13
Lea 2 x 1013	98.09	212	674**	99.50**	32.82**

***P < 5%; **P < 1%; ***P < 0.1%**

Table 4. Fresh cocoon technological characters in new F1 silkworm hybrids.

Hybrids	Females			Males			Mean		
	Fresh cocoon weight(mg)	Silk shell weight (mg)	Silk shell percentage (%)	Fresh cocoon weight(mg)	Silk shell weight (mg)	Silk shell percentage (%)	Fresh cocoon weight(mg)	Silk shell weight (mg)	Silk shell percentage (%)
Super 1 x Hesa 2 (control)	2160	381	17.64	1755	375	21.37	1958	378	19.31
19 x Magi 2	2191	403	18.39	1699	378	22.25	1945	391	20.10*
Magi 2 x 19	1978	359	18.15	1713	428	24.99	1846*	394	21.34***
19 x Lea 2	2048	362	17.68	1722	366	21.25	1885	364*	19.31
Lea 2 x 19	1892	322	17.02	1711	364	21.27	1802***	343**	19.03
1013 x Magi 2	2056	379	18.43	1645	370	22.49	1851*	375	20.26*
Magi 2 x 1013	1837	319	17.37	1594	349	21.89	1716***	334***	19.46
1013 x Lea 2	2118	374	17.66	1687	374	22.17	1903	374	19.65
Lea 2 x 1013	1861	327	17.57	1661	366	22.03	1761***	347**	19.70*

***P < 5%; **P < 1%; ***P < 0.1%**

Table 5. Silk filament main technological characters in new F1 silkworm hybrids.

Hybrid	Dry cocoon weight (mg)	Filament length (m)	Silk filament weight (mg)	Silk filament thickness (denier)	Reelability (%)	Raw silk percentage (%)
Super 1 x Hesa 2 (control)	850	961	285	2.67	94.68	33.53
19 x Magi 2	890*	1044***	307*	2.65	97.46*	34.49*
Magi 2 x 19	770**	1050***	293	2.51	93.61	38.05**
19 x Lea 2	800*	967	291	2.71	94.17	36.38**
Lea 2 x 19	740***	887***	261***	2.65	93.88	35.27*
1013 x Magi 2	830	1121***	319**	2.56	95.80	38.43***
Magi 2 x 1013	710***	755***	263*	3.14**	94.60	37.04***
1013 x Lea 2	790*	781***	272	3.13**	94.12	34.43
Lea 2 x 1013	720***	721***	247***	3.08*	90.48**	34.31

***P < 5%; **P < 1%; ***P < 0.1%**

REGULATION OF GENDER OF SILKWORMS BY MEANS OF CONSTANT MAGNETIC FIELD DURING THE MATING SEASON

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INTRODUCTION

Breeding male silkworms *Bombyx mori L.* (*Lepidoptera, Bombycidae*) in industrial rearing is economically advantageous for sericulture. Increased productivity of males is due to their better viability compared to females at all stages of development, as well as high amount of silk in the shell cocoons (the relative amount of silk in the cocoon), obtained from this male gender. In addition to increased productivity, males produce more aligned cocoons, silk thread that is much thinner than the females, which is of great industrial importance [4].

Given the great practical significance of this fact and in order to increase the productivity of the silkworm, we have studied more affordable method to obtain a relatively large number of male offspring in the family of the silkworm, with normal viability. The task is achieved by the pairing of silkworm moths, in a constant magnetic field (CMF).

MATERIALS AND METHODS

Experimental studies were carried out on silkworms breed "Sheki-2" in the laboratories of Sheki Regional Scientific Center of the National Academy of Sciences of Azerbaijan (ANAS ShRNS) [11].

The experiment was carried out in the following stages: 108 pairs of male and female moths were taken from the spring rearing of silkworms; they were divided into 18 batches; 17 batches of moths were mated in CMF of varying intensity - from 63.66 to 1022,57*kA/m* (800-12850*E*). To maintain the moths in the magnetic field immediately after mating, they were placed in a paper tube with a diameter of 10-15*mm* and 40-50*mm* in length (depending on its size of moths) then in gaps of the magnetic poles and kept them in the CMF for 4 hours. After that separated moths, and females were placed in paper bags.

As a control experiment, six pairs of moths were taken from the same rearing, they were mated in vivo, without influence if CMF.

Next spring the grain of each batch was incubated separately. The worms were fed and kept under identical conditions. At the fifth age by the worms' sign on the pupal stage, by weight of the cocoon and at the moth stage by moths' sign males and females were defined. The experiments were repeated eight consecutive years.

RESULTS OBTAINED

The data on the changes in the relative number of males in the family of the silkworm, depending on the intensity of the CMF is shown in Table 1. On the basis of the table, the curves of dependence of the relative number of males on the field intensity are formed (Fig. 1). The mathematical study of the curve in Fig. 1 showed that the dependence of the relative number of males in the family on the intensity of CMF is adequate as so called Michaelis-Menten curve [5]:

$$N = N_0\left(a - be^{-kH}\right), \qquad (1)$$

where N - the number of males in the family, N_0 - the total number of worms in the family ($N_0 = N + N$♀**)**, where N♀ - number of females, a and b - coefficients determined during the experiment, k - activating factor by magnetic fields (the constant of effect of CMF on cytogenetic mechanism of silkworm), H - CMF intensity.

Table 1. Effect of magnetic field on the number of male worms in the family of silkworm, with orientation N♀♂S.

H, *kA/m*	N_0	N♂	N♂/N_0, %	ΔN♂/N_0, %
0	735.05	366.0 ± 18.6	49.48	2.5
63.66	756.67	421.0 ± 29.9	55.68	4.0
79.58	812.33	439.0 ± 24.1	56.02	3.0
113.80	770.86	428,0 ± 41,6	60,60	5,4
178.25	679.33	454.0 ± 17.6	62.20	2.6
224.41	740.83	490.0 ± 20.0	66.14	2.7
288.07	680.83	452.0 ± 16.1	66.39	2.4
321.49	701.16	484.0 ± 10.5	69.03	1.5
385.95	697.67	484.0 ± 42.6	69.37	6.1
429.72	695.16	501.0 ± 40.3	72.07	5.8
503.73	741.33	528.0 ± 15.6	71.22	2.1
600.41	770.05	561.0 ± 21.6	72.85	2.8
729.73	634.67	476.0 ± 20.9	74.99	3.3

819.65	717.00	524.0 ± 17.2	73.08	2.4
920.00	627.83	467.0 ± 22.6	74.39	3.6
1022.60	712.33	527.0 ± 18.5	73.98	2.6

To determine k - by means of a graph, a and b - by means of the results, let's consider the logic of output equation (1), while maintaining the basic mathematical notation. Let us assume that with the increase in CMF intensity on ΔH the number of males is increased by Δn. It is known that the number of males and females in the family of silkworm is equal under natural conditions [4]. When applying CMF, the number of males in the family increases proportionally with ΔH and the difference $[(N_0/2)-n]$, where n – number of male worms "turning" of the female part under the CMF:

$$\Delta n = k\left(\frac{N_0}{2}-n\right)\Delta H\ , \qquad (2)$$

where k - proportionality coefficient.

Under the conditions where $\Delta H \to 0$, we can write that

$$dn = k\left(\frac{N_0}{2}-n\right)\cdot dH\ . \qquad (3)$$

Let's solve the equation (3) by means of integration from 0 to H, under the conditions $n(0)=0$:

$$\int_0^n \frac{dn}{\left(\frac{N_0}{2}-n\right)} = k\int_0^H dH\ ,$$

$$ln\left(\frac{N_0}{2}-n\right) - ln\frac{N_0}{2} = -kH\ ,$$

$$\left(\frac{N_0}{2}-n\right)/\frac{N_0}{2} = e^{-kH}\ ,$$

$$n = \left(1-e^{-kH}\right)\cdot\frac{N_0}{2}\ .$$

(4)

Solving the equation (3), it was suggested that, under the condition $H \to \infty$ all females are "transformed" into males. However, we conducted experiments showing that after some value of H saturation occurs, and approximately half of the females are "transformed" into males. Therefore, in the latter expression (4) instead of the multiplier 1/2, 1/4 should be written:

$$n = \left(1-e^{-kH}\right)\cdot\frac{N_0}{4}\ .$$

(5)

Using equation (5), we turn on the total number of male worms in the family:

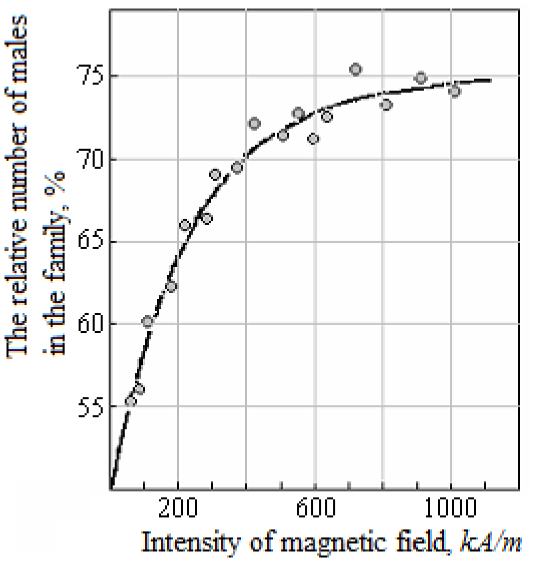

Fig.1. The dependence of the relative number of males in the family of the silkworm on the magnetic field.

$$N \approx \frac{N_0}{2} + n \approx \frac{N_0\left(1 - e^{-kH}\right)}{4} + \frac{N_0}{2} \approx N_0\left(\frac{3}{4} - \frac{e^{-kH}}{4}\right). \qquad (6)$$

When comparing the equation (6) with equation (1) we find out that $a \approx 3/4$ and $b \approx 1/4$. According to Equation (6), and the dependence shown in Fig. 1, k was counted and it was determined that when laying females with their head to the north (N), and males - to south (S) pole of the magnet (N♀♂S), k - the constant of effect of CMF on cytogenetic mechanism of silkworm is about $4{,}02 \cdot 10^{-3}$ *m/kA*.

DISCUSSION OF THE RESULTS OBTAINED

It is known that under normal fertilization of silkworm moths in ready to fertilize oocytes (*WZ*) the nuclear fission is blocked at the metaphase of the first maturation division. Spermatozoids penetrated into the egg (*Z*) encourage the resurgence of the two maturation divisions: reducing and equational. Haploid pronucleus plunges deeper into egg connecting in ~ 50% of cases with the *W*-chromosome in ~ 50% of cases with the *Z*-chromosome [4].

When meiotic parthenogenesis exactly the same maturation division occurs, but evolved haploid pronucleus without meeting the male pronucleus is divided into two genetically identical nuclei. In half of the egg pronucleus receives a *W*-chromosome, and then, after the restoration of diploid, there is construction *WW*, which is unsustainable. Only the second half of the egg with a diploid nucleus (*ZZ*) survives - males.

Ameiotic parthenogenesis occurs with non-reducing nucleus (*WZ*), completely identical in genetic structure with the nucleus of the mother. Therefore, all parthenogenetic offspring is represented by the female sex (*WZ*), genotypically repeating their mothers [9].

We carried out a large number of experiments to identify the effect of CMF on cytogenetic mechanism of the silkworm, that have shown that the magnetic field activates the eggs in the body of unfertilized moths and some of the eggs develop to the stage of formation of pigment in the cells of serous membrane (Fig. 2). The increase in the number of males in the family of the silkworm when mating moths in the magnetic field and intensity nature of "the transformation of the female into the male" has led us to a more detailed study of this process.

For the experiment white male worms and black female worms were chosen. In the resulting family there was the same number of black and white males and the same number of black and white females. The experiment was repeated with black males and white females. The result was the same - roughly equal numbers of white and black offspring: for males and for females. For the purpose of the explanation for this outcome, the formalized model of reorganization of microtubules (MT) of spindle in metaphase was given.

It is known that the MT not only control the spindle, but also an integral part of the mechanism of movement within it [2]. Given these facts, and the proportionality between the length of the thread and the effort put through the thread $\vec{F}_W$ and $\vec{F}_E$, J. Richard McIntosh concluded that driving mechanisms of the spindle are distributed along the length of kinetochore threads [7].

Metaphase spindle of oocyte is shown schematically in Fig. 3, for the notion that the yolk and pigment granules are localized polar in oocytes. The cytoplasm contains a structural continuous network of microtubules, intermediate filaments and the cytoskeleton

Fig.2. Egg-laying of unfertilized moth placed in CMF of 80 kA/m intensity, for 4 hours.

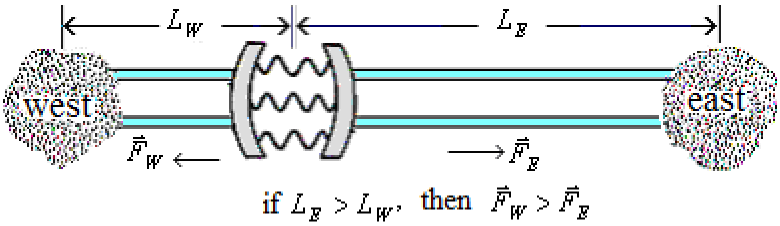

Fig.3. The ratio of the forces applied to the chromosomes [6]: before the onset of metaphase chromatids joined together respond to the impact as a whole.

of oocyte is formed by strands of two types: connecting the chromosomes to the poles and stretching from pole to pole.

Spindle thread connecting the kinetochore to its respective pole has on chromosome effect toward the poles. According to [2], the amount of force is proportional to the length of the thread.

If $L_E > L_W$, then $\vec{F}_E > \vec{F}_W$ where L_E and L_W are lengths of threads, connecting kinetochores with the western and eastern spindle poles, $\vec{F}_E$ and $\vec{F}_W$ - forces having impact on the chromosome directed to the western and eastern poles. Before the onset of metaphase between the distances L_W and L_E and forces moving the chromosome towards the poles - $\vec{F}_E$ and $\vec{F}_W$, there is inter-relative equilibria. Thus, interconnected chromatids respond to exposure integrally (Fig. 3).

Actin and tubulin macromolecules are packaged in an orderly manner to the MT, the reason for that - the interaction forces between adjacent spatially asymmetric molecules. Wherein MT remains liquid, movable, devoid of elasticity in relation to shear [1]. When pairing silkworm moths in CMF, MT spindle turns in a magnetic field, and orientation effects arise there (depending on the field intensity), connected with their anisotropy.

In an external magnetic field tubulin molecules have induced magnetic moments, directed strictly orderly - in the direction opposite to the vector of CMF. Consequently, in the CMF MT rebuilt (as is recrystallize) so that the long axis of the tubulin molecule coincided with the direction of the magnetic field. Consequently, for $\vec{F} = (F_W + F_E)$ there is an equilibrium value when the spindle retains its pre-metaphase state. Depending on the direction of the CMF, the magnetic force ($\vec{F}_M$) can either enhance or by compensating them to weaken $\vec{F}_W$ and $\vec{F}_E$. If under the CMF the conditions of $\vec{F} < (\vec{F}_W + \vec{F}_E + \vec{F}_M)$ are satisfied, the connection between chromatids is destroyed and anaphase begins (Fig. 4).

Kinetochores respond to $\vec{F}_W$ and $\vec{F}_E$ individually, and the further metaphase division of oocyte nuclei extends. When the condition is satisfied $\vec{F} > (\vec{F}_W + \vec{F}_E + \vec{F}_M)$, then force moving chromosome to the equator of the spindle amplifies. Whereby pre-metaphase state of spindle persists until the normal oocyte fertilization by sperm.

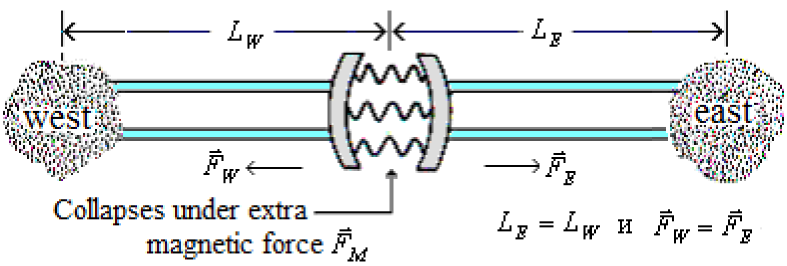

Fig.4. The ratio of forces applied to the chromosomes in early anaphase.

According to Weber [10], the scheme of arrangement of ovary in reproductive tracts in the abdomen of lepidopterous insects, including the abdomen of the silkworm moths can be represented as in Fig. 5. It can be seen that in the primitive ovary of silkworm, ovarioles are collected in the brush, where starts the complicated reproductive tract (Fig. 5a). Type of ovarioles of silkworm to Obenberger [6], corresponds to meristic - polythrophic (Fig. 5b). Ovarioles are located in the body of moths - along the growth and eggs are close (Fig. 5c). The spatial location of the cytoplasm of oocytes, with respect to ovarioles axis is asymmetric - for ~ 50% of the eggs of the cytoplasm located in one and for ~ 50% of the eggs - on the other side of the micropyle. We assume that for this reason, the polarity of the spindle of the serial oocytes is antiparallel. When placing the silkworm moths in CMF, thanks to the antiparallel arrangement of the cytoplasm of successive oocytes in ovarioles in ~50% of cases $\vec{F}_M$ coincides with a force $\vec{F} = (F_W + F_E)$ and, in ~50% of cases, $\vec{F}_M$ oppositely locates with $\vec{F}$.

In the amplification, ie $\vec{F} < (\vec{F}_W + \vec{F}_E + \vec{F}_M)$, in eggs blocking maturation division is removed and meiotic parthenogenesis begins, activated by a magnetic field. In oocytes, where meiotic parthenogenesis began, the selected haploid pronucleus is divided into two genetically identical nuclei. After separation of the chromatids in the egg meiotic parthenogenesis begins - haploid pronuclei formation is divided into two genetically identical nuclei. Due to the fact that the haploid pronuclei may either *Z*, or *W*-chromosome, one half of the eggs is obtained *Z*-, and the other - *W*-chromosome. After restoring the diploid either *ZZ*-, or *WW*-constructions are created. But only half of the eggs (*ZZ*- construction) will survive, and they give meiotic worm - male. From this calculation it is evident that they constitute about 25% of the total number of eggs in the family.

In the other half of the eggs receiving *W*-chromosome, after recovery of diploidy construction - *WW* occurs, which is not viable. However, these - meiotic non-viable eggs are still located in ovarioles and during laying eggs, as all the eggs, it also receive sperm. и во время откладки грен, According to Kavakuchi [3], silkworm has natural polyspermy and silkworm eggs are penetrated by 2 to 5 sperms. These eggs are already activated by a magnetic field and penetrated into them few intact sperms - without encountering a female haploid nuclei - fuse and form a diploid nucleus, which is later involved in the further development. The result is androgenetic males, with signs of their father, and they account for about 25% of the total number of worms in the family of the silkworm.

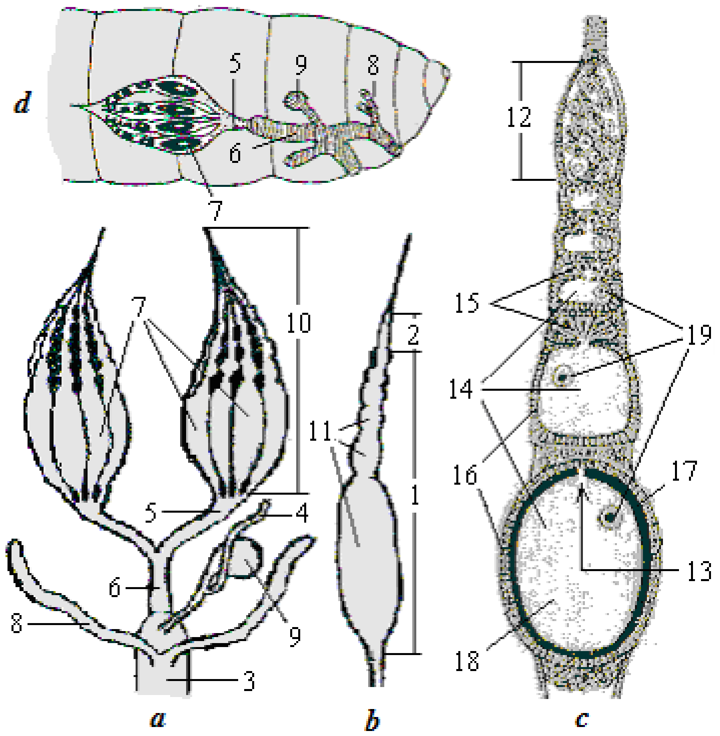

Fig.5. (***a***) - Scheme of female breeding organs; (***b***) - ovarioles (egg tubes); (***c***) -polytrophic type ovarioles (by Snodgrass, 1935); (***d***) - positions of the ovaries in the abdomen of the silkworm (by Obenberger, 1952): 1 - vitellyary, 2 - germar, 3 - genital chamber, 4 - spermathecal gland, 5 - lateral oviduct, 6 - medial oviduct, 7 - ovarioles, 8 - accessory gland, 9 - spermatheca, 10 - the ovary, 11 egg chambers, 12 - nutritious degenerating cells, 13 - micropyle, 14 - oocytes, 15 - nourishing cells, 16 - follicular cells, 17 - chorion, 18 - formed egg, 19 - the spatial position of the oocyte cytoplasm.

In those eggs where $\vec{F}_M$ and $\vec{F} = (F_W + F_E)$ directed opposite and $\vec{F} > (\vec{F}_W + \vec{F}_E + \vec{F}_M)$, blocking the maturation division is not removed and during the oviposition they undergo normal fertilization. As a result, there are ~ 25% of normal males and ~ 25% of normal females from the total number of worms in the family of the silkworm.

Thus, it was found that within mating of moths of silkworm in CMF ~ 75% of males and ~25% females are obtained in the family.

Table 2. Comparative characteristics of the silkworm obtained from the eggs of moths interbreed in CMF with intensity 113.80 kA / m.

Batch	Revivalness, %	Harvest of cocoons *kg/g* of worms	The average weight of a living cocoon, *g*	Silk bearingness, %	Output of raw silk, %	Viability of worms %	The number of cocoons with unreleased moths, %
Control	96,7	4,225	2,04	20,6	41,8	93,5	4,5
Pilot	97,5	4,050	1,96	23,8	43,3	95,7	2,7

* After the unwinding of cocoons, produced pupas are used as raw material for other purposes and
therefore transfer of harmful genetic information to offspring is unlikely.

Table 2 shows the comparative characteristics of the spring rearing of silkworms of "Sheki-2" breed (2009), derived from moths interbreed in CMF with 113.80*kA/m* intensity ($N♂/N_0 \approx 60$, i.e. 60%). As can be seen from the table, the pilot batch of worms has normal viability, is as good as the control batch in other biological and technological characteristics. This is due to the fact that our proposed method will increase the proportion of males in the family of the silkworm, without exposing the moths to external destructive factors: radiation, thermal, chemical, and others. In addition, this method does not require expensive installation, is not harmful for the environment and can easily be applied to any relevant laboratories and silkworm breeding enterprises.

It is known that male worms have a higher viability and relatively low need for food than females. This satisfies the silkworm breeders. Another advantage: - male cocoons contain ~ 20% more silk [8] and that satisfy the requirement of silk-processing industry. For this region it's more profitable to buy the cocoons of males than females. Because male worms has high silk output, and their cocoons - weight and dimensions are inferior to females, ie unwinding ability and metric number of thread of male cocoon is higher than in females.

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REGULATION OF GENDER OF SILKWORMS BY MEANS OF CONSTANT MAGNETIC FIELD DURING THE MATING SEASON

Y.H. SHUKURLU

SUMMARY

Developed a method of controlling the floor silkworm with constant magnetic field (CMF**)**. It is shown that mating butterflies silkworm in CMF increases the relative number of males in the family.

It was revealed that mating silkworm moths in CMF from silkworm eggs obtained from these moths ~ 25% - normal, ~ 25% - meiotic, ~ 25% - androgenetic males and ~ 25% - normal females hatch, i.e. the gender ratio among newly hatched worms becomes equal to 3:1.

It was found that the parthenogenetic breeding of silkworms using CMF can get a wide practical application. This method is a promising approach to solving problems in breeding at industrial rearing of large number of males at no additional cost, with the preservation of the natural and normal vitality of worms.

Partly explained by the approximate mechanism of the effect CMF on the sexual reproduction silkworm and a form of sexual reproduction as parthenogenesis - not providing for the merger process haploid sex cells, or gametes, leading to the formation of a diploid cell zygote.

Established the dependence of the number of males in the family on the magnetic field. It is shown that this dependence is subject to respect $N = N_0\left(a - be^{-kH}\right)$, where N - the number of males in the family, N_0 - the total number of mulberry silkworms in the family, k - factor of activation of silkworm eggs with magnetic field, H - the intensity of the magnetic field, a and $b-$ constants depending on the orientation of crossed butterflies in CMF. Preliminary calculations show that, $k \approx 4{,}02 \cdot 10^{-3} м / A$. When coupling: butterfly female - head towards the north, males - head toward the south pole of the magnet (N♀♂S), $a \approx 0{,}75$; $b \approx 0{,}25$.

Keywords: ***oocyte, meiotic spindle, chromosome, kinetochore, aktin, tubulin, microtubules, intermediate filaments, metaphase, ovarioles, silkworm eggs, micropyle***

Creation and Testing of Silkworm, Bombyx mori L. F_1 Hybrids between Bulgarian and Italian Breeds

By

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ABSTRACT

The present study aimed to test several F1 hybrids between promising Bulgarian and Italian silkworm pure breeds and had been conducted during the spring seasons of 2010-2011 at the Sericulture and Agriculture Experiment Station, Vratsa, Bulgaria.The pure Bulgarian silkworm breeds Vratsa 35 (Japanese type) and Merefa 2 (Chinese type) and the pure Italian breeds 118 (Japanese type) and 121 (Chinese type) were used as parents of the F1 hybrids Vratsa 35 x 121 and the reciprocal, 118 x Merefa 2 and the reciprocal and Vratsa35x118 x Merefa2x121 and the reciprocal. As a control, the widely adopted Bulgarian F1 commercial hybrid Super 1 x Hesa 2 was used. Two gram of eggs of each silkworm hybrid were incubated and larvae reared together until the end of 2^{nd} instar. At the 3^{rd} instar beginning 4 replicates, consisted of 200 larvae each were counted from each hybrid and further reared until the cocoon spinning. The new Bulgarian-Italian silkworm F1 hybrids, tested in Bulgaria manifest a significantly lower pupation rate than the control, near to the control fresh cocoon weight, silk shell weight, silk shell rate, filament weight, raw silk percentage, higher filament length and lower filament thickness. The fresh cocoon weight and silk shell weight in the new hybrids are comparatively high, namely from 2628 mg to 2756 mg and from 572 mg to 621 mg. After a further adaptation of the Italian pure breeds to Bulgarian climatic and soil conditions, and improvement of their larval viability respective, the new Bulgarian-Italian F1 hybrids may be suggested for testing at the field level.

Key words: silkworm, Bombyx mori L., F1 hybrids, Bulgarian, Italian, testing

INTRODUCTION

In fact, the creation and utilization of F_1 hybrid forms in the silkworm, *Bombyx mori L.* has lead that now whole production of industrial cocoons in the sericulturally developed countries is based on a hybrid base. (Kantaratanarul et al., 1987; Jeong et al., 1990; Chatterjee, 1993; Ovesenska at al., 1986, 1998). In the evolution of the contemporary selection programs of Bombyx mori L., together with the selection and hybridization, great attention is paid to the use of populations of different geographic origin (Petkov, 1995; Rajavendra Rao 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, 2008). In the silkworm hybridization usually two, three or four pure breeds are crossed, each one characterized by comparatively high productivity, which is further increased in the F1 hybrid due to the good combining ability and high heterosis effect (Harada, 1952; Gupta, 1992).
The present study aimed to test several F1 hybrids between promising Bulgarian and Italian silkworm pure breeds.

MATERIAL AND METHODS

The study has been conducted during the spring seasons of 2010-2011 at the Sericulture and Agriculture Experiment Station, Vratsa, Bulgaria. For hybridization two Bulgarian and two Italian silkworm pure breeds were used. The Bulgarian pure breeds were:
Vratsa 35: the larvae are with markings and plain, the cocoons are white with peanut shape.
Merefa 2: the larvae are plain and the cocoons are white and oval.
The following two Italian silkworm breeds were used in the study:
118: the larvae are with markings, the cocoons are white with peanut shape.
121: the larvae are plain and the cocoons are white and oval.
The following F1 hybrids were tested:
Vratsa 35 x 121 and the reciprocal
118 x Merefa 2 and the reciprocal
Vratsa35x118 x Merefa2x121 and the reciprocal.
As a control, the widely adopted Bulgarian F1 commercial hybrid Super 1 x Hesa 2 was used.
2 g of eggs of each silkworm hybrid were incubated and larvae reared together until the end of 2nd instar. At the 3rd instar beginning 4 replicates, consisted of 200 larvae each were counted from each hybrid and further reared until the cocoon spinning.
The silkworm larvae were reared following the standard method for spring rearing in Bulgaria (Panayotov and Ovesenska, 2002), and fed “ad libitum” with mulberry leaves of №106 Bulgarian variety. The mulberry plantation was rain fed only, without any irrigation. The data obtained were processed statistically (Lidanski, 1988).

RESULTS AND DISCUSSION

The results obtained in 2010 are presented in tables 1 and 2. The pupation rate in all the new hybrids tested is significantly lower than the control. In most of the new hybrids however the fresh cocoon weight, silk shell weight and silk shell rate are near to the control. The fresh cocoon yield by one box of eggs is significantly lower than the control in the new hybrids due to the lower pupation rate. The filament length in the new hybrids is near or higher than the control. The silk filament weight, raw silk percentage and reelability are near to the control. The new hybrids perform thinner filament than in the control. In the hybrids 118 x Merefa 2 and reciprocal the raw silk yield by one box of silkworm eggs is not significantly different, compared with the control, but in the rest hybrids it is significantly lower.
The data from 2011 testing are shown in tables 3 and 4. Again, like in the previous year all the new hybrids display lower than the control pupation rate values. We could explain this fact with the need of a further adaptation of the Italian breeds in Bulgaria. Except for the hybrids 121 x Vratsa 35 and Vratsa35x118 x Merefa2x121 all the rest hybrids manifest significantly lower than the control fresh cocoon weight and silk shell weight. However the values of these two characters are comparatively high – from 2628 mg to 2756 mg and from 572 mg to 621 mg. On the other hand the new hybrids perform a near to the control or higher than the control silk shell percentage, which varies from 21.46 % to 22.53 %. Due mainly to the significantly lower pupation rate the new hybrids manifest a significantly lower fresh cocoon yield by one box of eggs than the control. In almost all new hybrids the filament length is higher than the control. The silk filament weight, raw silk percentage and reelability in the new hybrids are

near or a bit lower than the control. The filament thickness in the new hybrids is lower than the control. The raw silk yield in the new hybrids is lower than the control, but the difference is not so high like in the fresh cocoon yield by one box of eggs because the too low pupation rate has been partly compensated by silk filament technological characters values near to the control.

CONCLUSIONS

The new Bulgarian-Italian silkworm F1 hybrids, tested in Bulgaria manifest a significantly lower pupation rate than the control, near to the control fresh cocoon weight, silk shell weight, silk shell rate, filament weight, raw silk percentage, higher filament length and lower filament thickness.

The fresh cocoon weight and silk shell weight in the new hybrids are comparatively high, namely from 2628 mg to 2756 mg and from 572 mg to 621 mg.

After a further adaptation of the Italian pure breeds to Bulgarian climatic and soil conditions, and improvement of their larval viability respective, the new Bulgarian-Italian F1 hybrids may be suggested for testing at the field level.

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Table 1. Main productive characters values in Bulgarian-Italian F1 silkworm hybrids in 2010.

Hybrid	**Pupation rate (%)**	**Fresh cocoon weight (mg)**	**Silk cocoon shell weight (mg)**	**Silk shell ratio (%)**	**Fresh cocoon yield by 1 box of silkworm eggs (kg)**
Vratsa 35 x 121	79.13***	2280**	450**	19.74***	33.53***
121 x Vratsa 35	80.60**	**2498**	**526**	21.06	36.84**
118 x Merefa 2	84.63*	**2506**	**543**	21.67	**37.87***
Merefa 2 x 118	80.38**	**2556**	**531**	20.77	**38.88**
Super 1 x Hesa 2 (control)	**90.88**	**2578**	**549**	**21.30**	**43.71**

***P < 5%; **P < 1%; ***P < 0.1%**

Table 2. Silk filament technological characters values in Bulgarian-Italian F1 silkworm hybrids in 2010.

Hybrid	**Filament length (m)**	**Silk filament weight (mg)**	**Raw silk percentage (%)**	**Reelability (%)**	**Silk filament thickness (denier)**	**Raw silk yield by 1 box of silkworm eggs (kg)**
Vratsa 35 x 121	1291	383*	37.40	90.76	2.67**	5.14**
121 x Vratsa 35	1248	392	37.80	86.92***	2.83	5.71*
118 x Merefa 2	1488***	394	38.29	89.95	2.38***	5.95
Merefa 2 x 118	1322*	390	36.86	90.07	2.65**	5.88
Super 1 x Hesa 2 (control)	**1295**	**423**	**37.80**	**90.58**	**2.94**	**6.77**

***P < 5%; **P < 1%; ***P < 0.1%**

Table 3. Main productive characters values in Bulgarian-Italian F1 silkworm hybrids in 2011.

Hybrid	Pupation rate (%)	Fresh cocoon weight (mg)	Silk cocoon shell weight (mg)	Silk shell ratio (%)	Fresh cocoon yield by 1 box of silkworm eggs (kg)
Vratsa 35 x 121	**71.50*** **	**2664***	**572***	**21.47**	**32.86*** **
121 x Vratsa 35	**87.50**	**2756**	**621**	**22.53***	**42.54*** **
118 x Merefa 2	**82.00*** **	**2637***	**583***	**22.11**	**40.04*** **
Merefa 2 x 118	**79.50*** **	**2628***	**580***	**22.01**	**39.05*** **
Vratsa35x118 x Merefa2x121	**79.50*** **	**2772**	**595**	**21.46**	**37.92*** **
Merefa2x121 x Vratsa35x118	**79.50*** **	**2597*** **	**583***	**22.45***	**38.78*** **
Super 1 x Hesa 2 (control)	**92.13**	**2836**	**615**	**21.69**	**48.38**

***P < 5%; **P < 1%; ***P < 0.1%**

Table 4. Silk filament technological characters values in Bulgarian-Italian F1 silkworm hybrids in 2011.

Hybrid	Filament length (m)	Silk filament weight (mg)	Raw silk percentage (%)	Reelability (%)	Silk filament thickness (denier)	Raw silk yield by 1 box of silkworm eggs (kg)
Vratsa 35 x 121	1446***	460**	42.20	93.88	2.86***	5.69***
121 x Vratsa 35	1421****	500	43.86	92.59	3.17	7.65
118 x Merefa 2	1398**	480*	43.64	92.31*	3.09*	7.16*
Merefa 2 x 118	1445***	470*	42.73	92.16*	2.93**	6.84***
Vratsa35x118 x	1269	440*	40.00**	91.67**	3.12*	6.22***

Merefa2x121						
Merefa2x121 x Vratsa35x118	1433***	490	41.18*	89.09***	3.08*	6.55***
Super 1 x Hesa 2 (control)	**1296**	**509**	**43.65**	**95.50**	**3.53**	**8.66**

***P < 5%; **P < 1%; ***P < 0.1%**

Section Silkworm rearing and feeding

Study on Different Terms of Autumn Silkworm Rearing Beginning in Bulgaria

By

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ABSTRACT
While the optimum terms of spring silkworm rearing in Bulgaria have already been well studied, the information concerning optimal terms for the beginning of summer-autumn silkworm rearing is too scarce. Actually in Bulgaria if taking one crop only from mulberry it is possible to have the summer rearing during a period, starting from the beginning of July, but it is not clear when should be the latest term to begin the rearing in the autumn. However in the practice, two crops from mulberry are usually taken, that's why when decide the summer-autumn rearing beginning there should be considered also to have enough mulberry shoots growth after the spring bottom pruning. As the spring bottom mulberry pruning in Bulgaria is usually performed from the beginning to the mid of June and considering that mulberry needs of about 3 months to sprout and form new shoots, suitable for top pruning it may be concluded that the beginning of the summer autumn silkworm rearing should not be earlier than the mid of august. On the other hand the mulberry leaf quality after the beginning of October gets quickly worse day by day, therefore the summer autumn rearing period beginning in Bulgaria should be from the mid of August, but it is yet to be investigated until what time in September will still be possible to start the rearing. This study aimed to investigate different terms of summer-autumn silkworm rearing beginning from the end of August to the last decade of September in Bulgaria. The study has been conducted during the period 2007 – 2009 at the Sericulture and Agriculture Experiment Station, Vratsa, Bulgaria. Two Bulgarian F1 commercial silkworm hybrids, namely Super 1 x Hesa 2 and SN1xI1 x M2xN2 were used in the study. The silkworm larvae were reared following the standard method for summer-autumn rearing in Bulgaria, and fed "ad libitum" with mulberry leaves of №106 Bulgarian variety. The mulberry plantation was rain fed only, without any irrigation.

From the results obtained it is concluded that the summer-autumn silkworm rearing in Bulgaria should be started not later than the mid of September. If the autumn silkworm rearing starts after the mid of august there should be obligatory provided a proper heating of the house.

Key words: sericulture, rearing season, summer-autumn, viability, productivity.

INTRODUCTION

There are two silkworm rearing seasons in Bulgaria, namely spring (May and June) and summer - autumn (August and September). While the optimum terms of spring silkworm rearing have already been well studied (Petkov, 1978, 1979; Petkov and Penkov, 1976; Tzenov, 1996), the information concerning optimal terms for the beginning of summer-autumn silkworm rearing is too scarce. Petkov, 1980 investigated mulberry leaves from different varieties and feeding amounts utilization by the silkworm larvae in the spring and summer-autumn seasons. Panayotov, 1995 studied the silkworm rearing performance during the late-autumn season. Ovesenska at.al., 1996 compared the results of some univoltine silkworm breeds and their hybrids rearing during the spring and autumn seasons in Bulgaria. Actually in Bulgaria if taking one crop only from mulberry it is possible to have the summer rearing during a period, starting from the beginning of July, but it is not clear when should be the latest term to begin the rearing in the autumn. However in the practice, two crops from mulberry are usually taken, that's why when decide the summer-autumn rearing beginning there should be considered also to have enough mulberry shoots growth after the spring bottom pruning. As the spring bottom mulberry pruning in Bulgaria is usually performed from the beginning to the mid of June and considering that mulberry needs of about 3 months to sprout and form new shoots, suitable for top pruning it may be concluded that the beginning of the summer autumn silkworm rearing should not be earlier than the mid of august. On the other hand the mulberry leaf quality after the beginning of October gets quickly worse day by day, therefore the summer autumn rearing period beginning in Bulgaria should be from the mid of August, but it is yet to be investigated until what time in September will still be possible to start the rearing.
This study aimed to investigate different terms of summer-autumn silkworm rearing beginning from the end of August to the last decade of September in Bulgaria.

MATERIALS AND METHODS

The study has been conducted during the period 2007 – 2009 at the Sericulture and Agriculture Experiment Station, Vratsa, Bulgaria. Two Bulgarian F1 commercial silkworm hybrids, namely Super 1 x Hesa 2 and SN1xI1 x M2xN2 were used in the study. The silkworm rearing began on different dates from the end of August to the last decade of September. In each rearing term 2 g of eggs of each silkworm hybrid were incubated and larvae reared together until the end of 2nd instar. At the 3rd instar beginning 4 replicates, consisted of 250 larvae each were counted from each hybrid and further reared until the cocoon spinning.
The silkworm larvae were reared following the standard method for summer-autumn rearing in Bulgaria (Panayotov and Ovesenska, 2002), and fed "ad libitum" with mulberry leaves of №106 Bulgarian variety. The mulberry plantation was rain fed only, without any irrigation. The data obtained were processed statistically.

RESULTS AND DISCUSSION

The results obtained are presented in Tables 1 – 6. As the year of silkworm rearing is very important as a factor influencing the silkworm viability and productivity we present the data for each year separately. It is evident from tables 1 and 2 that in 2007 the term of summer-autumn silkworm rearing beginning has not influenced significantly the values of the characters larval period duration, pupation rate, fresh cocoon yield by one box of eggs, filament length and thickness. The fresh cocoon weight and silk shell weight characters values are not influenced significantly up to 15.09. as a date of hatching, while they are lower in the next two terms, but not significantly. It could be supposed that the values of these characters are influenced mostly by the rains distribution during the larval period rather than the term of rearing beginning. The silk shell ratio, filament weight, raw silk percentage and raw silk yield by one box of eggs tend to be lower during the last term of rearing.

The data in table 3 display that in 2008 in the last term of rearing the total larval period is shortened, but the 5th instar duration is longer. The pupation rate in the 2nd and 3rd terms of rearing is lower, compared with the 1st term. The term of silkworm rearing has not influenced significantly the fresh cocoon weight, silk shell weight and silk shell ratio values, while the fresh cocoon yield by one box of eggs in most of the cases is lower in the second and third terms of rearing. In the hybrid Super 1 x Hesa 2 the filament length is the highest in the first term of rearing, but in the other hybrid tested there are no any significant differences detected between the terms of rearing (Table 4). Concerning the silk filament weight the differences between the rearing terms are very small. In the hybrid Super 1 x Hesa 2 the raw silk percentage is significantly lower in the third term of rearing, but in the other hybrid tested there are no any significant differences detected. In both the hybrids however the reelability is significantly lower in the third term of silkworm rearing. The silk filament thickness and raw silk yield by one box of eggs characters values are not influenced significantly by the term of rearing.

In 2009 the data obtained display a clear decrease of the pupation rate in the second and third terms and the fresh cocoon weight, shell weight and shell ratio values in the second and third terms. The silk filament technological characters however have not been influenced significantly by the rearing term.

In our present experiments, as the mulberry trees have not been irrigated at all and the mulberry leaves not treated by water or some additives, their nutritional quality is entirely natural, depending on the rainfall. This is completely in unison with the conditions at the field level. On the other hand the silkworm rearing temperature in our experiments was strictly (automatically) maintained within the optimal levels throughout the whole larval period, the cocoon spinning and stay on the mountages until harvesting. These conditions however differ from the mass field practice in Bulgaria where the sericulturists in order to save money and/or because the type of rearing house does not allow any heating, usually do not heat the rearing houses during the 4th and 5th instars and cocoon spinning. From our present experiments it might be concluded that it is possible to begin the autumn silkworm rearing up to the mid of September, but in our opinion it will be too riskily in the real sericultural practice in Bulgaria. The reason is that after the mid of September there often appear sudden cool even cold weather which if the rearing house is not properly heated may lead to cocoon crop failure.

CONCLUSIONS

-The summer-autumn silkworm rearing in Bulgaria should be started not later than the mid of September.

- If the autumn silkworm rearing starts after the mid of august there should be obligatory provided a proper heating of the house.

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Table 1. Main productive characters values in different terms of autumn rearing beginning in 2007.

Hybrid	Date of hatching	Larval period duration (h)	5th instar duration (h)	Pupation rate (%)	Fresh cocoon weight (mg)	Silk cocoon shell weight (mg)	Silk shell ratio (%)	Fresh cocoon yield by 1 box of silkworm eggs (kg)
Super 1 x Hesa 2 (control)	**29.08.**	**625**	**170**	**91.13**	**1837**	**382**	**20.79**	**30.32**
Super 1 x Hesa 2	**07.09.**	**680****	**176**	**87.25**	**1660*****	**336***	**20.24**	**27.31**
Super 1 x Hesa 2	**09.09.**	**648**	**162**	**90.75**	**1755***	**345***	**19.66***	**28.80**
Super 1 x Hesa 2	**15.09.**	**626**	**162**	**86.50***	**1902***	**385**	**20.24**	**30.16**
Super 1 x Hesa 2	**18.09.**	**696*****	**180***	**88.25**	**1873**	**372**	**19.86**	**29.06**
Super 1 x Hesa 2	**24.09.**	**650**	**187****	**89.50**	**1702*****	**304*****	**17.86*****	**28.73***

***P < 5%; **P < 1%; ***P < 0.1%**

Table 2. Silk filament technological characters values in different terms of autumn rearing beginning in 2007.

Hybrid	Date of hatching	Filament length (m)	Silk filament weight (mg)	Raw silk percentage (%)	Reelability (%)	Silk filament thickness (denier)	Raw silk yield by 1 box of silkworm eggs (kg)
Super 1 x Hesa 2 (control)	29.08.	1004	321	39,31	99,23	2,88	4.89
Super 1 x Hesa 2	07.09.	1062	293	37,24	92,55***	2,48**	4.17*
Super 1 x Hesa 2	09.09.	1026	293	37,18	89,96***	2,57*	4.39
Super 1 x Hesa 2	15.09.	1135*	336	39,59	90,77***	2,66	4.90
Super 1 x Hesa 2	18.09.	1062	310	45,66***	99,23	2,62	5.44*
Super 1 x Hesa 2	24.09.	925*	256**	38,61	88,15***	2,49**	4.55

***P < 5%; **P < 1%; ***P < 0.1%**

Table 3. Main productive characters values in different terms of autumn rearing beginning in 2008.

Hybrid	Date of hatching	Larval period duration (h)	5^{th} instar duration (h)	Pupation rate (%)	Fresh cocoon weight (mg)	Silk cocoon shell weight (mg)	Silk shell ratio (%)	Fresh cocoon yield by 1 box of silkworm eggs (kg)
Super 1 x Hesa 2 (control)	03.09. (control)	711	190	85.50	1426	263	18.44	20.73
Super 1 x Hesa 2	13.09.	720	196	64.25***	1481	274	18.50	16.57**
Super 1 x Hesa 2	25.09.	648***	216***	84.50	1460	276	18.90	23.09
SN1xI1 x M2xN2	03.09. (control)	707	186	87.88	1436	274	19.08	22.04
SN1xI1 x M2xN2	13.09.	696	172	75.00***	1388*	252*	18.16*	17.88***
SN1xI1 x M2xN2	25.09.	648**	216**	66.13***	1502*	298*	19.84*	18.21***

***P < 5%; **P < 1%; ***P < 0.1%**

Table 4. Silk filament technological characters values in different terms of autumn rearing beginning in 2008.

Hybrid	Date of hatching	Filament length (m)	Silk filament weight (mg)	Raw silk percentage (%)	Reelability (%)	Silk filament thickness (denier)	Raw silk yield by 1 box of silkworm eggs (kg)
Super 1 x Hesa 2 (control)	03.09. (control)	1001	256	40.57	92.00	2.60	3.45
Super 1 x Hesa 2	13.09.	919*	241	39.06	91.63	2.36*	2.65**
Super 1 x Hesa 2	25.09.	822***	241	34.04***	87.60**	2.64	3.22
SN1xI1 x M2xN2	03.09. (control)	887	235	36.72	96.00	2.34	3.32
SN1xI1 x M2xN2	13.09.	898	226	40.87**	90.04*	2.26	3.00
SN1xI1 x M2xN2	25.09.	903	268*	37.69	89.33**	2.67*	2.81*

***P < 5%; **P < 1%; ***P < 0.1%**

Table 5. Main productive characters values in different terms of autumn rearing beginning in 2009.

Hybrid	Date of hatching	Pupation rate (%)	Fresh cocoon weight (mg)	Silk cocoon shell weight (mg)	Silk shell ratio (%)	Fresh cocoon yield by 1 box of silkworm eggs (kg)
Super 1 x Hesa 2 (control)	01.09. (control)	77.50	1383	257	18.58	20.88
Super 1 x Hesa 2	13.09.	49.63***	1627***	323***	19.85*	20.00
Super 1 x Hesa 2	24.09.	-	1308*	227	17.35*	-
SN1xI1 x M2xN2	02.09. (control)	64.63	1402	266	18.97	16.48
SN1xI1 x M2xN2	14.09.	31.75***	1368**	288*	21.05**	12.47***
SN1xI1 x M2xN2	25.09.	-	1356**	247*	18.22	-

***P < 5%; **P < 1%; ***P < 0.1%**

Table 6. Silk filament technological characters values in different terms of autumn rearing beginning in 2009.

Hybrid	Date of hatching	Filament length (m)	Silk filament weight (mg)	Raw silk percentage (%)	Reelability (%)	Silk filament thickness (denier)
Super 1 x Hesa 2 (control)	01.09.	946	250	38.46	94.70	2.38
Super 1 x Hesa 2	13.09.	1045*	260	35.62*	95.59	2.24
SN1xI1 x M2xN2	02.09. (control)	858	210	37.50	90.13	2.20
SN1xI1 x M2xN2	14.09.	848	220	34.92	96.92**	2.33

***P < 5%; **P < 1%; ***P < 0.1%**

Section Silkworms as biological models.

New protein studies in Polish sericulture

By

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Abstract: Beyond thecommonlyknown proteinsbuilt silk fibres -fibroinandsericin–there are almost 300bioactiveproteins in thesilkwormhemolymph.The aim of this work is to present bioactive compounds, obtained from the silk fibre andisolatedfrom the body of this insect, which may be used in medical and pharmacological applications.The most important are bioactive proteins. However, juveniles stages of the mulberry silkworm possess others, very valuable active substances.

Key words: *Bombyx mori* L., proteins, hemolymph, silk fibre.

Introduction

The silkworms are a group of night moths that produce a silk fibre during their life cycle. The fibre produced by caterpillars adheres the old epidermis to bedding during moulting and serves for building cocoons where the chrysalise transforms into a butterfly. The mulberry silkworm (*Bombyx mori*L.)is a domesticated insect bred by humansfor about five thousand years due to its ability to produce one of the best natural silk fibers.

The aim of work is to present bioactive compounds, obtained from silk fibre andisolatedfrom the body of the mulberry silkworm, which areused in medical and pharmacological applications and tissue engineering.

Silkworms bioactive proteins

The mulberry silkworm is a main source of fibroin and sericin – two proteins of silk fibre, which are used for producing a biocompatible biopolymers for tissueengineering, biomedical and biotechnological applications and for regenerative therapy (Hakimi *et al*. 2007; Kundu *et al*. 2008, Kearns et al. 2008; Kundu and Kundu, 2010).The amino acid composition of silk fibroin from *B. mori* consists primarily of glycine (43%), alanine (30%)and serine (12%) (Kundu *et al*. 2008). Sericinischaracterized by unusually high serine content (40%) along with significant amounts of glycine (16%) (Kundu *et al*. 2008).

Innovative fibroin biomaterials, such as hydrogels, films, non-woven silk mats, porous silk sponges, screws, scaffolds and plates are widely used in orthopedics, craniofacial surgery, dental applications, to repair broken bones or reconstruction of damagedvesselsand nerves by injury or disease (Kundu *et al*. 2008, Zhang *et al*. 2009).Silk fibroin has been also investigatedformany other biomedical applications including osteoblast, hepatocyteand fibroblast cell support matrixes as well as for ligament tissue engineering (Sionkowska and Płanecka, 2013). Sericin has excellent antibacterial, antioxidant, anticancer and UV-protecting activities. Moreover, this protein enhances the attachment of primary cultured human skin fibroblast.Thus a sericin cream is used as an agent used in treatment ofdifficult to healwounds, without causing allergic reactions (Aramwit and Sangcakul, 2007).Thus, dermatitis and other skin problems can be controlled with this protein.

A huge amount of very precious bioactive proteins may be also found in hemolymph of silkworm caterpillars. The number of proteins rangesfrom 241 to 298 (Li *et al.* 2006).However, in 2013 only 61 structures of silkworm proteins were deposited in the Protein Data Bank. Among the hemolymph proteins two major groups can be distinguished: high molecular weight storage proteins (SP, hexamerins of a molecular weight of about 500 kDa) and 30-kDa lipoproteins (LPs).

Three storage proteins SP1(SP1; Sakurai *et al.*, 1988), SP2;(Fujii *et al.*, 1989) and SP3 (Hou *et al.*, 2010) are very important for regular development of butterfly. The main physiological role of these proteins is the storage of amino acids at the final developmental stages of adult (Levenbook and Bauer, 1984).

SP1 and SP2 are hexamerins and contain six subunits of a molecular weight of about 85 kDa. They were always described as homohexamers, howerever, the crystallographic studies carried out on proteins isolated from silkworm hemolymph revealed that SP2 and SP3 are present in silkworm body in the form of heterohexamer composed of three SP2 and three SP3 chains(Pietrzyk *et al*. 2013a).The biological role of proteins SPs is strictly dependent on their primary structure. Arylphorins are silkworm storage proteins, they serve as the main supply of nitrogen during the pupal stage (Riddiford and Law, 1983).

The largest group of hemolymph proteins are lipoproteins (molecular weight 30-kDa) involved in lipid transport. Hemolymph lipoproteins transport lipids released from the silkworm FB. They serve as storage proteins during pupation and adult development (Vanishree *et al.*, 2005). The 30-kDa LPs are used as the source of nutrition after enzymatic digestion (Hou *et al.*, 2010). Moreover 30-kDa LPs are probably also involved in immune response pathway, namely antifungal defense system (, because they are able to specifically bind glucose and glucans which are the main components of fungal cell walls. What is more, it was reported that a member of the 30-kDa LP family activates a prophenoloxidase cascade, the immune response pathway (Ujita *et al.*, 2005).

Silkworms hemolymph contains a number of different chemical compounds and it might be that 30-kDa LPs are able to interact with them. It was reported that the 30-kDa LPs contain binding cavities for lipids, carbohydrates and maybe for other unknown compounds. Bmlp3 and Bmlp7 were used for the analysis and four potential binding cavities were found. Two pockets are located in the CTD and one in the NTD, one between the NTD and CTD (Pietrzyk *et al*. 2012; Pietrzyk *et al*. 2013b).

The 30-kDa LPs might be capable of interacting with other proteins, especially proteins involved in the apoptosis process. This activity of Bmlp7 and Bmlp3 might be related tothe N-terminal domain (Pietrzyk et al. 2012; Pietrzyk *et al*. 2013b).The addition of silkworm hemolymph to cell cultures inhibits apoptosis and improves viability of the cells. To this date, anti-apoptotic properties of hemolymph were proven for insect, Sf9 (Rhee and Park,2001), mammalian, CHO and human cell lines, HeLa (Choi *et al.*, 2002) and HEK293 (Kim *et al.*, 2004). Additionally, apoptosis inhibition by hemolymph resulted in a five-fold increase of erythropoietin production in the CHO cell culture (Choi *et al.*, 2005).

Moreover, it is plausible that the 30-kDa LPs are also capable of carbohydrate binding and this particular domain could be directly involved in immune response to fungal infections via β-glucan recognition.The C-terminal domain has a β-trefoil fold,suggesting a role of Bmlp7 in sugar binding and in theimmune response to fungal invasion (Pietrzyk *et al*. 2012).

Recently, the unexpected identification of a cadmium binding site in the Bmlp7-I(Cd) structure suggested that Bmlp7 may be involved in a silkworm detoxification mechanism related to heavy metal pollution (Pietrzyk *et al*. 2012). The link between the unexpected cadmium presence in the Bmlp7-I(Cd) and the biological sense of this discovery was established on the basis of reports about the silkworm ability to bioaccumulate heavy atoms (Pietrzyk *et al*. 2012). Especially, the fifth instar larvae is able to ingest mulberry leaves with very high cadmium content.

Cell-penetrating properties of30-kDa LPs made themcapable to penetrate into various typesof living cells via a receptor-independent endocytosis. They could be used for the deliveryof biologically active proteins, DNA and other compounds into cell cultures and animalmodels *in vivo* (Wadia and Dowdy, 2002). Therefore, members of the 30-kDa LP family are potentialmedicinal tools for cargo molecule delivery into target tissues (Park *et al.*, 2012).

Summary

The mulberrysilkwormis usedby man for centuries.Initiallyin ancient Chinasilkglands of this insect were usedfor the production ofstringsfor musical instrumentsandfishing lines. Later,for fifth centuriessilkworm was usedfor the production ofsilk fibres.Nowadays, it appears that this insectisvaluable to humansnot only by thewonderfulfibers, but also the bioactivecompoundsby whichwe developnew opportunitiesin various fieldsof science.

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Section Economy: Domestic and international markets, prices, trading, economic analyses of projects etc.

SERICULTURE IN TURKEY:
CURRENT SITUATION, CONSTRAINTS AND POLICIES

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ABSTRACT
Having 1500 years of history in Turkey, sericulture is mostly done by small scale family enterprises with small scale production.
In Turkey; in the absence of alternative sources of income where agricultural areas are limited, barren and prone and transportation is difficult, sericulture is an important economic activity for the low income producers provides an important alternative for livelihood income. Turkey producing silkworm eggs free from disease and are one of the few countries which have its own silkworm genetic resources. As of 2014, 37 out of 81 provinces in the fresh cocoons are produced. In terms of climate conditions although Turkey is appropriate for growing mulberry tree and suitable for sericulture, it is mostly done during spring season. For the last two decades fresh cocoon production volume has decreased by approximately 90% due to lower import prices, high return of alternative crops income than the sericulture, excessive and unconscious use of pesticides in crop production, industrialization, urbanization and migration. On the other hand, Turkey is dependent on foreign at raw silk. Related products of silkworm breeding (seed, dry cocoon, raw silk) Zero customs duty is applied on imports into Turkey. Given, in the exports of the same product no subsidies are not provided
For this reason, to encourage production in Turkey, to keep the place where growers and in order to lay claim to sericulture that a cultural product, Silkworm breeding is subsidised by goverment since 2002. Silkworm subsidies are seed (TL/Box) and cocoon (TL/kg) subsidies. Breeding and fresh cocoon subsidies are provided per kg of the amount of cocoons produced.

There is no prerequisite to benefit from the support and The amount of subsidy is determined for every year.
The amount of subsidies paid to the silkworm breeders is very vital for the producers. Indeed, 82.4% of revenue in the hybrid business cocoons per box and those in the breeding business consist of 50% of state support in 2014. It is imperative to continue to goverment subsidies for continuity of production and hampering the extinction of the Sericulture.
In this study, The status of the silkworm breeding in Turkey and existing support policies are evaluated. In the study as well as secondary data and conducting surveys with totally 207 producers face to face in provinces constituting 66% of Turkey fresh cocoon production and Bursa in which the silk worms breeding were utilized.
According to findings of the research, There is no other agricultural enterprises operating outside of the 20.7% of sericulture. Most of the business sericulture as well as vegetable or animal activity engaged in to carry out these activities in order to meet the needs of families and they do not receive any income. Indeed, the business of the average annual income of sericulture is 645 Euro and sericulture's share of total agricultural income is 54.7%. The average number of enterprises they open is 2.17, the average yield is 25.26 kg / box.
The absence of manufacturers' feeding house and shortage of mulberry tree and labor are the most important causes affected the production of the cocoon. The low price of cocoons and reduction of labor due to youth's moving away from production are the responsible factors for the release of the silkworm.

Keywords: Sericulture, Kozabirlik, silkworm subsidies and cocoon.

1. INTRODUCTION

Sericulture in Turkey is an old activity. After the proclamation of the Republic in 1926, the production of silkworm seeds, care and nurture of them are secured by the law no.859. Sericulture started scientifically with the establishing of Bursa Sericulture Research Institute in 1988 (GDL).
Sericulture in Turkey is mainly performed in the mountanious areas where the agricultural lands are not suitable for other agricultural activities as a supplemantary activity, and is performed within a small scale. Fresh cocoon production is generally made by elder people and women from families with lower incomes in the areas of production and all the family labor is utilized.
Sericulture can be performed twice in a year in spring and fall. Although Turkey is one of the countries which is suitable for sericulture in terms of climate conditions, it is economically performed only in Spring (Tatlıdil, 2008).
Sericulture that does not need much investment, it employed family labor in 1709 farms so it helped rural employement. In sericulture, approximately 500,000 people are employed for the production process from fresh cocon production to silk carpet marketing, and 14-fold added value is provided as a result of transformation of fresh cocoon into silk carpet (Anonymous 2014a).
Turkey is one of the few countries that produce silkworm eggs free from polarin disease (sanitary) and has its own genetic resources, and meet the big part of the EU's need of silkworm eggs.
Sericulture in Turkey is still an economical activity for the producerswho have lower incomes and in the places that have limited, unproductive, slanting agricultural lands which has bad transportation conditions and do not have alternative income sources. Moreover sericulture

has an important place for Turkey in terms of protecting cultural heritage and genetic resources.

2. MATERIAL AND METHOD

The main material of the study is the primary data which is provided from the interviewed producersand as well as the secondary data. Primary data are obtained from the findings of the surveys that are conducted with 203 producersin the province of Diyarbakır, Antalya, Bilecik which produces 66 percent of fresh cocoon, and 207 producers in Bursa that also performs breeding sericulture. These data are evaluated by frequency distribution tables and likert scale.

The secondary data are obtained from the records of Cocoon Union (KOZABIRLIK) and the Directorates of Provinces, TURKSTAT Statistics, the records of other institutes relavent to the topic and the results of the studies about the topic that are carried out before.

3. THE CURRENT SITUATION OF SERICULTURE IN TURKEY

a. Production

In 2014, fresh cocoon production is made in 37 of the 81 provinces of Turkey. 80 percent of fresh cocoon production is made in the provinces of Antalya, Diyarbakır, Bilecik, Ankara, İzmir and Sakarya in 2014 (Figure1).

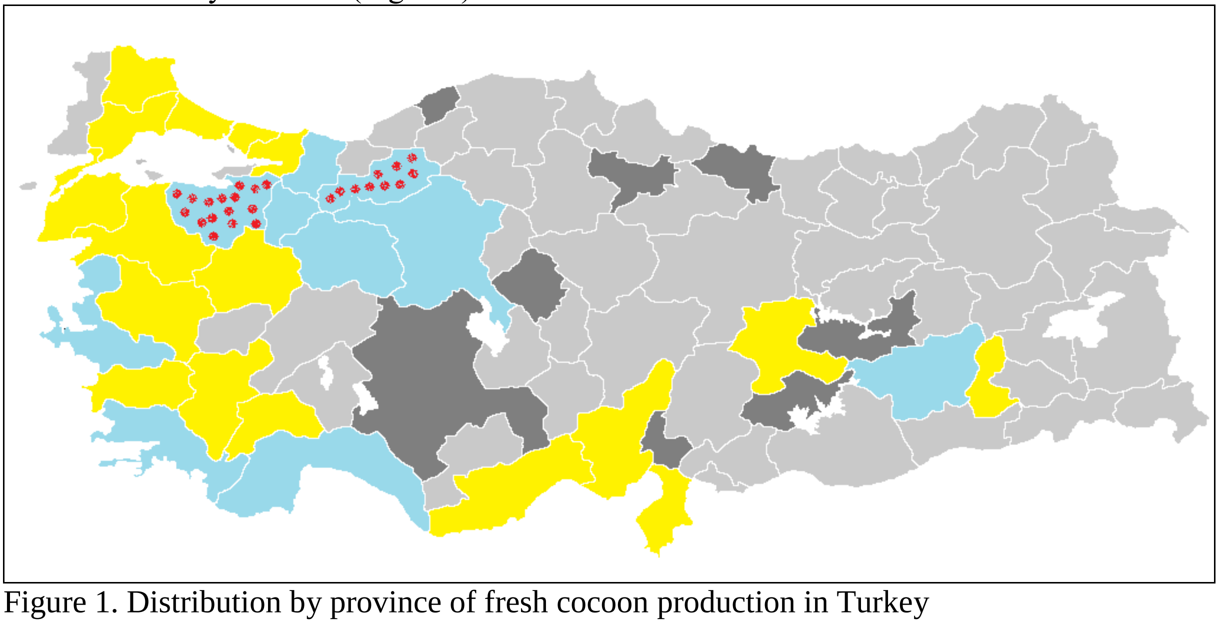

Figure 1. Distribution by province of fresh cocoon production in Turkey

p.s.: Blue: 97 per cent of fresh cocoon production, Yellow: 3 percent, Grey: the provinces that are unproductive, Red points: the provinces that make 100 percent of the breeding production

The sericulture in Turkey was affected negatively by the gulf crisis in 1990 and crashing of Soviet Union. Although the sericulture that was performed by 44,960 families in 1,781 villages in 1982, because of the decreasing prices in domestic market due to the lower import prices, the more revenue of alternative agricultural activities than that of sericulture, the structural problems of the farms, the changes and interactions in social structure, the excessive use of agricultural chemicals, industrialization, urbanization and immigration, the number of households that perform sericulture was decreased gradually to 1,709 in 338 villages in 2014 (Figure 2). Relevant to this decrease, the fresh cocoon production that is 1,353 tons in 1991 became 775 tons by 94 percent decrease (Table 1)

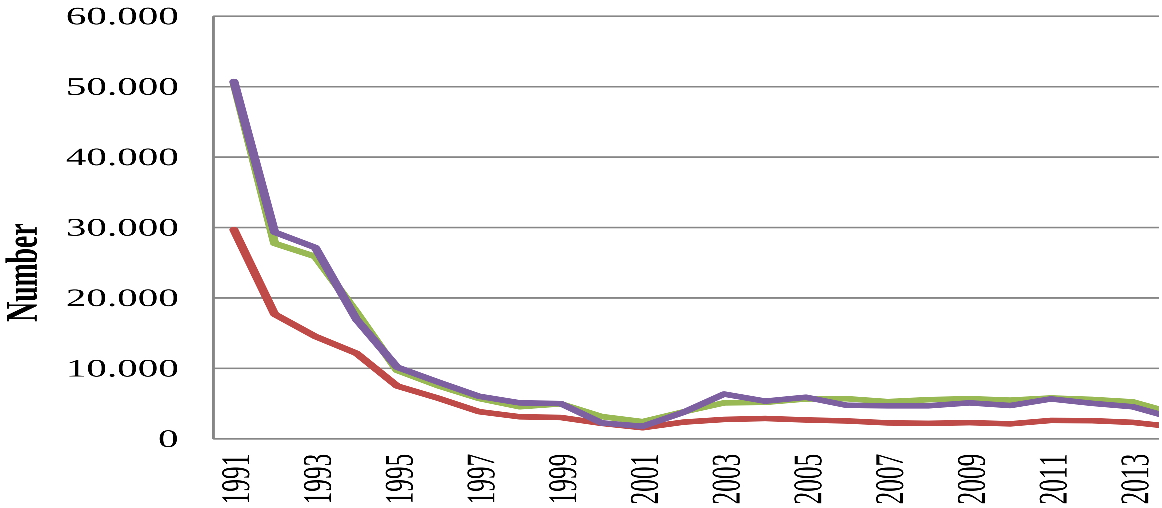

Figure 2. The number of households engaged in sericulture, opened boxes and fresh cocoon production in Turkey

Table 1. The number of households engaged in sericulture, opened boxes and fresh cocoon production in Turkey

Years	Households (number)	Opened box (number)	Production (tons)
1991	29.689	50.623	1.353
1992	17.703	27.732	782
1993	14.544	25.884	724
1994	12.151	17.953	452
1995	7.493	9.702	271
1996	5.756	7.529	215
1997	3.863	5.741	161
1998	3.115	4.543	136
1999	3.019	4.964	133
2000	2.210	3.147	60
2001	1.555	2.445	47
2002	2.356	3.839	100
2003	2.758	5.097	169
2004	2.888	5.161	143
2005	2.677	5.669	157
2006	2.527	5.699	127
2007	2.274	5.273	125
2008	2.193	5.564	125
2009	2.295	5.683	136
2010	2.134	5.477	126
2011	2.623	5.808	151
2012	2.572	5.576	134
2013	2.343	5.261	121
2014	1.709	3.625	77,5

Kaynak: TURKSTAT and KOZABIRLIK

After 2000, although the decreasing of sericulture production is stopped by the subsidies, the production amount in 1990s can not been achieved. According to the Table 1, the fresh cocoon production which decreases to 47 thousand tons in 2001 in recent years it has been increased to over 120 thousand tons due to the increasing prices which is affected by the intensive activities of Cocoon Union and govenment subsidies. The number of province that breeds silkworms was increased from 12 in 2000 to 37 in 2014 and the number of villages from 230 to 327 (Kozabirlik, 2014).

Raw silk is produced, drawing filaments from the big part of cocoon produced in Turkey and raw silk thread production is started in the facility that was established by Cocoon Union in Eskişehir in 2009 in order to draw filaments from silkworm cocoons. However, the production is ceased for a while in February of 2012 because of the decreasing prices towards the end of 2011 (GTB, 2013). Moreover, to prevent the losses stemmed from dehiscence in 2008, a dehiscence facility was established to disseminate the dehiscent bugs to the producers in the region (GTHB, 2014).

b. Consumption

Although the share of silk is lower than other textile products in the World, silk products have a trade volume of million dolars. Moreover, it has 20-fold more value than cotton (Anonymous, 2014b).

The dry cocoon is used mostly by Cocoon Union and silk is produced, drawing filaments from annually average of 50 tons dry cocoon. The imported raw silk and silk thread is used in carpet sector (Tatlıdil, 2008). Silk carpet weaving of 40.000-50.000 m^2 is performed in 15 thousand carpet looms.

Because of the very high prices of silk carpet, nearly all of carpets are exported. However, 50 tons of silk textile products made by raw silk are consumed domestically (GTHB, 2014).

Taking into account market conditions, nearly average of 100 tons of silk thread imported annualy is used by carpet manufacturers. However, the silk carpeting is gradually decreased and the firm number in Hereke that is a trademark in silk carpeting dropped to 5 (GTB, 2013).

c. Foreign trade

The fresh silk cocoon is not for trade in Turkey but dry cocoon, raw silk and silk thread. The products (seed, dry cocoon, raw silk) of sericulture has zero tariff rate and there is no subsidy for their exportation (Tatlıdil, 2008).

The importation and exportation of dry cocoon, raw silk and silk thread between 2000-2013 is given in Table 2.

i. Importation

Because of supply of fresh cocoon not meeting the demand, Turkey not having modern drawing facilities for processing of cocoons produced domestically, production costs being very high, Turkey is dependent on foreign countries and is net importer for raw silk (Tatlıdil, 2008).

Table 2. Foreign Sericulture Trade (Kg)

Year	Export(Kg)		Import (Kg)	
	Dry Cocoon	Silk Thread	Raw Silk	Silk Thread
2000	54.000	138.387	203.650	8.080
2001	0	111.789	255.789	19.404
2002	3.050	74.945	205.482	29.803
2003	82.800	86.791	183.579	17.494
2004	61.200	91.911	193.737	62.640
2005	39.600	14.713	160.054	67.005
2006	32.400	14.679	116.636	73.709
2007	0	14.210	130.393	171.896
2008	0	26.721	96.571	198.022

2009	30.675	6.580	54.572	114.108
2010	67.568	7.927	92.422	87.510
2011	7.884	5.763	113.991	49.439
2012	80.238	9.006	47.957	36.688
2013	30.445	9.912	58.300	63.233

Kaynak: TURKSTAT, 2014

Raw silk and thread importation changes with the dependency on domestic market and carpet exportation. The big part of raw silk importation is from China, India and Uzbekistan, 70 percent of silk thread from China (Şahan, 2011). In 2013, Turkey imported 58,3 tons raw silk and silk thread and value of this importation is 6.3 million dollars (TURKSTAT, 2014).

ii. Exportation

Since there is no modern silk flatur machine and the cocon drawing capacity is limited, the big part of cocoons are exported (Tatlıdil, 2008). Therefore, Turkey is a net exporter of dry cocoon and it exports 80 percent of its products to Iran and China (GTB, 2013). Average 35 tons of dry cocoon were exported annually between 2002-2013 and ımportant decreases occured in the years of crisis since the product elasticity was very high (Table 2).

Turkish silk thread exportation was decreased by 92.8 percent and the exportation value of 1,65 million dollars in 2000 decreased to 445 thosand dollars in 2013. In line with exportation decrease, thread importation increased by 8-fold (Table 29). 64 percent of exportation was for İstanbul Free Zone, Uzbekistan, Tunus, India and Bulgaria (GTB, 2013).

Nearly all the silk carpets produced are exported and the value of exportation of silk carpet is annually some 100 million dollars (GTHB, 2014).

d. The role of Cocoon Union in sericulture in Turkey

The first cooperatives were established in Bursa, Bilecik and Adapazarı in 1940 to protect and increase the production of cocoon. Later, these cooperatives came together and established Bursa Cocoon Agricultural Sales Cooperatives Union (Cocoon Union). In 1963, Cocoon Union seed production facility was established. This facility produced domestic strain polyhybrid silkworm seeds whose yield per box is high, resistant to diseases. In this context, Turkey is one of the few countries that produce own seed (GTB, 2013).

The only organization in sericulture is Cocoon Union that is active in sericulture and marketing the products. Cocoon Union is an Agricultural Sales Cooperative that works according to the law no.4572 and the sole purchaser (monopsony) of the fresh cocoons produced domestically. After 1995, with the private secor withdrawing from the market, Cocoon Union purchasing share has reached to 100 percent. Union has an autonomous structure. Therefore, it easily intervene in the negativities to ocur in the sector as a private sector establishment.

125-130 tons of fresh cocoon and 2-3 tons of breeding cocoon annually produced in Turkey are purchased by Cocoon Union. These cocoons are drawn by the facilty of Cocoon Union established in 2009. Between 2009-2012 average of 7,4 tons of silk thread were produced. Since 2012, this facility has stopped its activity. Average of some 50 tons dry cocoon changing in years were sold by Cocoon Union. In 2023/2014 season, total 44,9 tons of dry cocoon was sold, 24,2 tons of it to domestic market and 20,7 tons to foreign market (Kozabirlik, 2014).

All the silkworm seed to feed is met from Cocoon Union. The seed capacity of Cocoon Union is 20 thousand box (GTHB, 2014). The sikworm eggs as dehiscent bugs have been given to the produces in all regions in recent years. The silkworm seeds produced at the Union seed

production facility are disseminated to the producers for free in livestock subsidies (GTB, 2013).
Within the scope of the activities of generalizing sericulture, to increase the capacity of mulberry trees Cocoon Union disseminates mulberry saplings to the producers as free. Union disseminated 350 thousand saplings between 2009-2013 (Kozabirlik, 2014).
Turkish prices are determined by mostly Union purchasing prices and subsidies. In recent years, Cocoon Union has purchased cocoons in world prices with fresh cocoon being included in the support system (Tatlıdil, 2008).

Since beside Cocoon union's fair pricing practises, producers produce cocoons in a conscious way to decrease losses to a minimum, training activities are arranged in all the production regions. All the bug houses are disinfected by Union's technic personnel and means (GTB, 2013).

e. Sericulture policies in Turkey

Sericulture was supported by Goverment Price Stabilization Fund in 2002-2005 in order to promote sericulture, keep producers in their villages and to protect it which is a cultural issue. It has been supported by the subsidies of the Ministery of Food, Agriculture and Livestock since 2006. A subsidy is given per kg of product to the producers who sell their product to the Cocoon Union. In addition to the subsidy, the purchasing price per kg of product is given to the farmers.
Moreover, since 2000, silkworm seeds have been disseminated as free to the producers within the animal subsidies. Seed costs are paid by the government to Cocoon Union. In 2014, government gave 30 TL per box for free to Cocoon Union and 30 TL per box to producers for fresh cocoon (Table 3).

Table 3.The Purchasing Prices of First Class Fresh Cocoon and Seed and Subsidies (Euro/Kg)

Years	Polyhybrid Fresh Cocoon		Breeding Fresh Cocoon		Seed	Total Support Price (Euro)*
	Union Purchasing Price	Support Price	Union Purchasing Price	Support Price	Support Price	
2002	1,39	3,83	3,13	5,57	4,18	390.126
2003	1,77	4,13	3,84	5,91	8,12	729.021
2004	1,29	4,34	3,66	6,19	8,44	665.020
2005	1,49	5,07	4,17	7,15	9,84	856.304
2006	1,38	5,25	3,87	7,19	11,06	732.724
2007	1,96	5,32	5,60	7,28	11,19	727.950
2008	3,15	5,25	6,51	7,35	11,02	721.002
2009	1,85	5,55	5,09	6,94	10,18	803.927
2010	1,50	7,50	5,00	9,00	12,51	1.024.325
2011	1,50	8,57	6,00	8,57	12,86	1.365.775
2012	1,73	8,64	8,64	8,64	12,96	1.227.078
2013	1,78	7,90	8,69	7,90	11,85	-
2014	1,72	10,31	8,59	10,31	10,31	-

Source: KOZABIRLIK, 2014; GTHB, 2014

The amount of support is of big importance for the fresh cocoon producers and has an important share in the price producers receive. As the support amount is added to the sericulture incomes of farmers, producers gain 13,8 Euro per kg for hybrid fresh cocoon (purchasing price+support) and 27.7 Euro for breeding fresh cocoon. Therefore, 86 percent of fresh cocoon incomes per box in hybrid farms and 55 percent in breeding farms comes from government support (Table 3). This shows the importance of the support and necessity of sericulture in terms of sustainability of sericulture in Turkey.

The sericulture subsidies in Turkey are given to per kg of fresh cocoon amount. There is no any precondition for benefting from support and the amount of subsidy is determined every year. There will be problems in the case of membership to EU because the subsidies are not inconsistent with EU rules (Tatlıdil, 2008).

Supporting has to be kept for sustainability of the production, protecting the historical and cultural values and sericulture not disappearing. However, the lack of any precondition such as least production amount, etc. for producers to benefit from support ensure the sustainability of the production but do not promote the yields.

4. RESEARCH FINDINGS

The findings that are obtained from the surveys conducted with fresh cocoon producers in the farms engaged in sericulture are given in this part of the study.

The work force gradually has decreased and the average age of producershas increased because young producers in the mountainous and forest villages for the reasons of the lower income level, unemployment, the need of social security and education have migrated to cities. 83,8 percent of freshcocoon producers in the farms engaged in sericulture t are over 40 and 20,3 percent over 65. This shows that the silkworm producers will become more aged population in the future period. Therefore it is estimated that there will be an important decline in the number of households that engaged in sericulture.

71,4 percent of houshold workers in the farms studied engages in sericulture. The off farm workers in the farms are used generally in the process of collecting leaves in age of 4 and 5, kun cleaning, cocooning frame collecting, transporting, cocoon collecting, sorting. The big part of the off farm workers is not paid, they do it for free to help.

The reasons of producers engaging in sericulture are to make a living and sustain family traditon. 20.3 percent of the farms do not any agricultural activity beside sericulture, 79.7 per cent of them also produce plants and/or livestock products. However, the income of vegetative and livestock production are the main source of income in a little part of farms. 74.9 percent of the producersinterviewed stated that their main income sources is sericulture, 17.4 percent of them livestock and 6.8 of them vegetative production.

The average annual income of the farms studied is 3625 Euro and the 32.5 per cent of total income is agricultural income. The annual average sericulture income of the farms 645 euro which is 54.7 of total agricultural income. The share of sericulture is 17.7 within average annual income per farm. Sericulture is an important income source for the small family farms. Since the annual total income of the producersthat engaged in sericulture is very lower than the ones that make other agricultural activites it is obvious that the farms studied need certainly the income of sericulture.

Whether or not sericulture is perfomed and its capacity are determined. By the existence and amount of mulberry leaves, The need of silkworm eggs is determined by Kozabirlik, taking into account the possibility of producers procuring mulberry leaves and current production capacity. It is determined that Mulberry trees in the farms studied were mostly (54.5 percent)scattered and border tress. This creates hardness for transporting leaves. During the procurement of leaves, producers have an informal organizational structure.

The number of opened cocoon is 2.4 in the farms that produce fresh cocoon, it is 2.1 in the ones that produce hybrid cocoon. In 2013, research year, the yield of fresh cocoon was 19.18 kg per box, and hybrid cocoon 28.36 kg per box. The fresh cocoon production per farm is 40,03 kg in breeding farms and 59.85 in hybrid ones.

The purchasing price of cocoon is declared by Cocoon Union and Union purchase cocoons in two different prices, one is for breeding cocoons and second for hybrid ones. The amount of subsidy has not been changed since 2011 (Table 3).

Gross Producion Value (GPV) per farm in 2013 was 153 Euro in the farms that produce hybrid cocoon and 400 Euro in the farms that produce breeding cocoon that because the breeding coon yield is low due to strain factor, the purchasing price was declared high. However, as all the producerswho produce silkworms get the government subsidy, the annual GPV is 802 euro in breeding farms and 605 in hybrid ones.

According to the study findings, when the fresh cocoon and seed subsidies are excluded, groos margin per farm is -11.72 euro/year otherwise 226.96 euro/year. The breeding farms that use production factors more effectively are more successful than the others as gross margins are taken into account. Thus, gross margins in cocoon breeding farms is 269.50 euro/year.

The inputs such as seeds and pesticides and etc. are met for free by Cocoon Union, the production cost of fresh cocoon is very low (Anonymous, 2007). The fresh cocoon cost is calculated as all expenses of sericulture activity is divided into annual production. Thus, 1 kg fresh cocoon cost is 2.67 euro in hybrid farms and 3.36 in breeding farms and 2.72 in all the farms.

Since it is not possible to cure diseases in sericulture, protection is more important than the cure. Therefore, there must be proper producing conditions and media and producers must have sufficient information in sericulture.

However, the production in Turkey is made mostly in traditional methods and the farms do not have proper facilities. 63.3 percent of the producersinterviewed use the part of their house as nurture facility and 30 percent of them seperate nurture house. Producers both live a social life and and produce in a part of their houses. 3.9 percentof them use the barn as nurture house which has the contamination risk and do not have proper physical conditions.

On the other hand, 47.8 percent of producers in survey year stated that they met silkworm disease and incurred yield loss. In the farms that faced with disease, yield per box was decreased by 18.96 percent from average 28.51 kg/box to 23.10 kg/box.

Subsidies have to be continued for sustainability of production, protection of historical and cultural values and sericulture not disappearing. However, 72 percent of fresh cocoon producers interviewed states that the subsidy amount is insufficient and 85.5 percent of them states that they will not continue producing without subsidies. On the other hand, producers demand nurture house support.

However, lacking of any precondition of minimum production amount and etc. for producers benefiting from subsidies ensure sustainability of production but not promote yields,

The producers interwieved in the study stated that the lowness of cocoon purchasing price, insufficient subsidies and the lack of proper facilities are the most important factors for giving up sericulture. Therfore, they want purhasing price and subsidy to increase and subsidies to be given to establish nurturing facilities.

According to the fresh cocoon producers interviewed, the most effective factor is the price of cocoon. The lowness of cocoon prices cause to producersto rip of their mulberry tress and tend towards the more gainful agriculturel activites (Başkaya, 2013). The other most important factor for giving up sericulture is the lack of work force for especially breeding silkwarm farmers. Although it creates income in a short period, the young population do not continue sericulture and tend towards other professions because of its hardness of working conditions and being labor intensive. The problems of procurement mulberry leaves and the more porifitability of other agricultural activities are the other reasons producers take into account for giving up sericulture.

5. CONSTRAINTS OF THE SECTOR AND RECOMMENDATIONS FOR THEM

The commitment of producers to sericulture and producers having necessary traditional information about it, producers being able to produce healthy silkworm eggs, the existence of the regions that are not polluted by pesticides and industry free, not requiring much expenses but producers workforce, good quality, having silk carpet trademark and the sector organizing in Cocoon Union which is the sole farmer organization on sericulture in Turkey are advantageous aspects to sustain sericulture

The main vision of sericulture sector in Turkey is first to create new employment and income sources and then keep historical and cultural heritage alive. To attain this aim it is required that production areas are expanded (GTHB, 2014).

However, insufficient workforce due to the migration of young population from villages to cities with indutrialization, insufficiency of the number of mulberry gardens and trees and the production being made once a year so nurture performing in the houses are the most important constrainst for increasing production.

Producers not having the special nurture houses and gaining low incomes due to low production, he yield losses due to the continued traditional production methods, the negative effect of importation due to competition for lower prices and zero tariff rate for silk importation affect production increase.

The main aim in the sector is to increase production. Therefore, it is required to create strategies directed to increasing production and consistent price policies and continue current support system. Thus, current susidies are important for producers. However, creating financial funds for nurture houses and mulberry gardens and giving information about current rural development subsidies are other importat issues.

Although there are various credits for agriculture in Turkey, these credits comprises are generally for postharvest phases. The current production will be protected if the long-term credits are provided for the construction of nurture places (GTB, 2013).

To increase quality and productivity, the use of new technologies in production, the modernization of nurture material, making effective of R&D activities, increasing corporating possibilities with international institutes and universities are required.

The mulberry tress used in nurture in Turkey are generally grown in mountanious villages, sides of roads, the areas which is free for agricultural chemicals. Therefore, sericulture is partly or wholly an organic agricultural activity.

However, since there is a demand increse for organic and ecological products with consumers being conscious about these products in the world and Turkey, organic agriculture is developed. Therfore sericulture as the second agricultural activity shoud be promoted in the organic agricultural areas. This potential should not be lost while such current sericulture is going on.

Required subsidies should be provided for silk carpet sector to compete with international markets, sertification should be generalized in carpet making. New employment possibilities and income sources will be created by producing new alternative products beside the silk carpet.

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Country Report Switzerland 2015

March 2015

Content

Introduction

In 2003, the project idea was developed by Mr. Ueli Ramseier. In 2009 the Swiss Association of Silk Producers "Swiss Silk" was founded as a private initiative including farmers, representatives from the Swiss textile industry and other interested persons. Today 30 farmers, 5 silk processors along the chain of production and 130 private persons and institutions are members of the association. Swiss Silk does not receive any support from the Swiss government or any other source and is financially independent.

Project Overview

Objectives

- The silk production in Switzerland shall be reintroduced.
- Main aims are the creating of additional income for Swiss farmers and at the same time strengthening the Swiss textile industry.

Project Characteristic:

- Decentralised Production of Biovoltine Cocoons
- Centralised cocoon drying and silk reeling.
- Manufacturer of silk accessories such as ties and shawls by the Swiss textile industry.
- Marketing by Swiss high end brands with as strong emphasis on Swissness and ecology.
- A board consisting of 5 people is overlooking and coordinating the project.
- The project has a modular structure. A „central unit" is responsible for the extension work, the silk worm nursery, the cocoon drying (2 locations) and the silk reeling.
- The activities to coordinate the project are done mainly on a voluntary basis; first paid labour has been introduced since 2013.
- The silk worms are reared by individual farmers. They deliver the cocoons to the "central unit" and get paid per weight of fresh cocoons.

Persons and Network

All the stakeholders along the supply chain are involved in the project:

Board Members

- Ueli Ramseier, farmer, textile engineer — President, Secretariat, PR
- Ursula Knuchel Streit, farmer — Vice –President, Producer relations
- Oliver Weisbrod, Consumer Brand — Relation Textile Industry
- Magdalena Stranner, Program Manager — Market access
- Max Leuzinger — Finances and special tasks

Other selected Resource Persons

- Hans-Jörg Moser, Minnotex GmbH — Silk Manufacturer
- Mathias Camenzind, Camenzind AG — Silk Manufacturer
- Patrick Genoud, Silk Opportunities Ltd. — Silk Trader

- Henri Brion — Resource person silk worm rearing
- Patrick Koch — Auditor
- Heinz Wenger — Auditor

The networking is an important success factor of this young initiative. The knowhow and experience of other countries and initiatives is a source of encouragement and knowledge for our organisation. The membership at BACSA is an important asset in this network.

Production

Mulberry Trees

During the last 6 years Swiss Silk has planted over 4'500 mulberry trees. The main variety is Kokuso 21. A total of 30 varieties are planted to broaden the genetic basis. The majority of the trees are planted between 500 and 700 meters above sea level. The cut of the trees is low stem (50 – 60 cm).

Together with ProSpezieRara, a private organisation dedicated to biodiversity, Swiss Silk identified over 60 old mulberry trees from Switzerland, used 100 to 150 years old for silk worm rearing. They are now multiplied and cultivated on a trial basis, to test their productivity. The first old Swiss mulberry varieties will be planted in spring 2015.

Silk worm rearing

Swiss Silk continues to invest in its knowledge in silk worm rearing. Every year a few new farmers are entering the system.

Farmers entering the system are given a sample of a few hundred eggs in order to get first experience in silk worm rearing. Silk worm rearing (as well as mulberry tree as a food crop) is totally new to them; combined with our limited resources for extension work, their progress is relatively slow and it takes comparable long time to get good quality cocoon from new farmers. With the growth and expansion of their plantations, they also will raise more silk worms. The rearing takes place in the houses of the farmers. The rearing rooms are equipped with low cost rearing equipment. For the spinning, Japanese cartons are used to get good quality cocoons.

The eggs are purchased from the agricultural research station Padua (Dr. Cappellozza).

The quantities Swiss Silk has produced so far:

Year	Planned Quantity*	Losses Insecticides	Losses Sickness	Effective Quantity
2009	0	n/a	n/a	700 cocoons
2010	0	n/a	n/a	2’000 cocoons
2011	1	0	¾	¼
2012	2	½	¼	1 ¼
2013	3	1	¾	1 ¼
2014	3	½	½	2 ¼
2015	4 ½			

***** Quantities in box-unit (20’000 silk worms)

As consequence of the losses through insecticides, the rearing season is shifted towards summer and autumn. Swiss Silk is therefore losing the spring readings. Nevertheless, with a an average of 1,91 Gramm per cocoon in 2014 (starting from 1,5 Gramm in 2010), we can see some progress.

Specific Training

As mentioned above, the training of the farmers is paramount. The training manual for cocoon production on a farm level, adapted to the central European context manual introduced in 2013 is of big help. At least twice a year Swiss Silk organises peer learning events, where farmers can exchange and get practical exposure to silk worm rearing.

Cocoon drying

The two hot air drier from Arya Silk (India), with a capacity of 50 kg fresh cocoons remain sufficient for drying our small quantities of cocoons.

Silk reeling

We recently made an upgrade of our “cottage type” silk reeling machine (12 ends). Automatic water temperature control of the reeling basin and other smaller investments will hopefully help to further improve the raw silk quality. Swiss Silk continues to produce mainly 30/33 denier raw silk.
Raw silk grading, twisting and weaving tests in 2014 have shown an improvement of raw silk quality, now good enough for neck tie production and other product with rather low requirements of raw silk.

Raw silk processing

The raw silk is processed mainly in Switzerland. Only the twisting is done in Italy, because the facility we used so far is undergoing a complete overall and will be ready in 2016 only.

Chrysalides

In 2015 the legal framework for food legislation in Switzerland will undergo a review. The Swiss Government declared that insect proteins shall be included in the updated food act. As silk worm chrysalides are the product of a controlled and safe process, Swiss Silk lobby’s that silk worm proteins would be one of the specific proteins listed in the updated food act. This would bring additional income for silk producers.

Market Entry

In September 2014, the first products, with silk produced in Switzerland, have been launched on the Swiss markets. The neck ties and the scarves have been launched by ***weisbrod*** (www.weisbrod.ch) and are sold in 4 shops and via the internet.
The ***weisbrod*** neck ties with silk from Switzerland (warp only) are 70% more expensive than the ones with 6A BRATAC silk (Brazil), CHF 150 instead of CHF 90.
We could enter into long term arrangements with two additional brands. With others brands Swiss Silk is in contact for future business relation ships. Nevertheless, besides the increase of quantity and quality of raw silk, the further finding of long term market partners remains a challenge for Swiss Silk.

Outreach

The market entry had an enormous response in the media. More than 95 articles in news papers and magazines, 3 television and 4 radio emissions both in Switzerland and abroad underlined the interest of the public in a European based silk production.

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⇒ For further information please see **www.swiss-silk.ch** and **www.facebook.com/pages/Swiss-Silk/**

Pictures

Mulberry leaf harvest

Rearing of 1 box

Silk reeling

Raw silk

Weaving

First products, with silk produced in Switzerland

BACSA 7th Executive committee meeting proposals:

1. Priority directions of sericultural industries production in BACSA member countries:
   - High quality raw silk production;
   - Organic raw silk production;
   - Integration in the sericulture value chains: farmers, raw silk reelers, silk processors and retailers;

2. BACSA to make a common action for a proposal to the European commission about the subsidies for the sericulture farmers and industry;

3. The non-textile use of sericulture products to be one of the BACSA priorities;

4. BACSA to coordinate the technological innovation of cocoon production in the region countries;

5. Sericulture promotion in the middle and high schools;

6. The enhanced role of BACSA in information exchange among the member states;

7. Determination of the common main sericulture development problems, facing the member states;

8. Establishment of a sub-page of BACSA web site for scientific and technical publications.