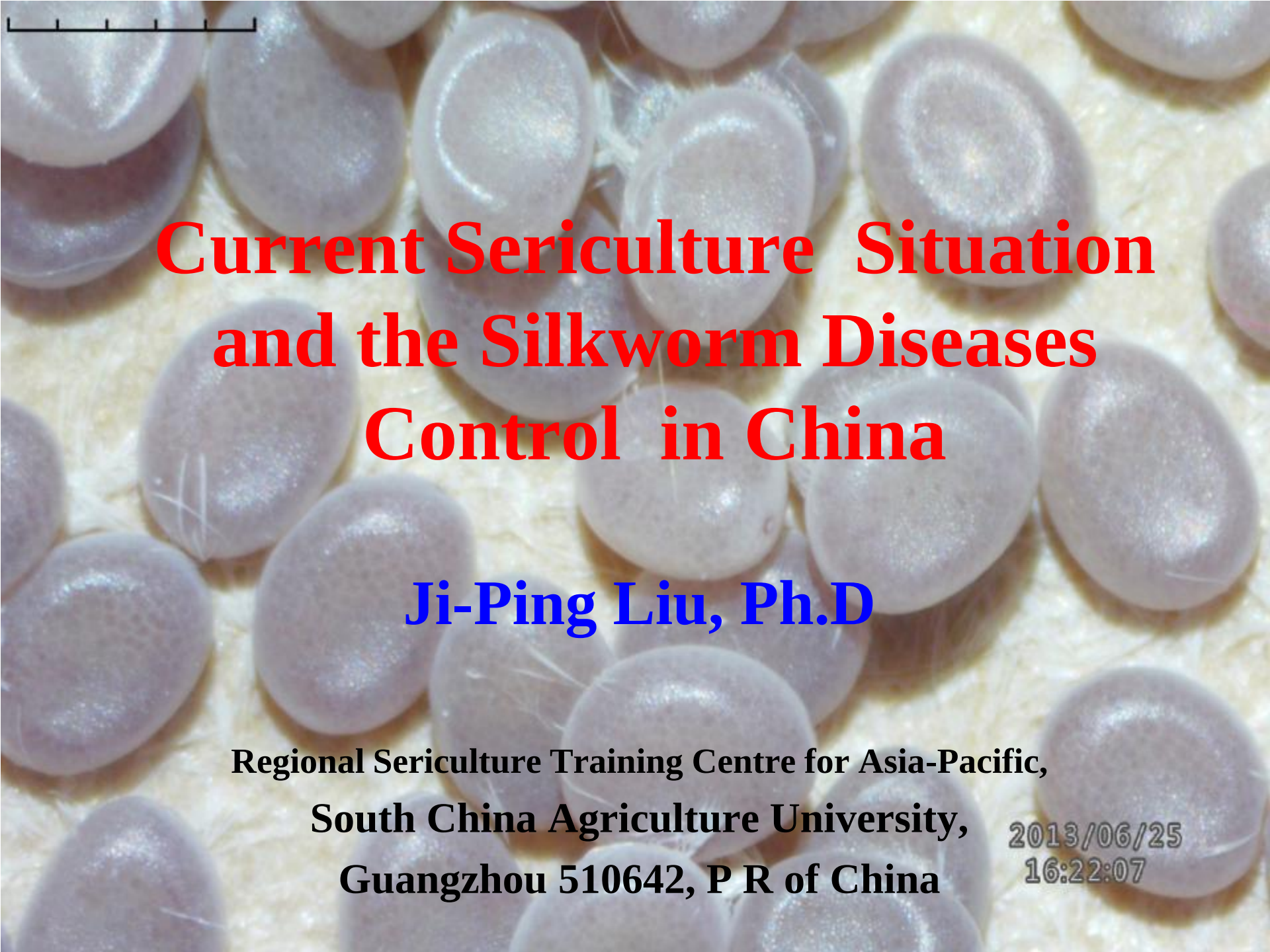

Current Sericulture Situation and the Silkworm Diseases Control in China

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South China Agriculture University,

Guangzhou 510642, P R of China

2013/06/25
16:22:07

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1. Introduction Current Sericulture status in China
2. Activities of Silkworm Diseases
3. Menace of Pebrine Disease in China
4. Prevention and Management of Silkworm Disease

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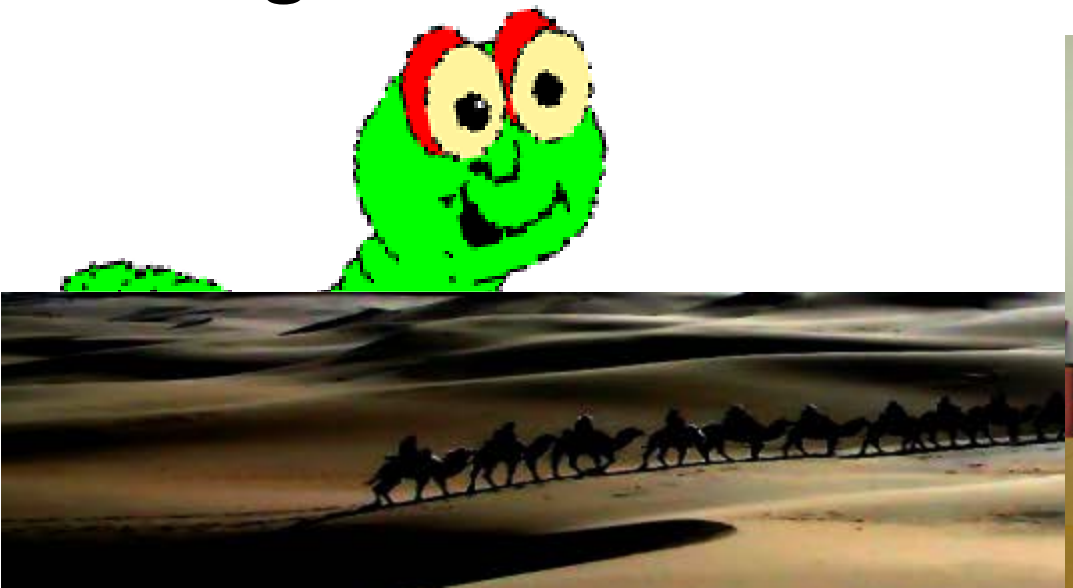
Sericulture
(Silkworm+Mulberry+Culture)

- **It's an economic, cultural and traditional secondary agricultural activity, which is particularly providing clothes , and additional income to farmers in agro-regions.**

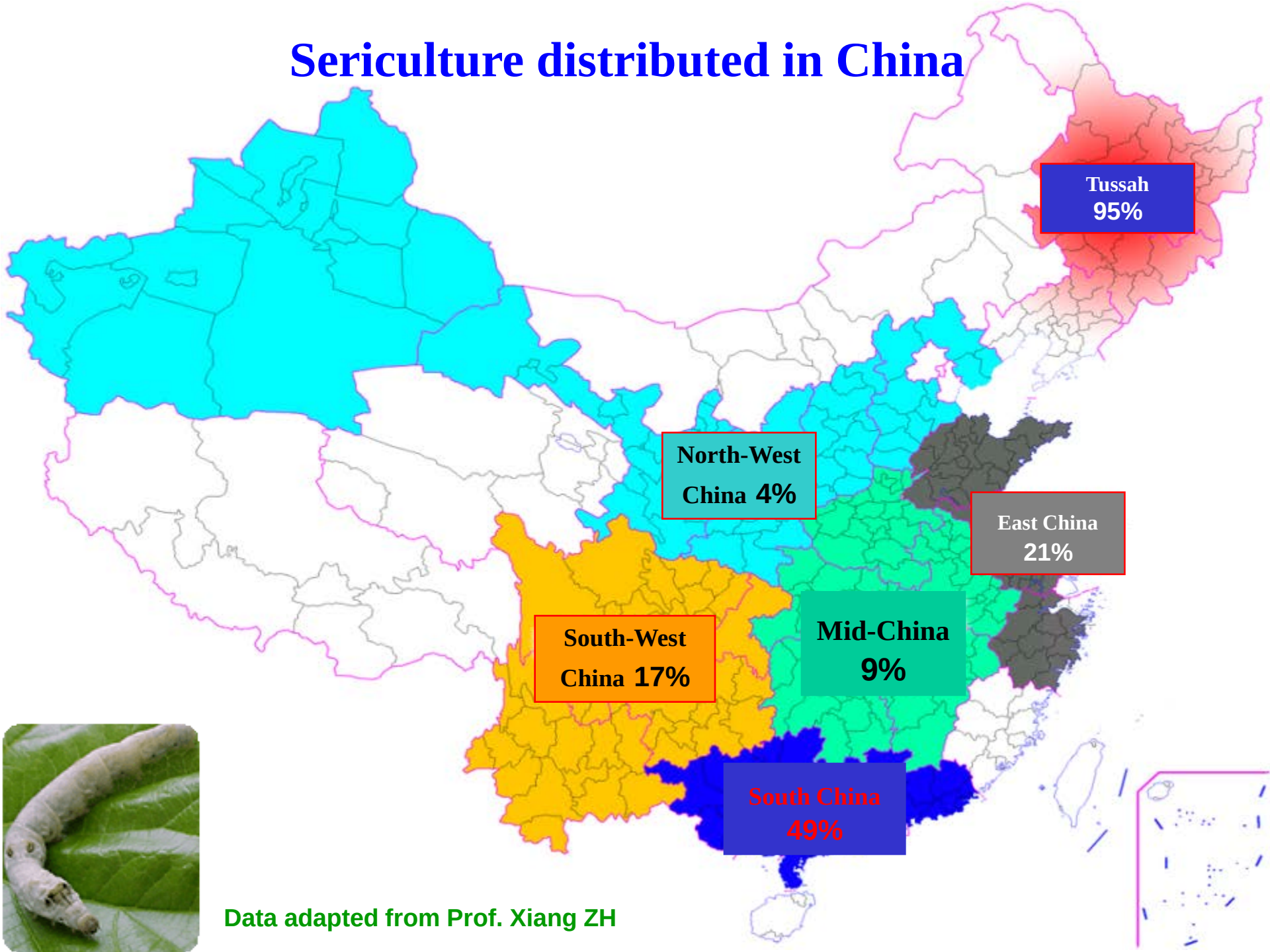


1. Introduction

- **Sericulture Changes in China**
- **within 1949 to 2014**
  - **Recovering (1949-1954)**
  - **Developing (1955-1959)**
  - **Adjustment (1960-1964)**
  - **Developing (1965-1985)**
  - **Improving and developing (1986-1995)**
  - **Adjustment(1996-2001)**
  - **Steady developing (2002-**

- **Sericulture Current Situation**

Sericulture distributed in China



Data adapted from Prof. Xiang ZH

Distribution:Sericulture Reforming

Roll out to other regions (e.g. west of China)

“ to improve economy of poor silkworm farmers ”

Scale young silkworms co-rearing base （cooperative rearing & saleable young larvae）

Yongfu,Guangxi,West China

Xinda Cocoon and Silk Ltd. Company, Wenyuan,Guangdong

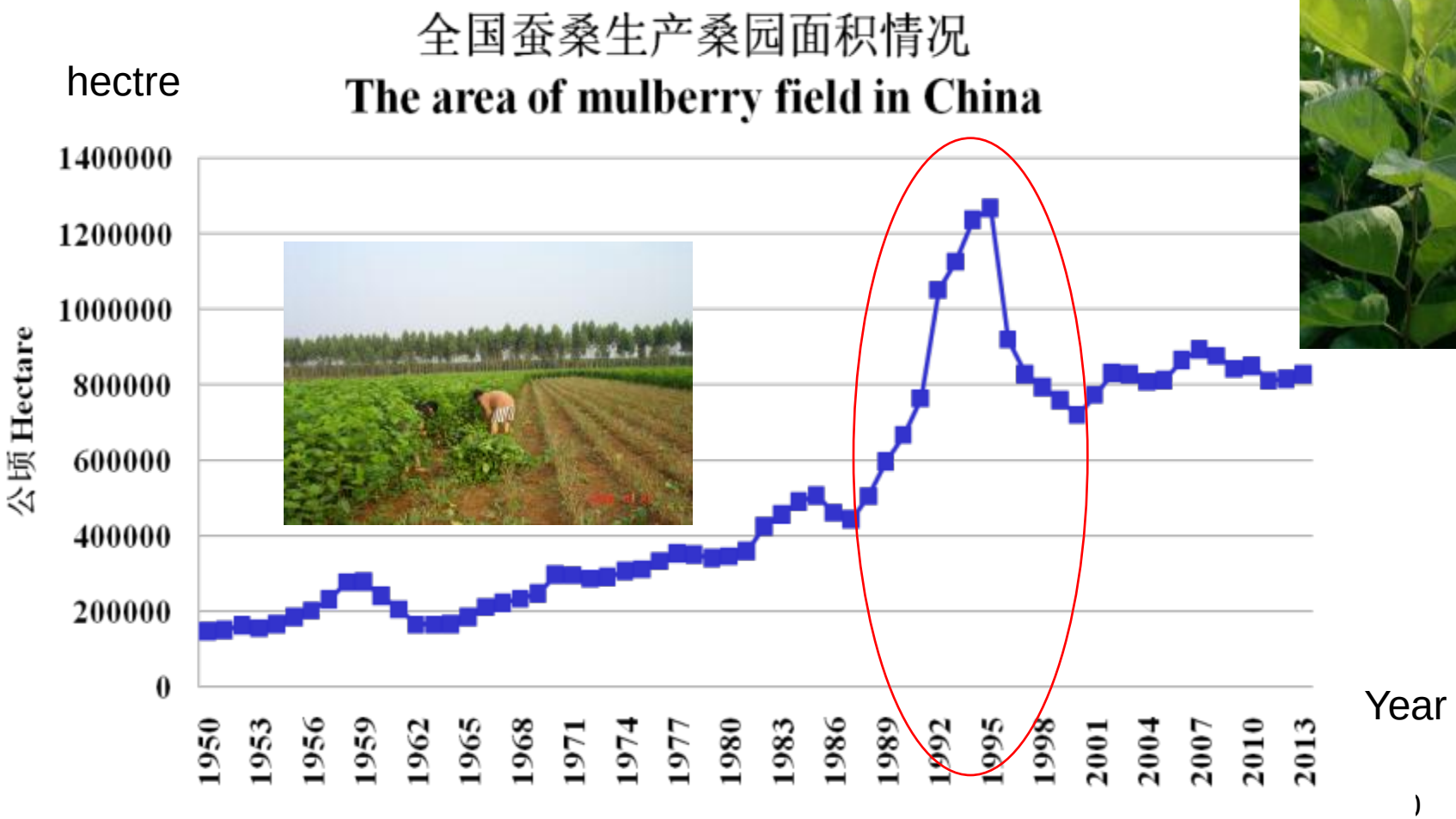
Saving labour,promting Semi-mechanized Farm Tools etc..

autocutting &branch feeding

air sterilization

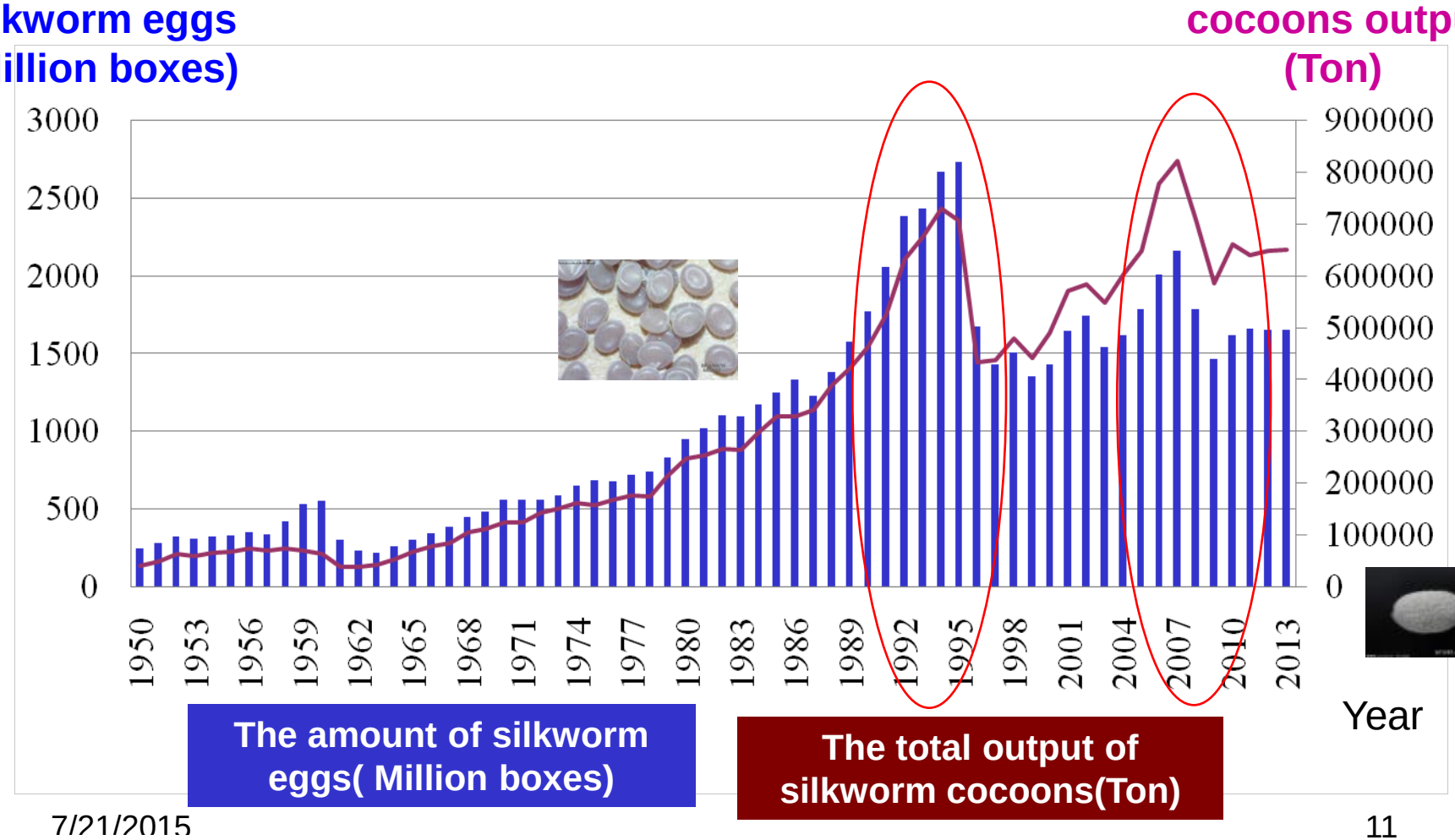
mechanization in reeling

The area of mulberry orchards in China 1950-2013



Data from Department of Plantation Management,MOA

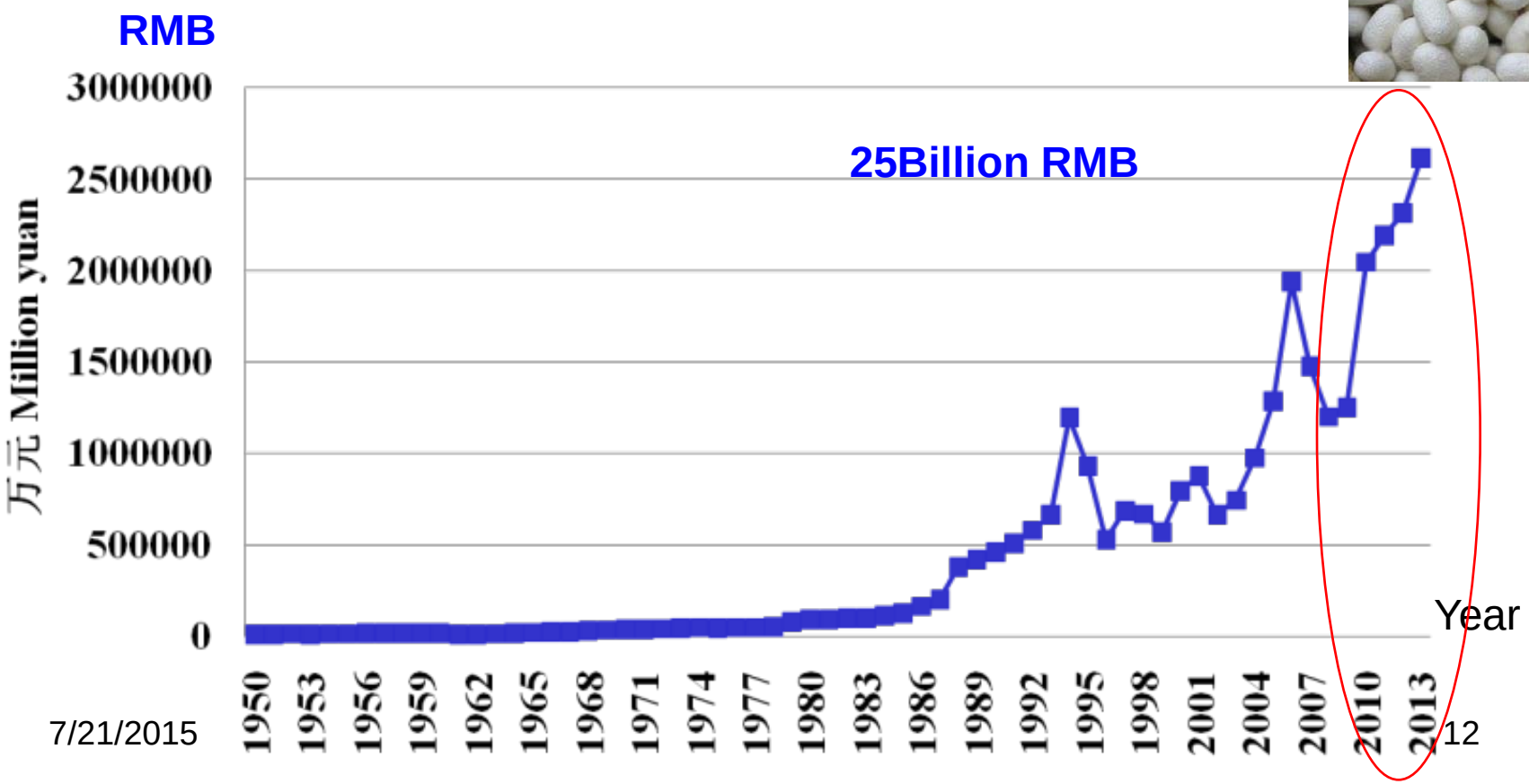
The amount of silkworm eggs for distribution and the total output of silkworm cocoons in China



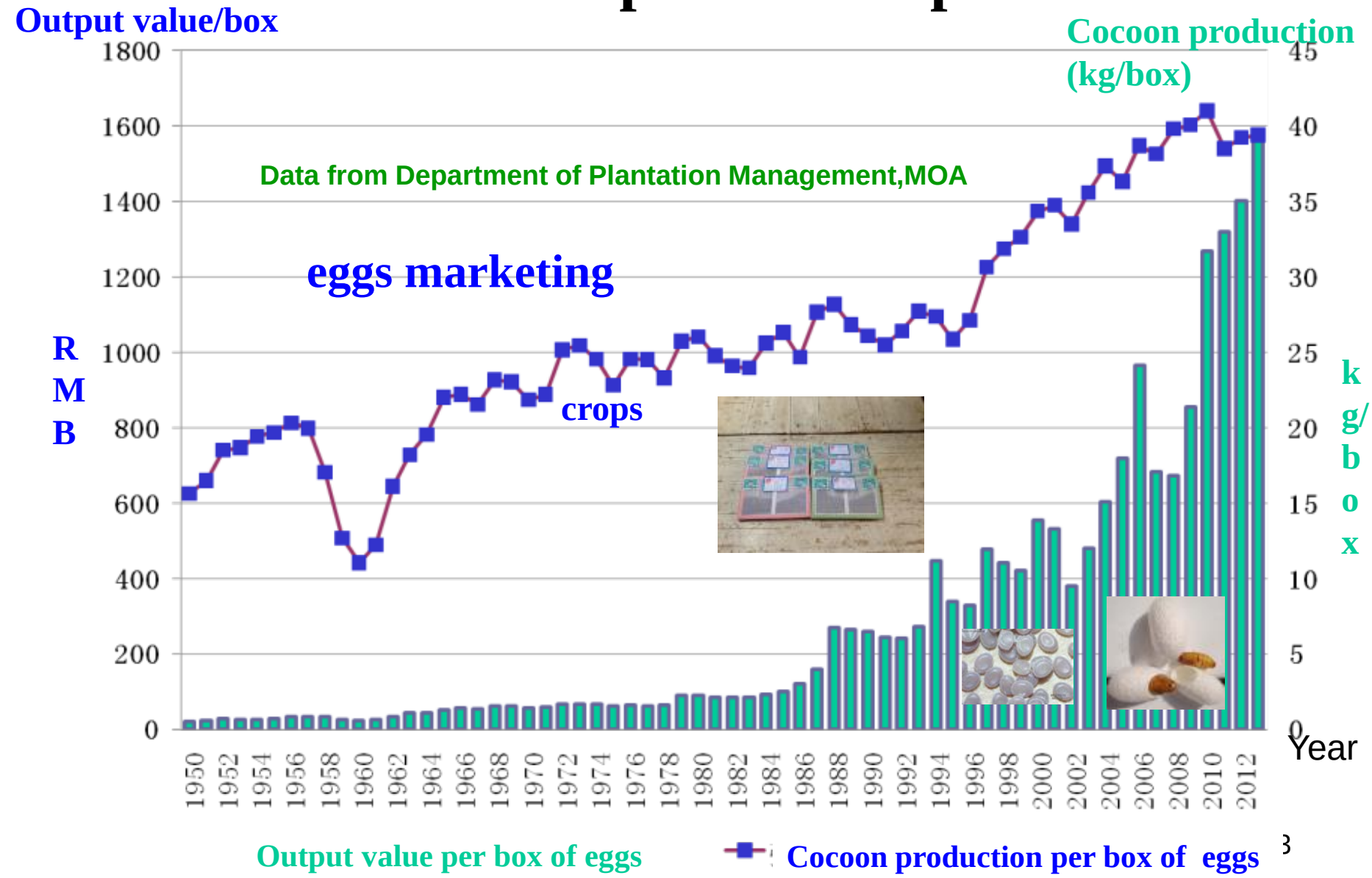
Data from Department of Plantation Management,MOA

The total output value of silkworm cocoons in China

Data from Department of Plantation Management,MOA

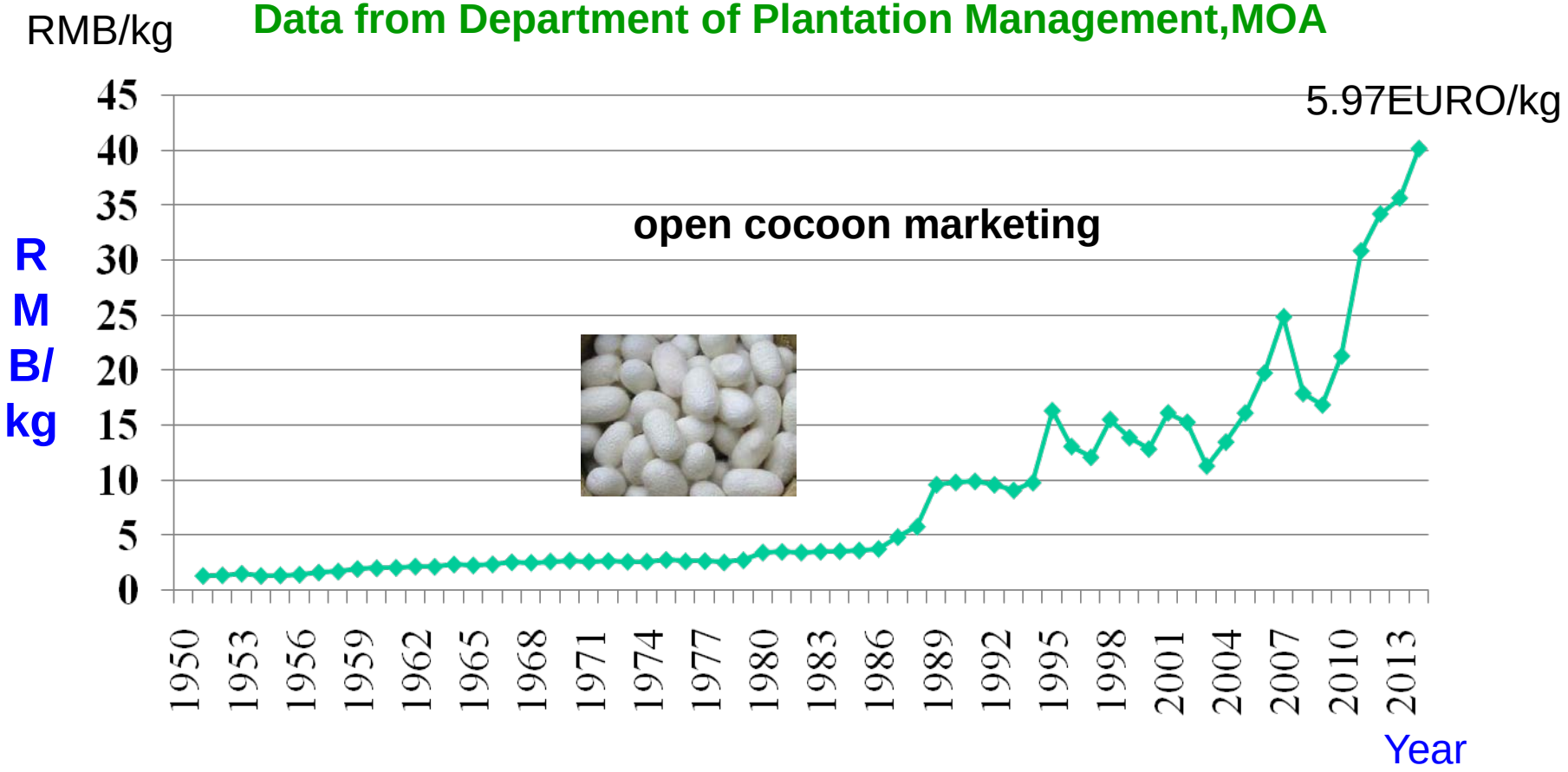


Output value per box of eggs and Cocoon production per box



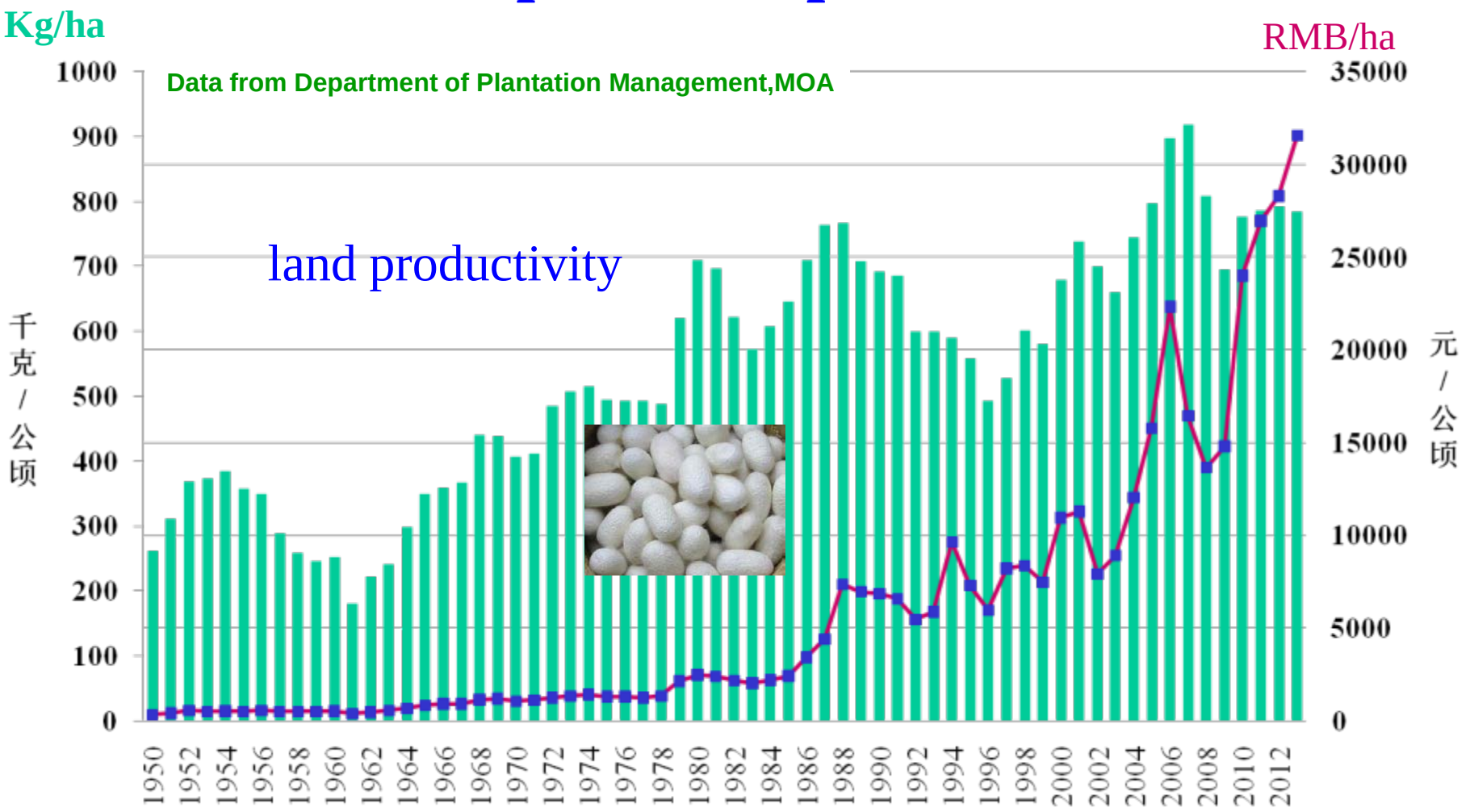
The trends of average price of fresh cocoon in China

Data from Department of Plantation Management,MOA

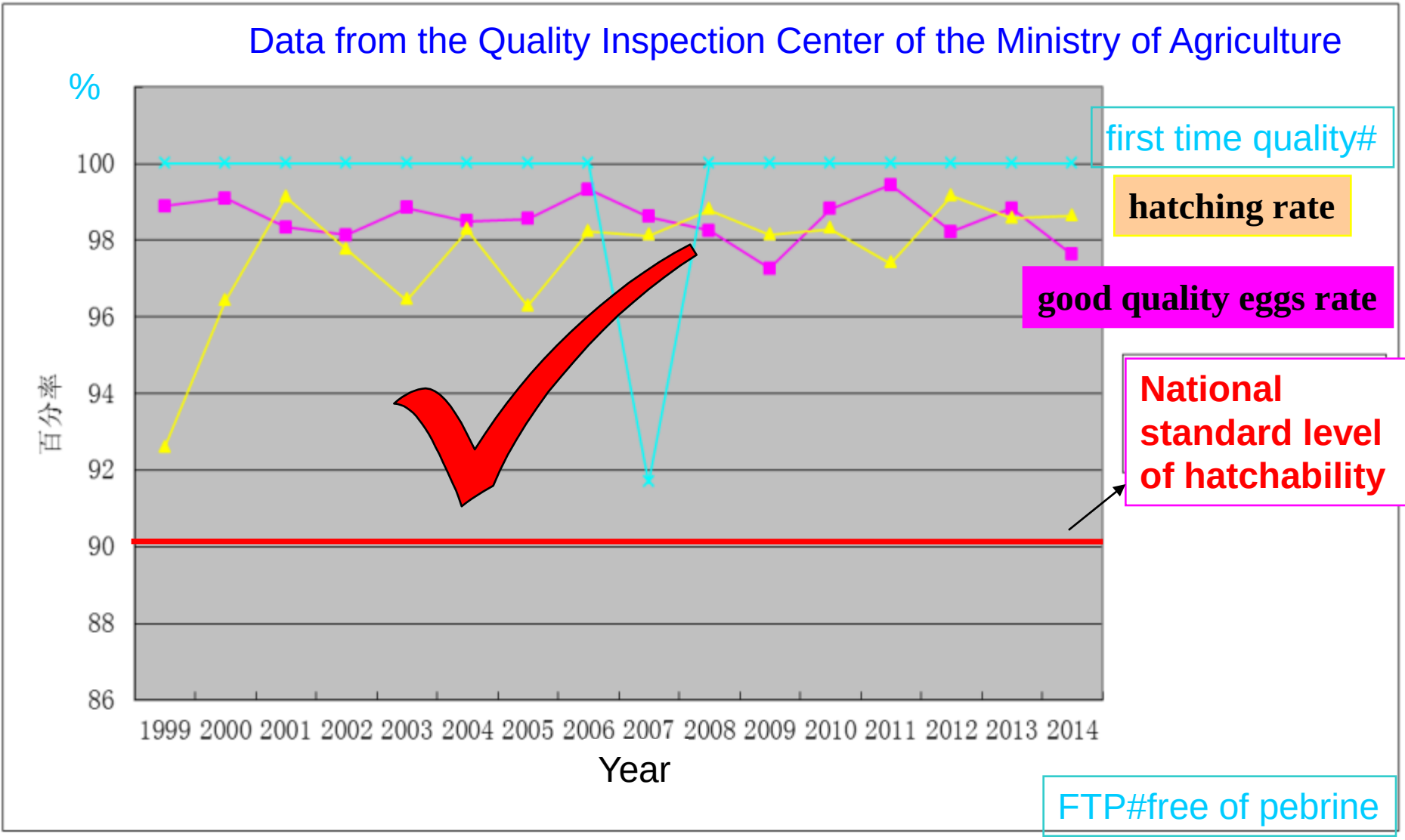


1EURO=6.7RMB

Cocoon yield per unit of mulberry land and output value per unit land



Sampling inspection of F1 hybrids in Guangdong(1999-2014)



The comprehensive utilization of sericulture resources

mulberry resources

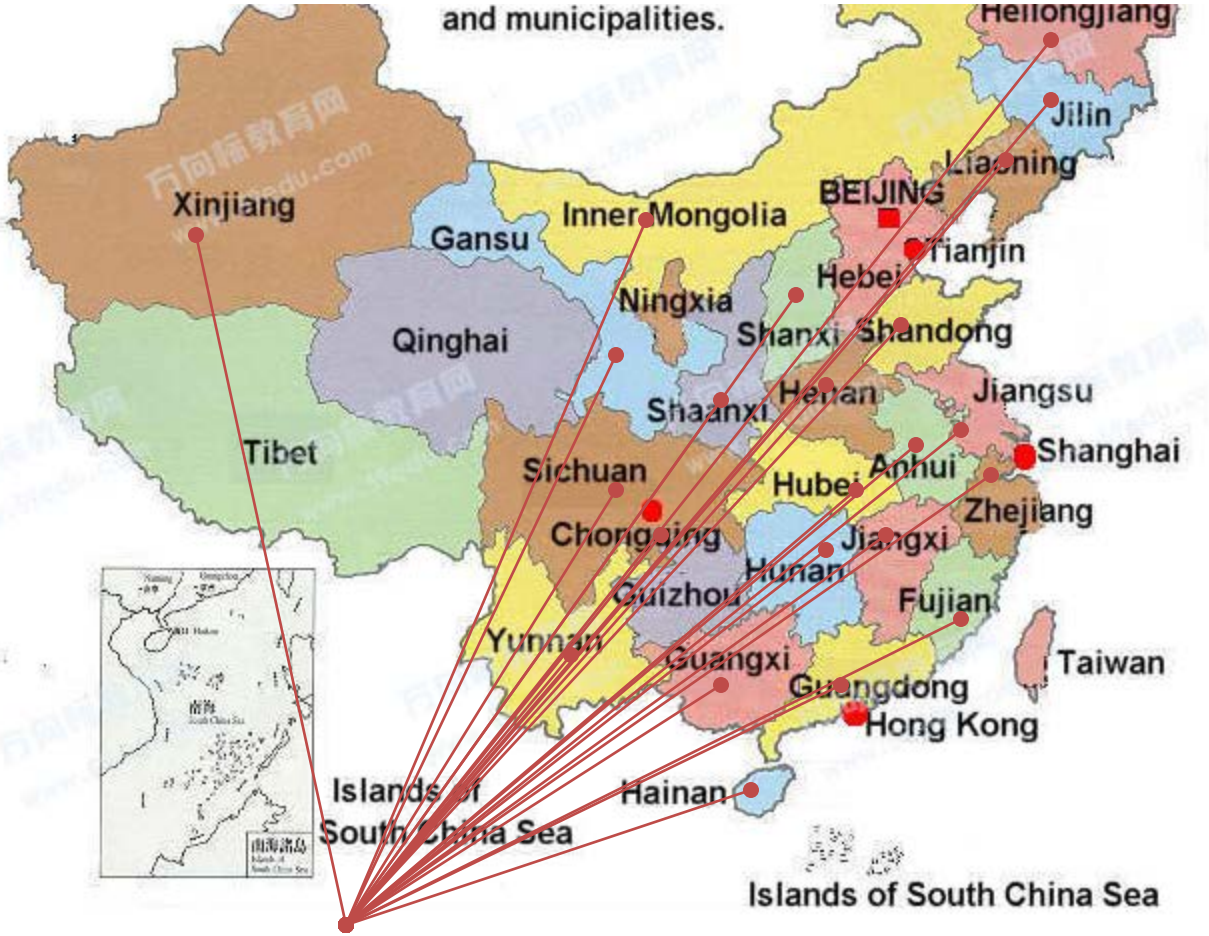
- Mulberry leaves
- Mulberry branches
- Mulberry fruit
- White mulberry root-bark

silkworm resources

- Young silkworms
- Silkworm pupa
- Silkworm moth
- Silkworm excrement
- Natural silk

Wide consensus on efficient development and utilization of sericulture resources has been reached in the industry

Comprehensive utilization of resources are very rich in sericulture



Sericulture resources all over the country's 26 provinces (cities, districts) more than 1,000 counties

The national annual output of 600,000 tons of fresh cocoons resources:

- **120,000 tons of silk**
- **480,000 tons of fresh pupa**
- **1.8 million tons of mulberry branches**
- **600,000 tons of mulberry Fruit**
- **900,000 tons of silkworm excrement**
- **810,000 tons residual mulberry**

Remarks

- ✓ **Volume of sericulture production Decreasing but Stable Business Development**
- ✓ **Sericulture swifting to the West-South China**
- ✓ **Science & Technology reforming**
- ✓ **Land Productivity improvement**
- ✓ **Promotion more innovation technology in the fields(Reeling machines,Labors productivity,Marketing)**
- ✓ **Diversity in Sericulture.....**

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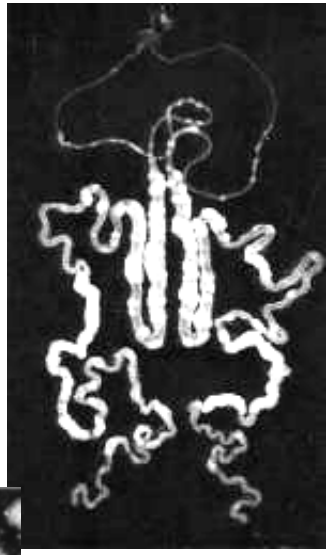
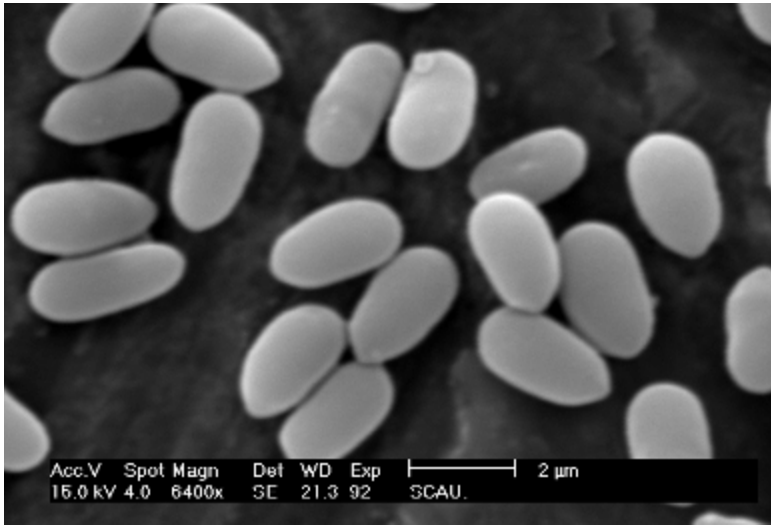
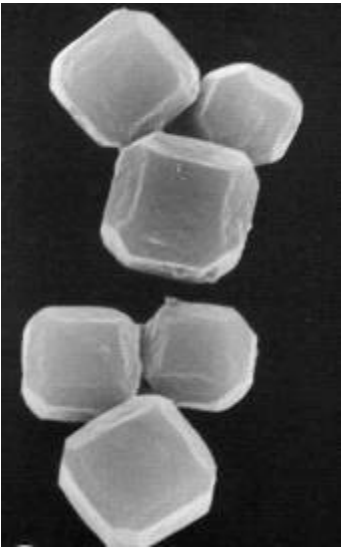
New activities of the occurrence and management of silkworm diseases

virus

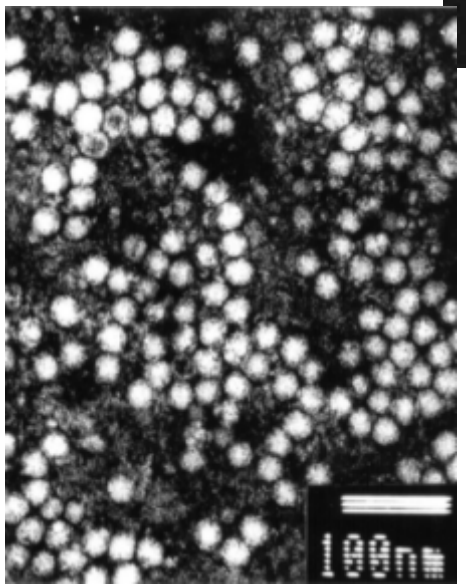




pebrine



NPV



bacteria

lack of disinfection

The threat of Viral Diseases

CPV Disease

NPV Disease

CPV&DNV

NPV Disease

Muscardine&White Muscardine , *Beauveria bassiana* (Bals.)

Vuill high prevalence on June,South China

Bombyx batryticatus: traditional chinese medicinal materials

White Muscardine, $40USD/kg

New trend of silkworm Pebrine Disease in the field

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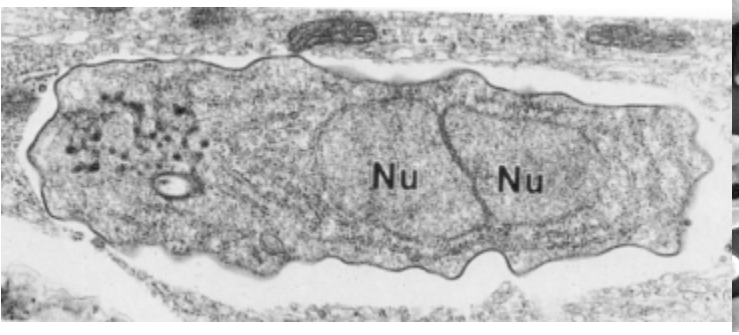
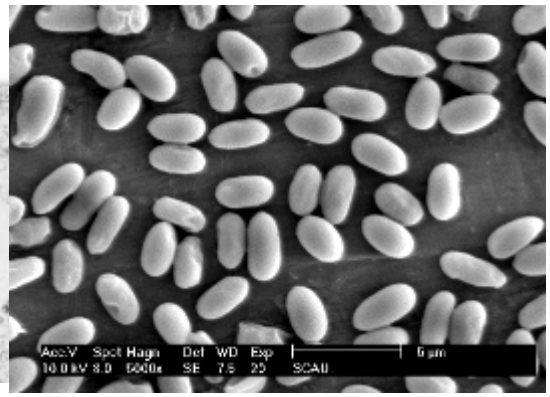
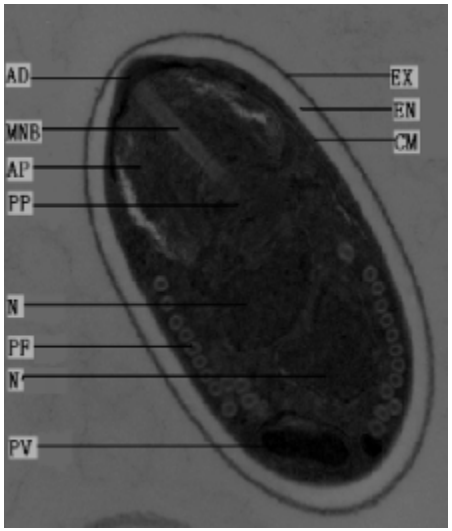
Symptoms of Pebrine Disease

Pebrine is a devastating parasitic disease caused by microsporidian parasites, mainly *Nosema bombycis* and to a lesser extent *Variomorpha*, *Pleistophora* and *Thelophania* species.







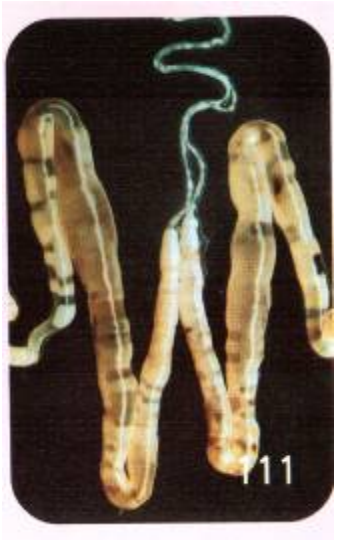
Nosema bombycis Microsporidia

Pebrine disease in silkworms

not molting

Pepper spot

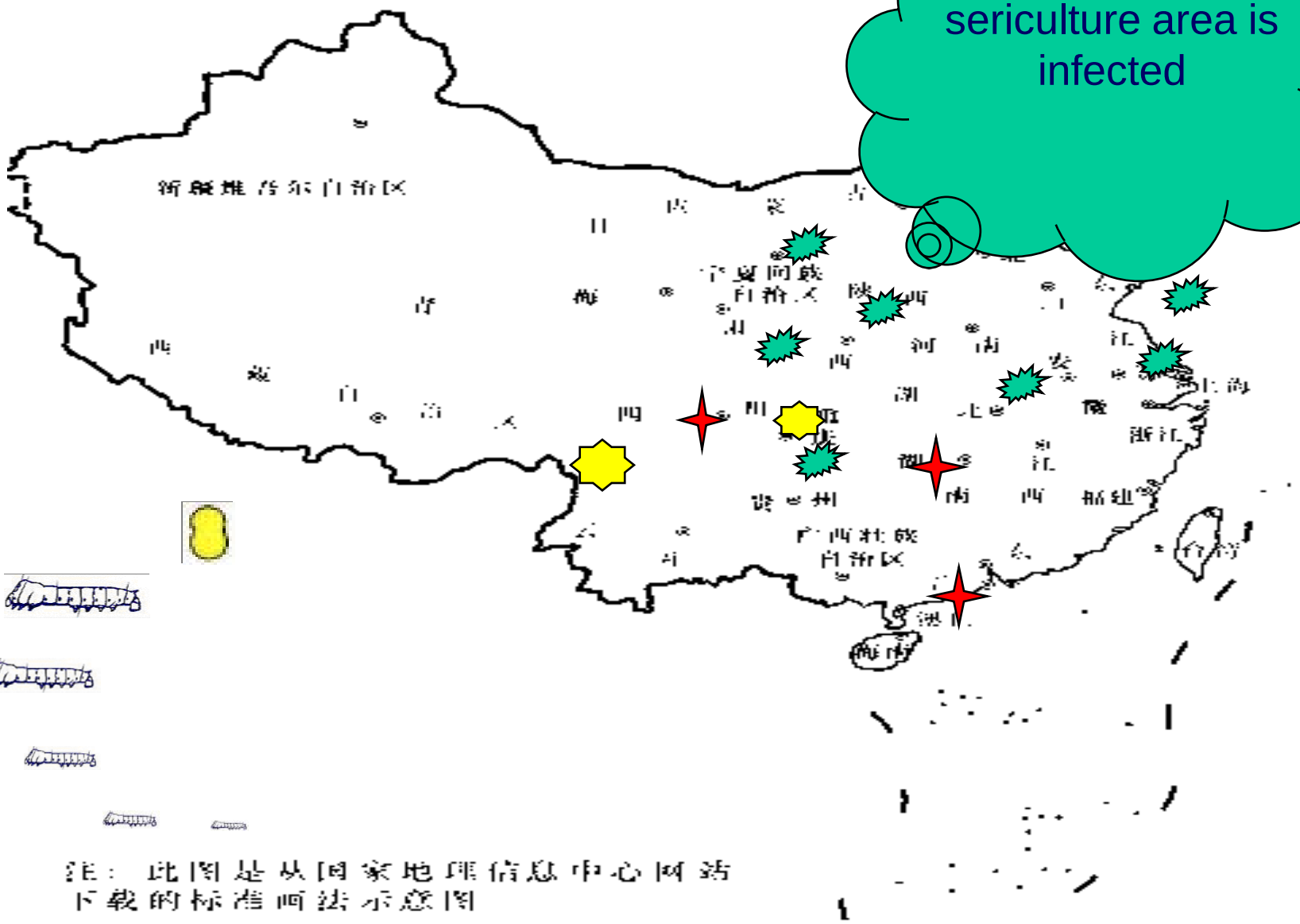
batch of silkworms



Infected silk gland

Pebrine disease in China

Over 85% of the sericulture area is infected



Microsporidians discovered from silkworms

I. Different genera: *Vairimorpha* （ Pilly,1976 ）

Pleisiophora (Gurley,1893)

Thelohania （ Henneguy,1892）

Endoreticulatus（Wan *et.al*，1995）

Nosema

II. Same genera but different species: *Nosema* sp .

III. Same species but different shapes. Sub-stains? serotype?

Microsporidians discovered from silkworms: pebrine&microsporidiosis?

I. Different genera: *Vairimorpha* （ Pilly,1976 ）

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Nosema

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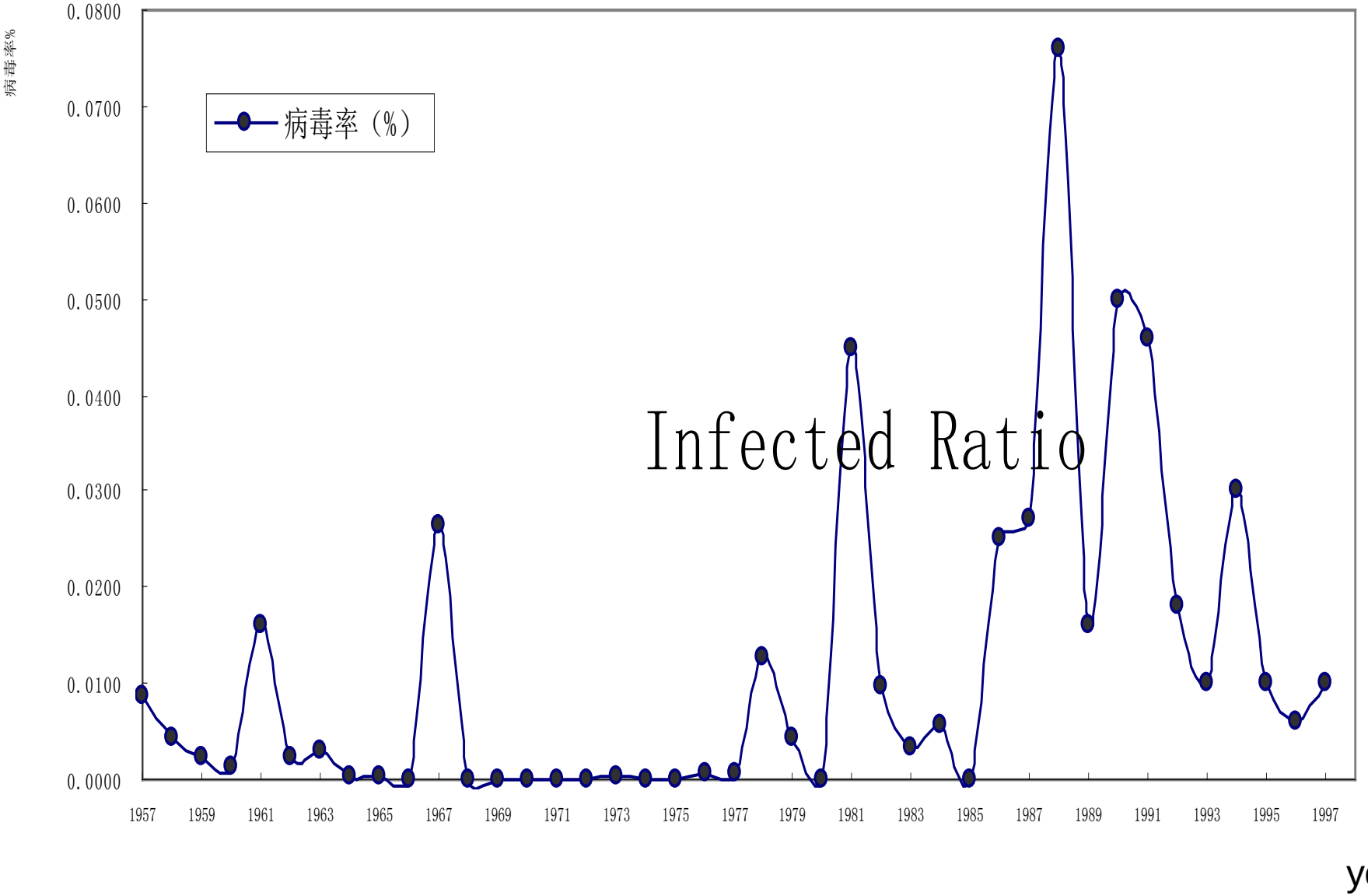
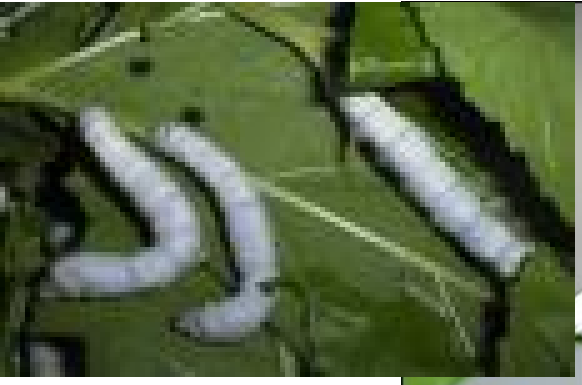
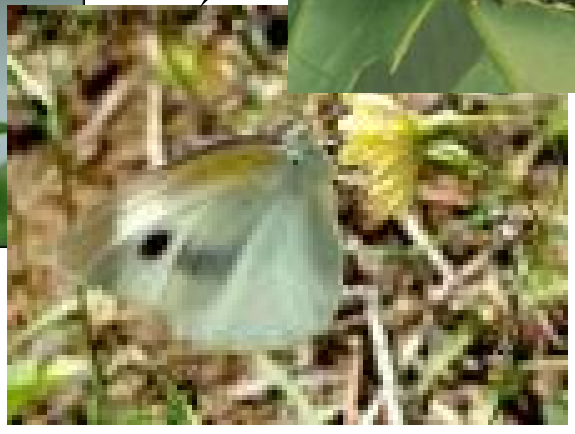
pebrine rate(%)



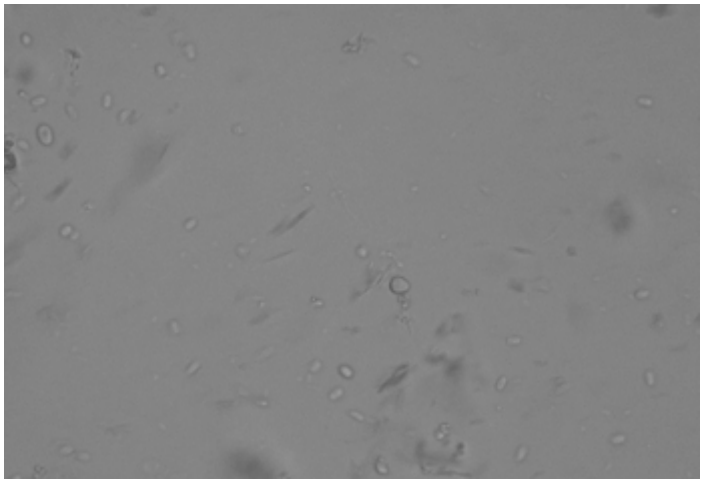


cabbage butterfly

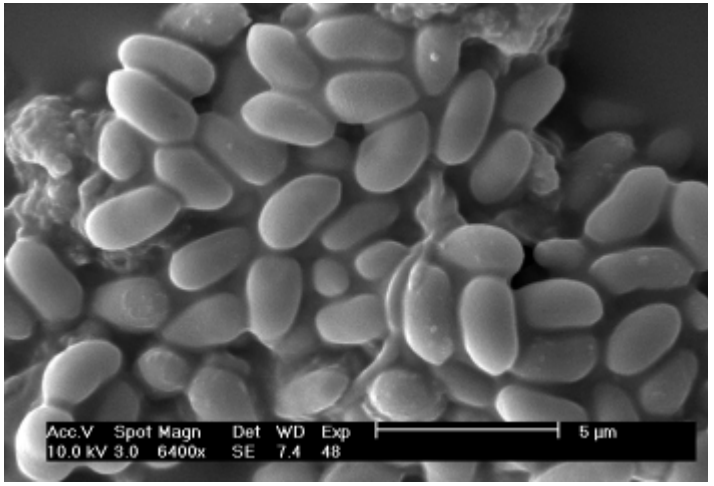


diamond back moth

mulberry looper?

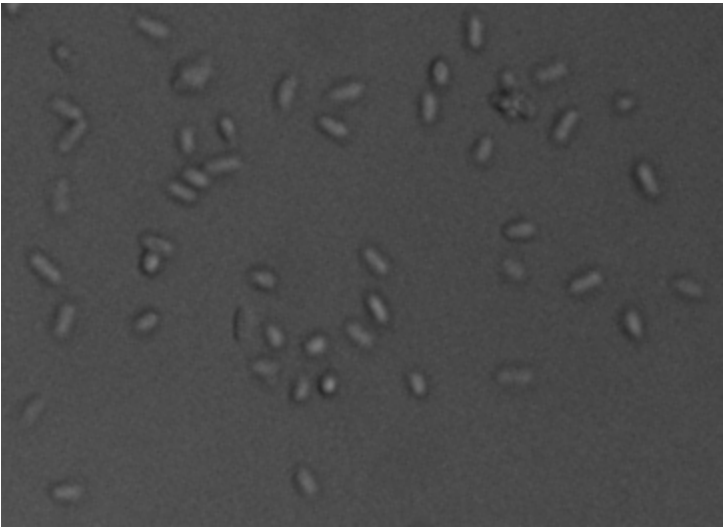


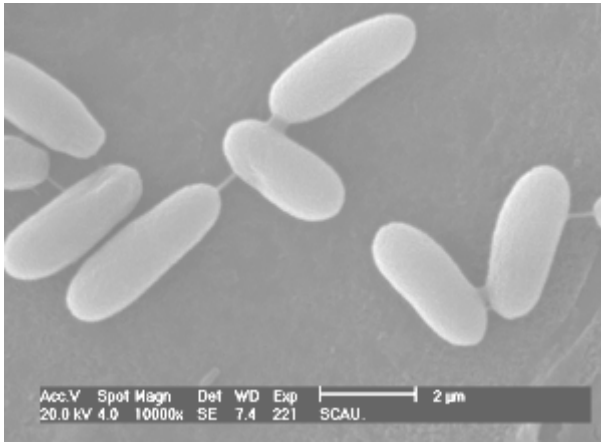
***Plutella xylostella* (Diamondback moth)**

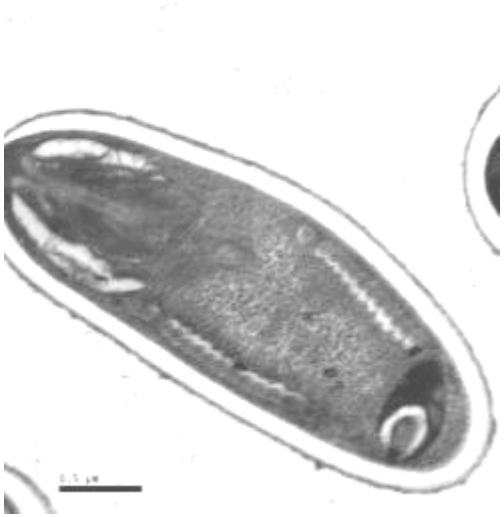


Microsporidian spores isolated
From ***Plutella xylostella***
（abbreviation: XCE）

***Antheraea pernyi* (China oak silkworm)**

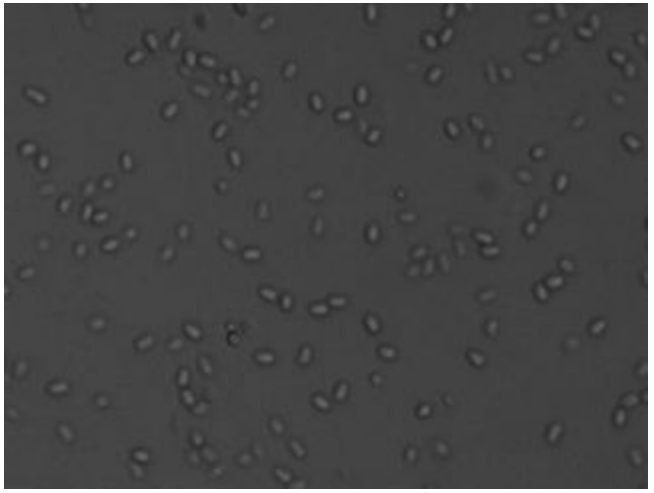


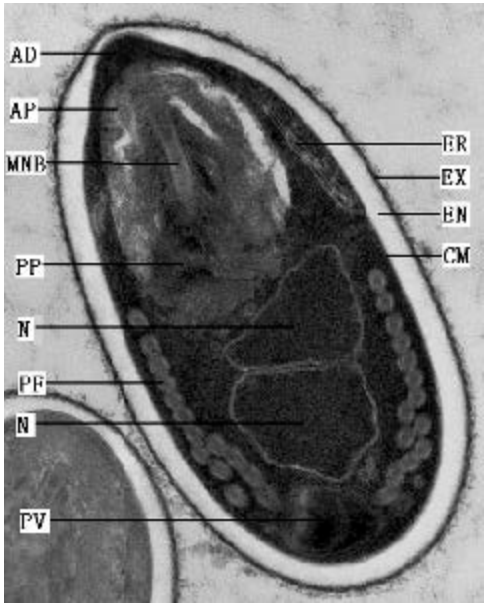




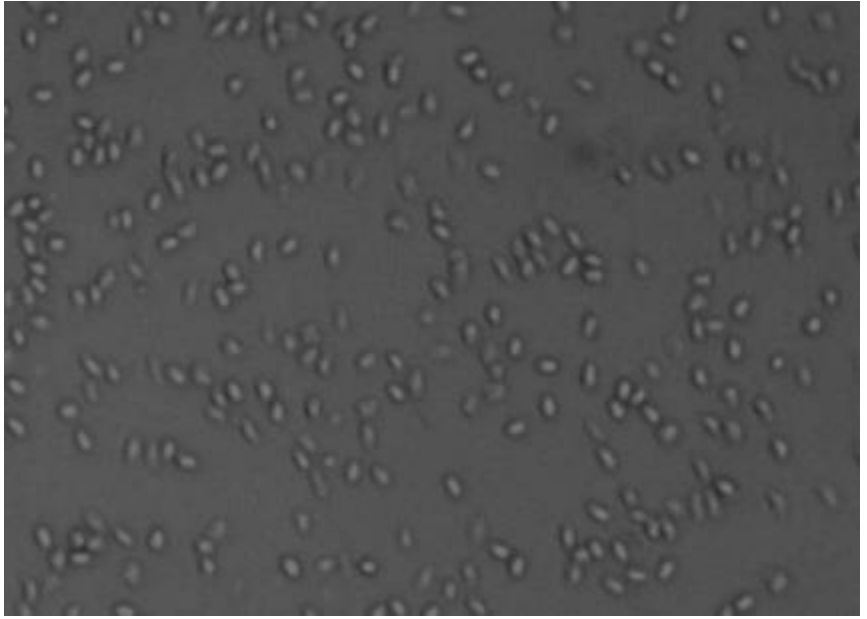
N. antheraeae

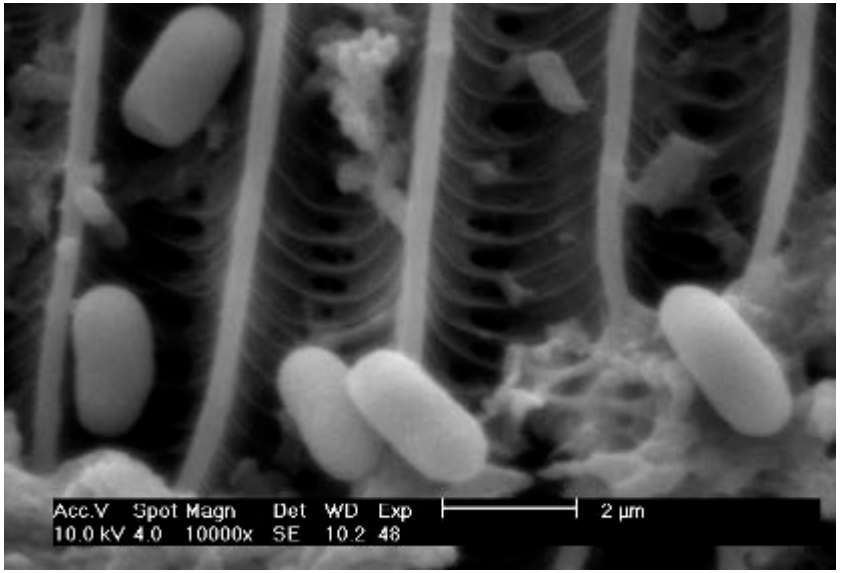
***Phthonandria atrilineata* Butler**
(Mulberry geometrid)





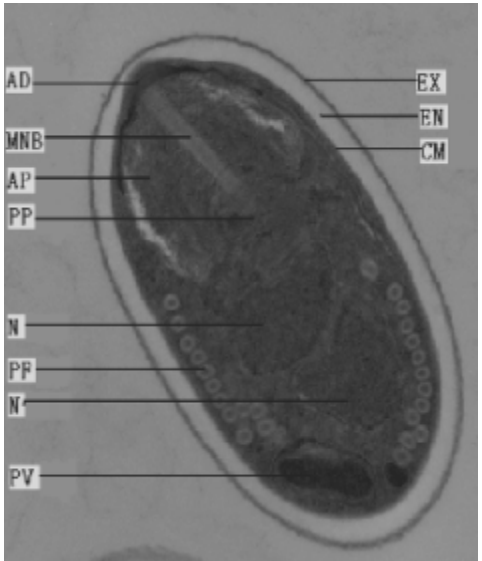
Microsporidian spores isolated
From ***Phthonandria atrilineata* Butler**
（abbreviation: SCH）





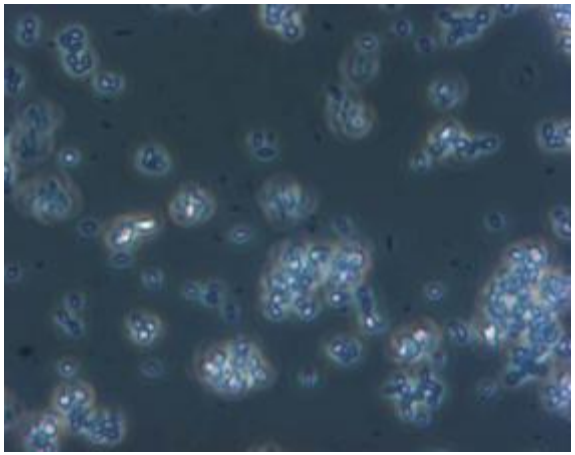
Pieris rapae

(Cabbage butterfly)



Microsporidian spores isolated
From ***Pieris rapae*** （abbreviation: CFD）

Control pebrine with microscopy



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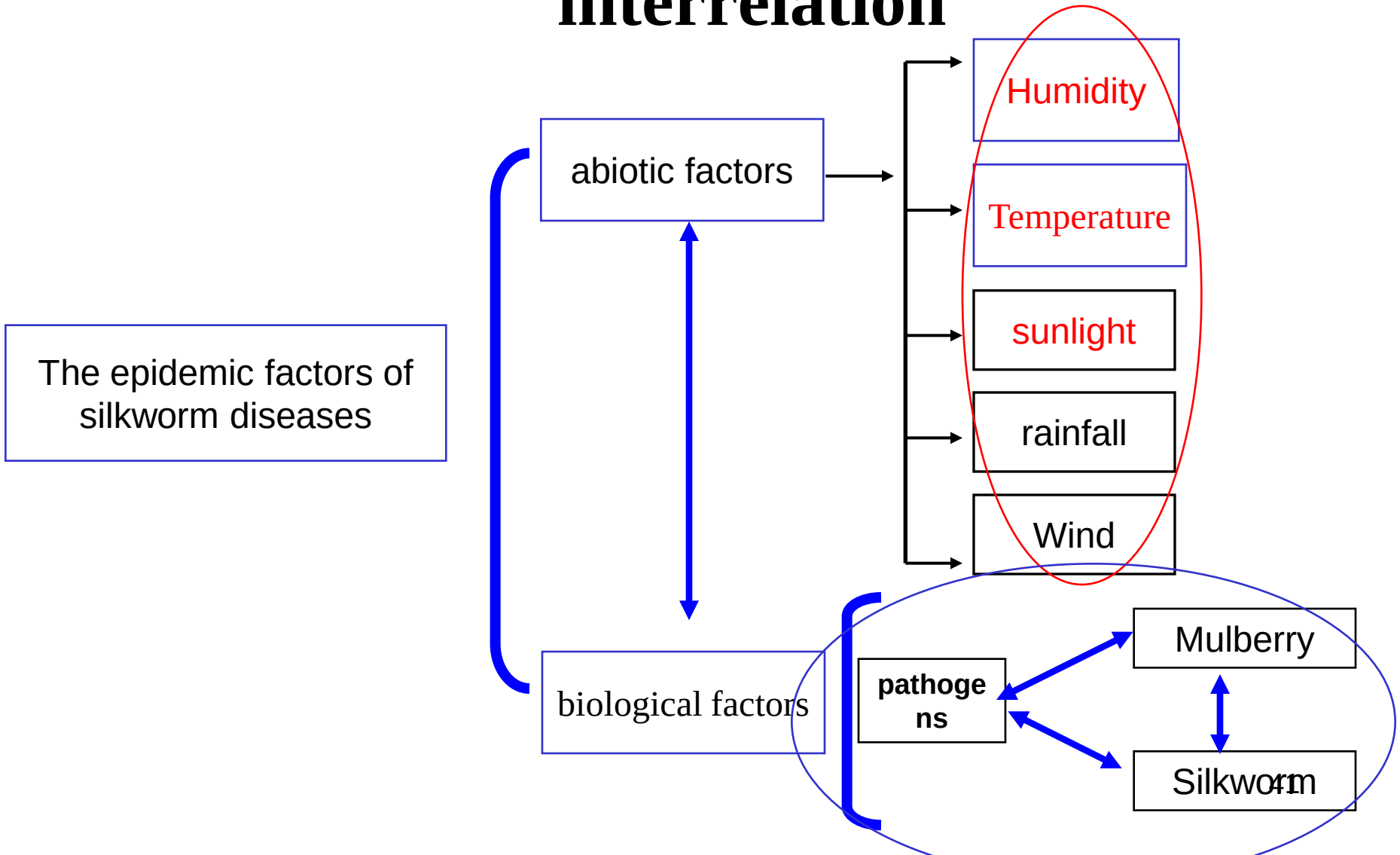
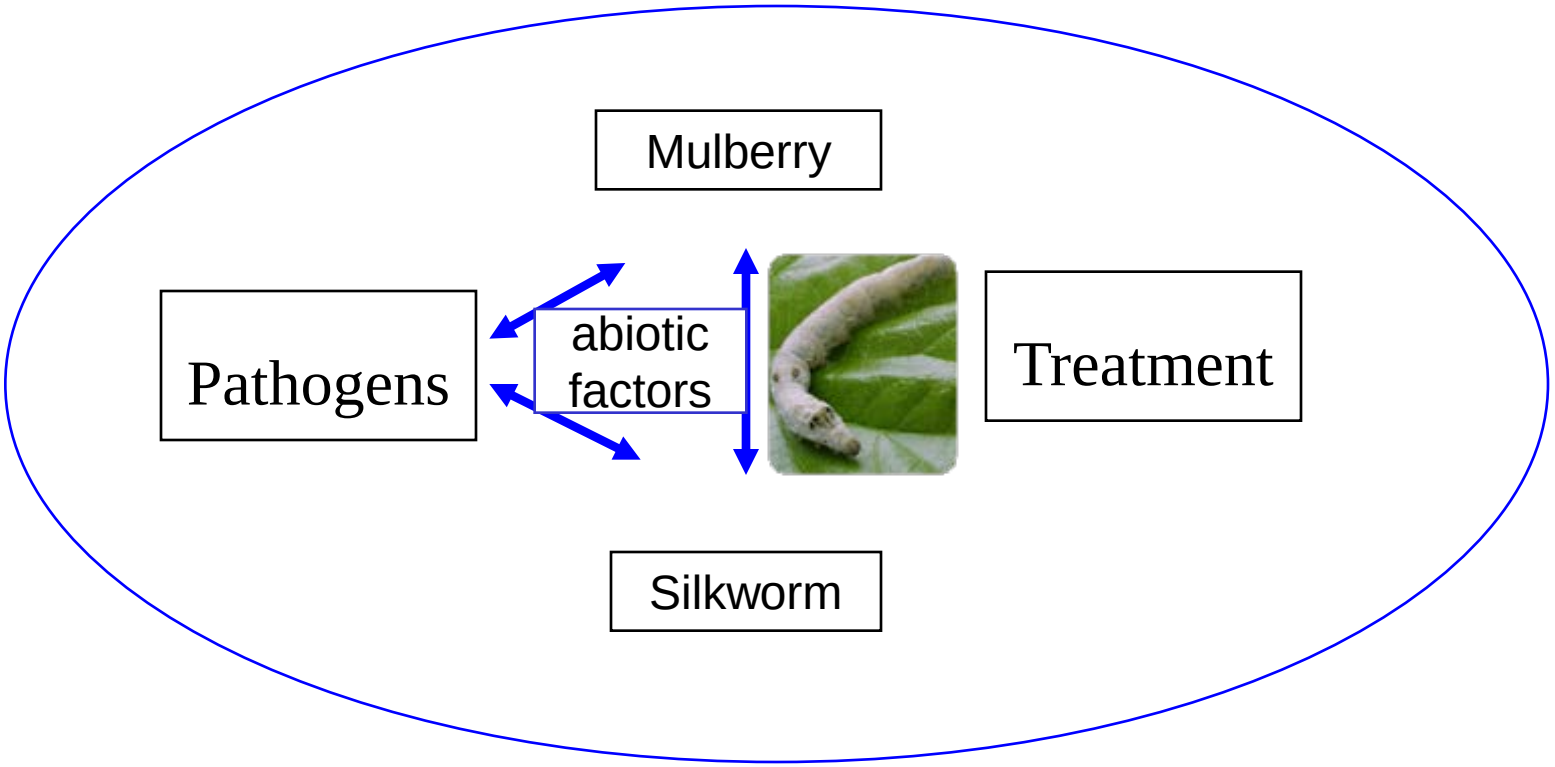
4.1 Influential factors of the occurrence of silkworm diseases and the interrelation

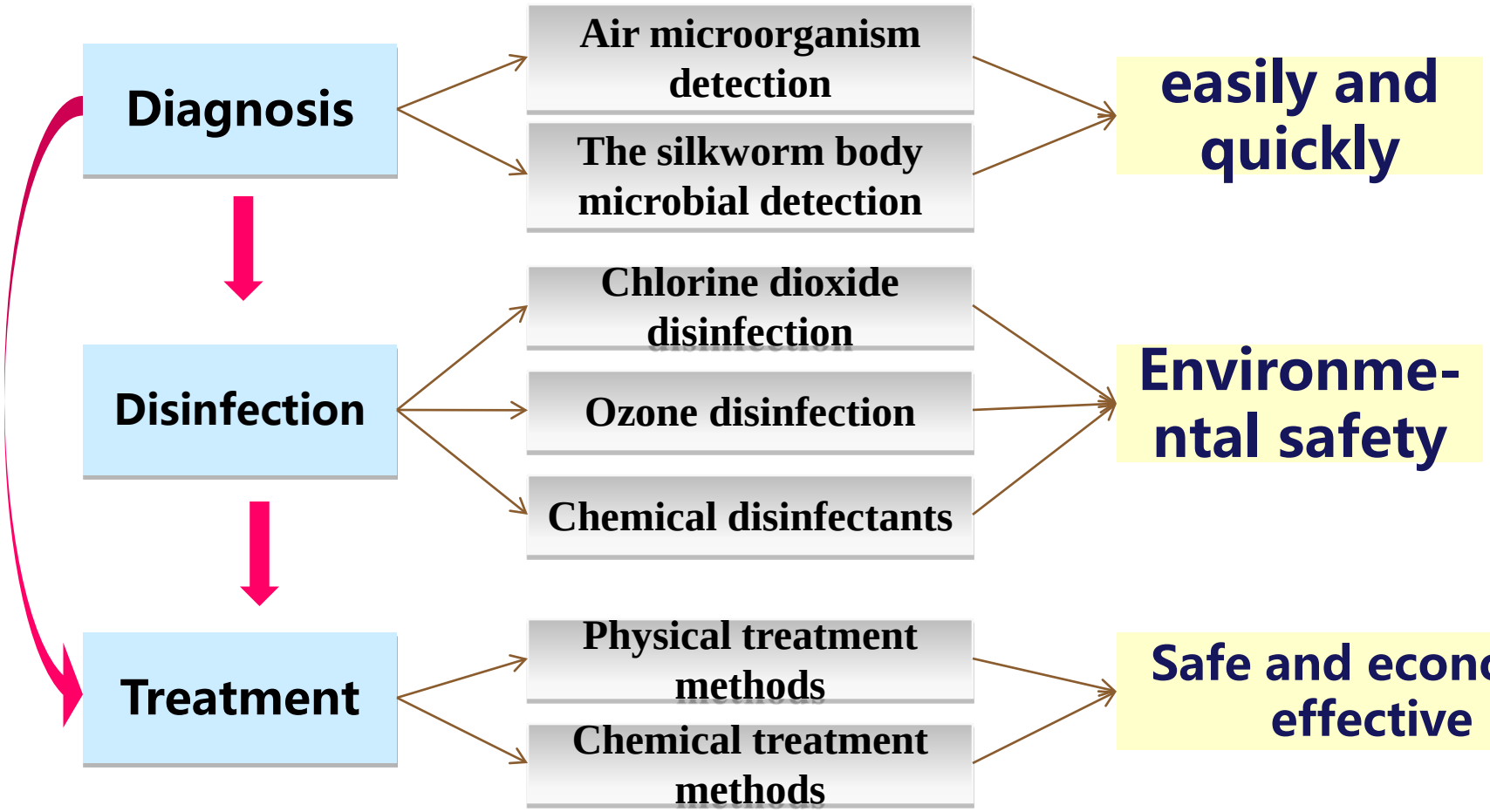


How to control the silkworm diseases?



4.2 The new ideas of silkworm diseases prevention and controls

The new ideas of prevention and control the silkworm diseases



4.3 Prevention and Management of Silkworm Diseases and its practicing

1. Pebrine disease prevention and control system
2. Standard and regulations of disease control
3. Innovation of detection technology of silkworm diseases
4. The reform of disinfection technology
5. Study on the drug for silkworm disease
6. Mulberry pest prevention and control
7. Application of the Internet of things technology

1. Pebrine disease prevention and control system

- **Preditcion， and control oral infection**
- **Integrated Pebrine Management**
- **Sytematic Control.**

managing of mulberry field

Disinfecting the mulberry and rearing facility

2、Standard and regulations of disease control

- **Eggs production**
- **Young Larvae**
- **Mulberry fields**

3、Innovation of detection technology of silkworm diseaseds

1）Classified collection of pathogens

2）Separation and identification techniques of *B. bassiana*

3）Development of visual microscope

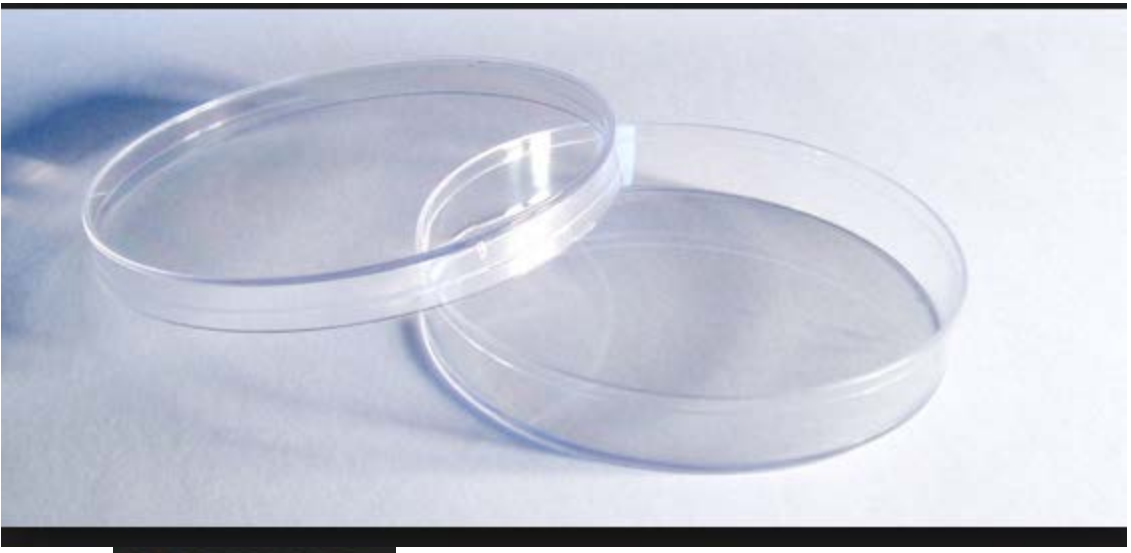
4）PCR molecular diagnosis

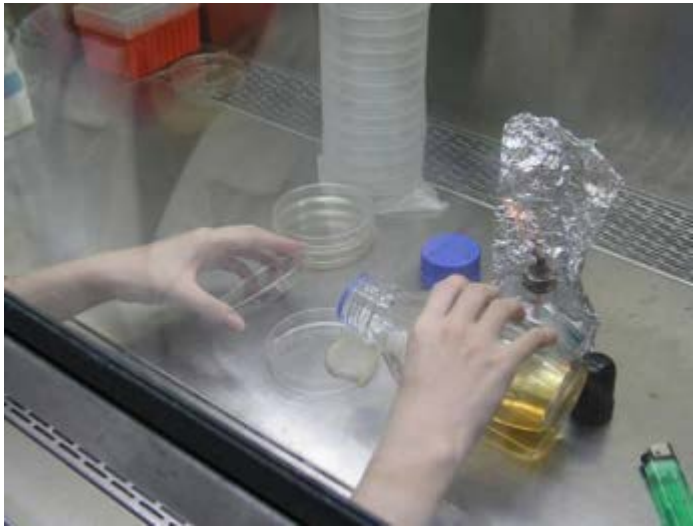
5）LAMP detection protocols

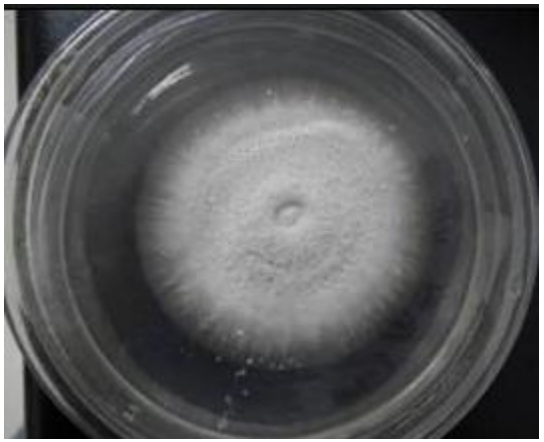
6）Improvement of disinfection technology

7）Exploration of ecological control of the mulberry pests

1） Collection ,classification and detection of pathogens



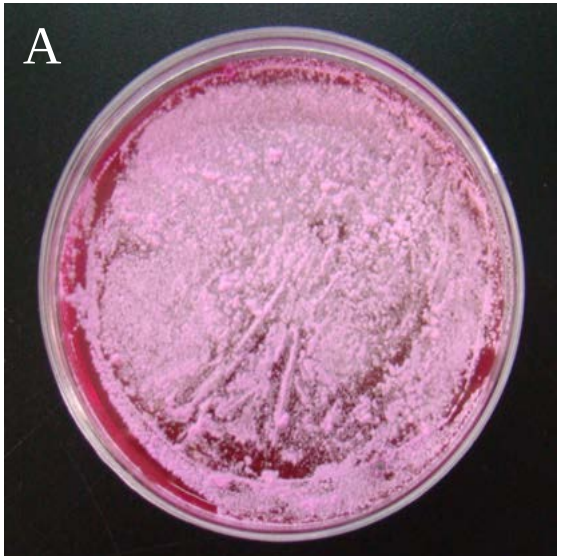


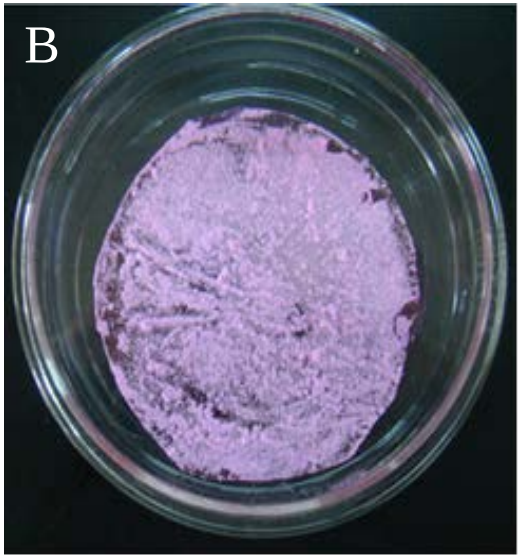


2）Separation and identification techniques of *Beauveria bassiana*

① **Separation and purification method of Beauveria bassiana.Patent No. CN201310566645.7**

② **CN201320717411，Culture device applicable to microorganism separation and purification.**

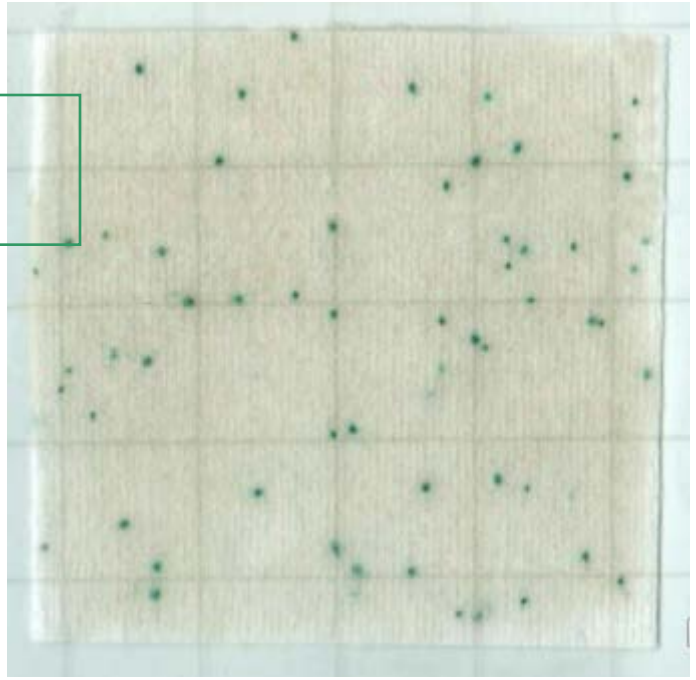


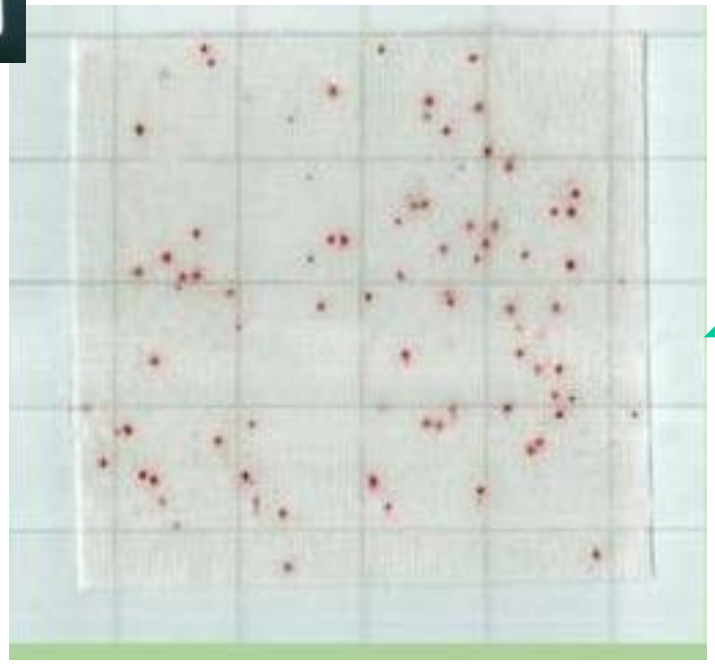


Rapid detection of the environment pathogenic microorganisms

tests card

The total number of colonies tests





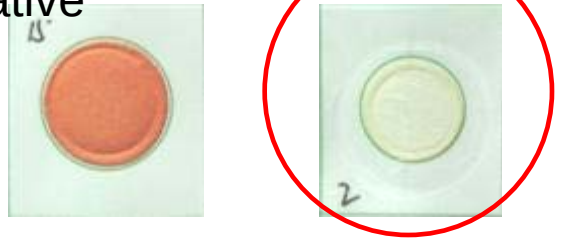
Fungal yeast tests card

2）Detection of pesticide residues in mulberry leaf

testing kit

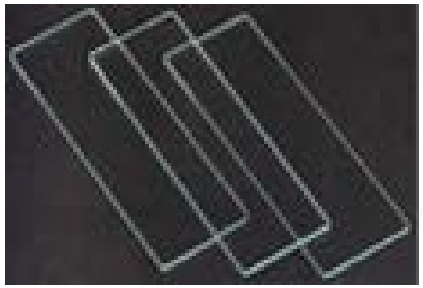
negative

positive



3) Digital multifunctional microscope

Stereology microscopy & Optical microscopy

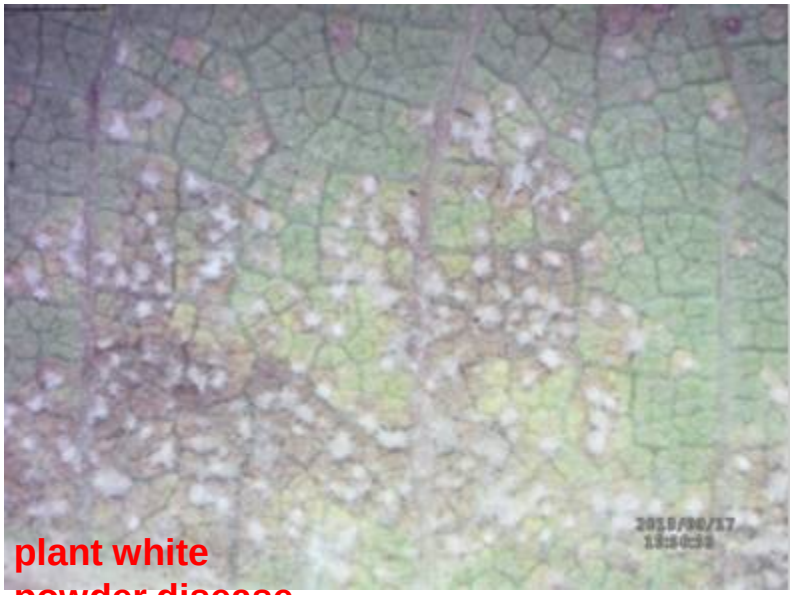



who
am I?

The visual microscope research and development

Multi function digital LED microscope to observe the silkworm eggs

Observe the plant diseases and insect pests

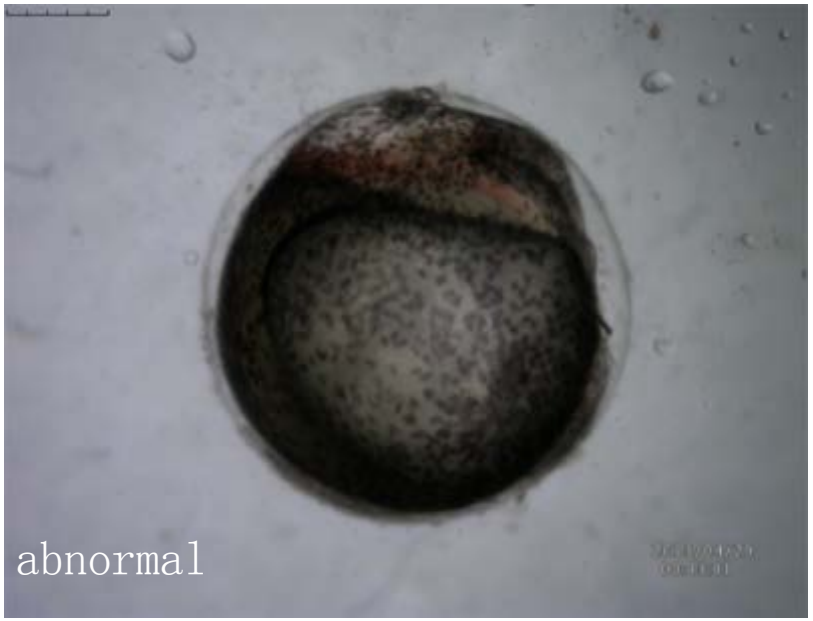


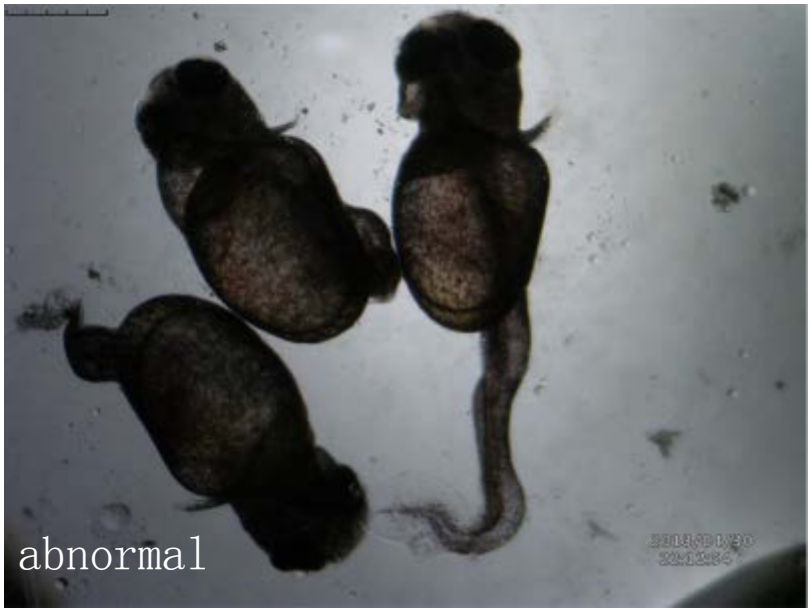
plant white powder disease

pest eggs

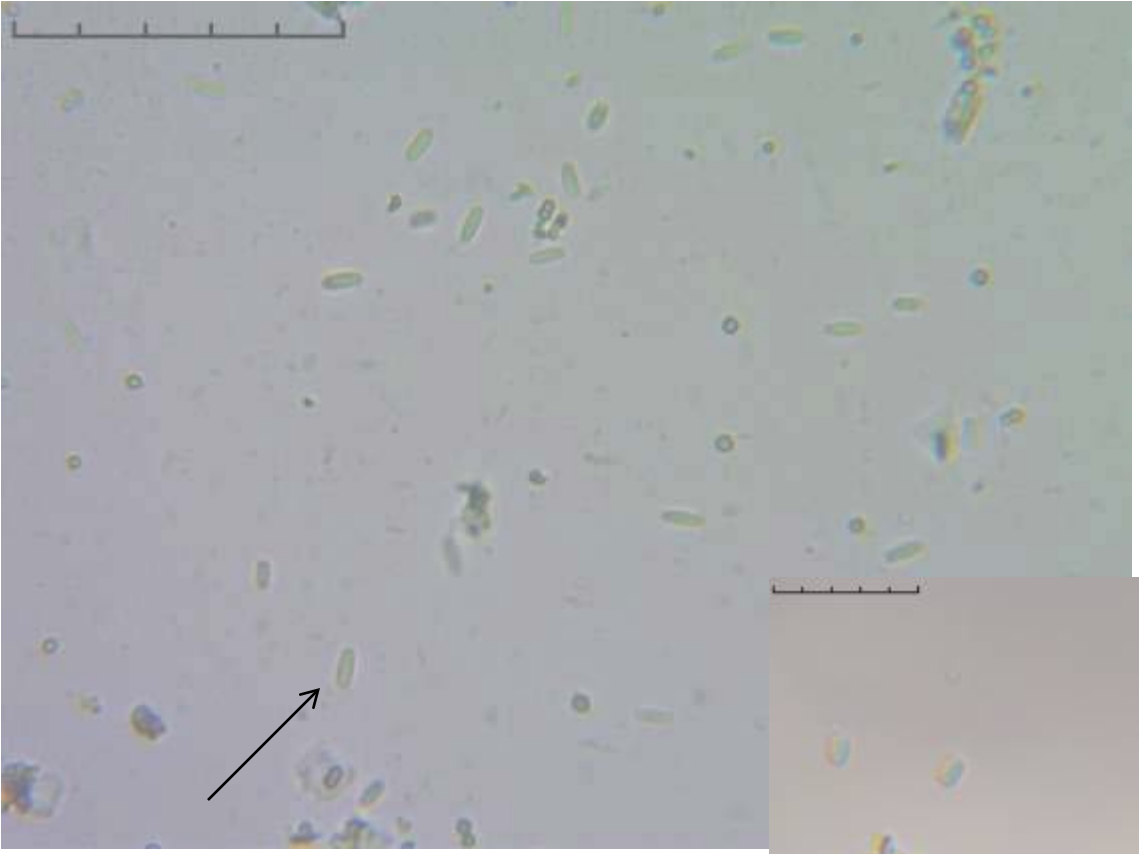

normal fish embryo
2013/04/29
01:08:55


abnormal


abnormal

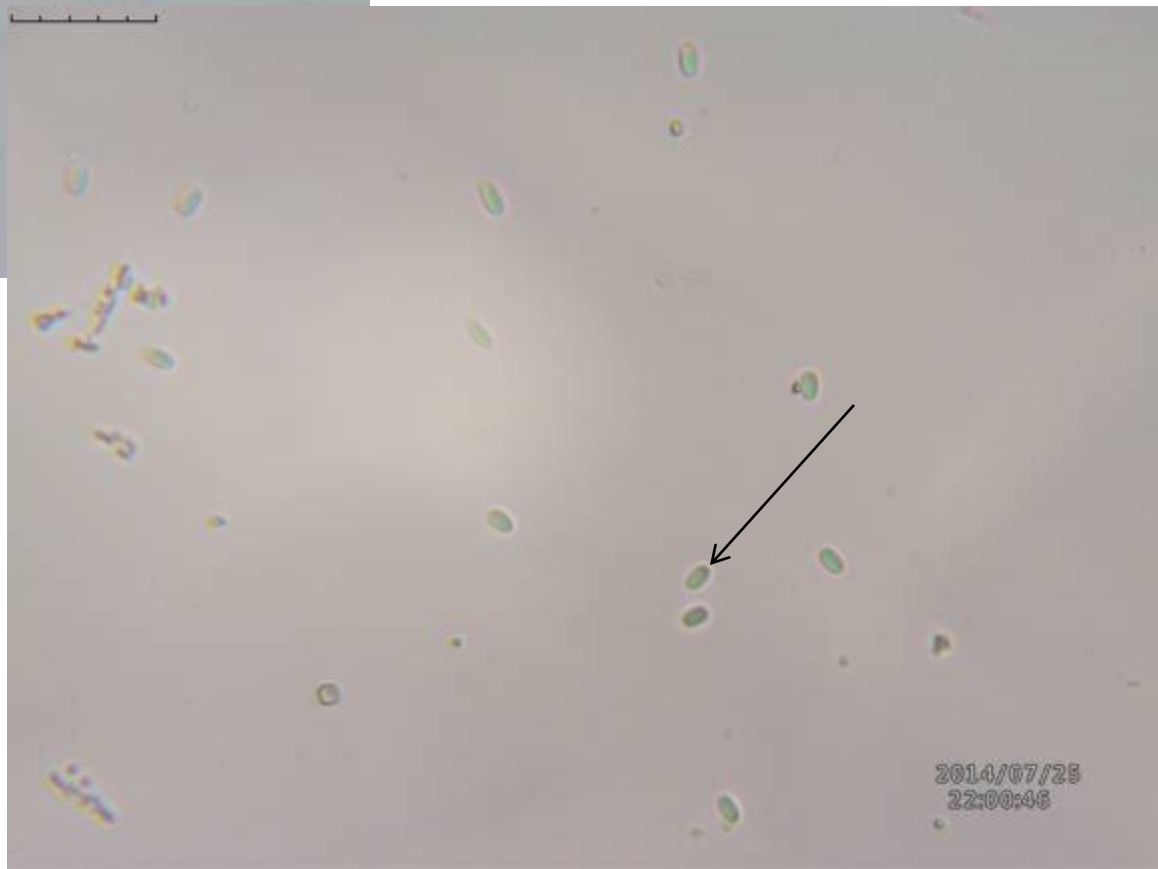

abnormal

Observation by light microscope

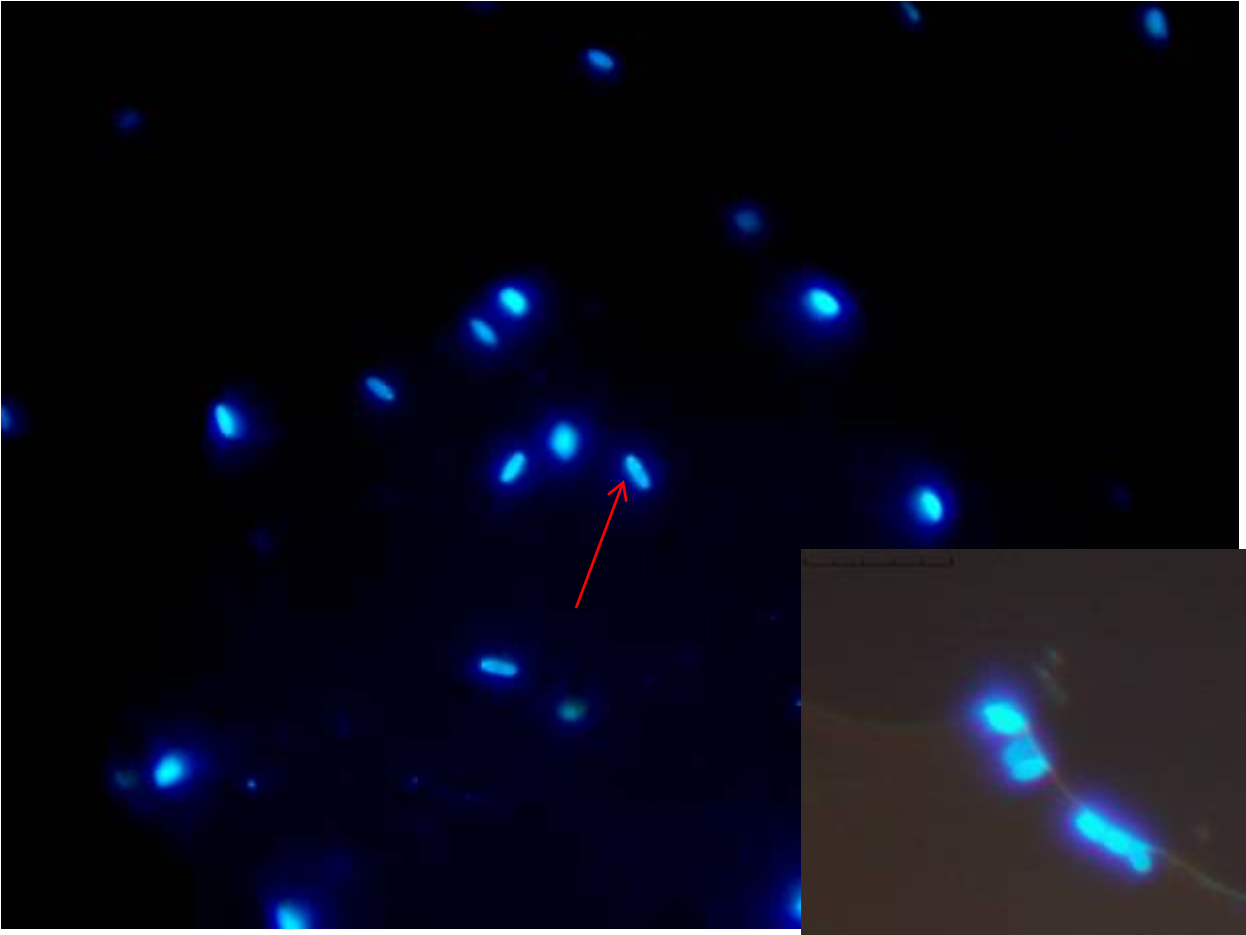


Microsporidian sp.

Nosema bombycis



Observation by fluorescence microscopy

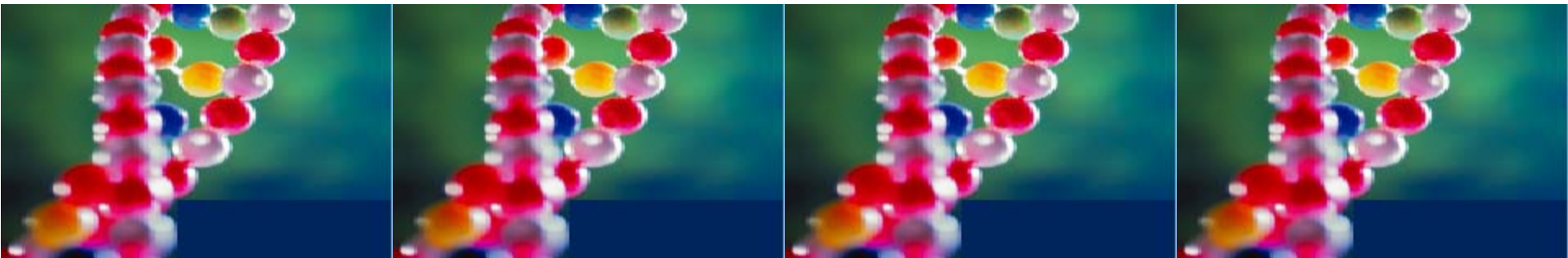


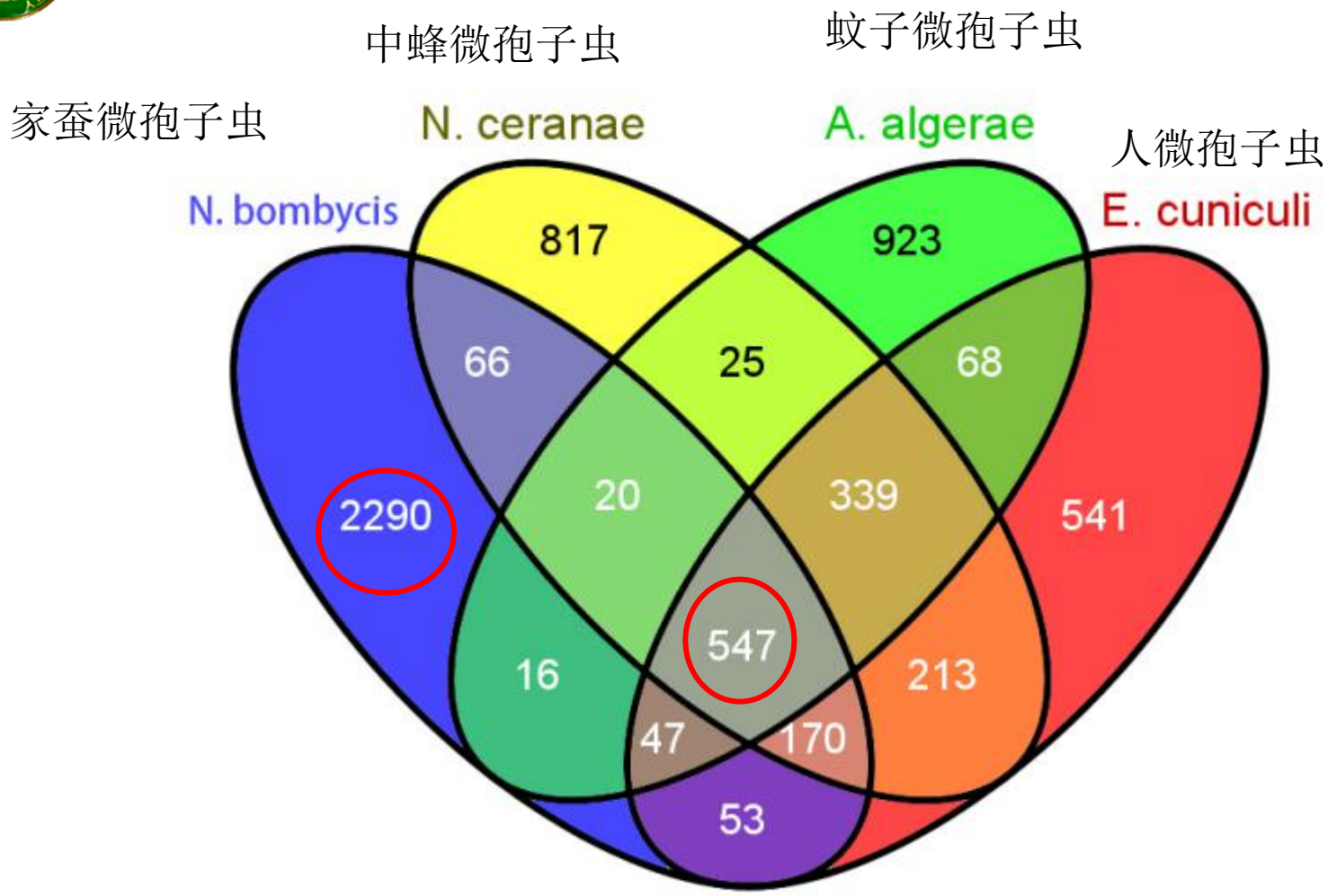
Microsporidian sp. stained with Calcoflluor White M2R

N.bombycis

4）PCR molecular diagnosis technology

PCR procedures





4种微孢子虫全基因组的比较

A rapid DNA extraction method of Nosema- Boiling

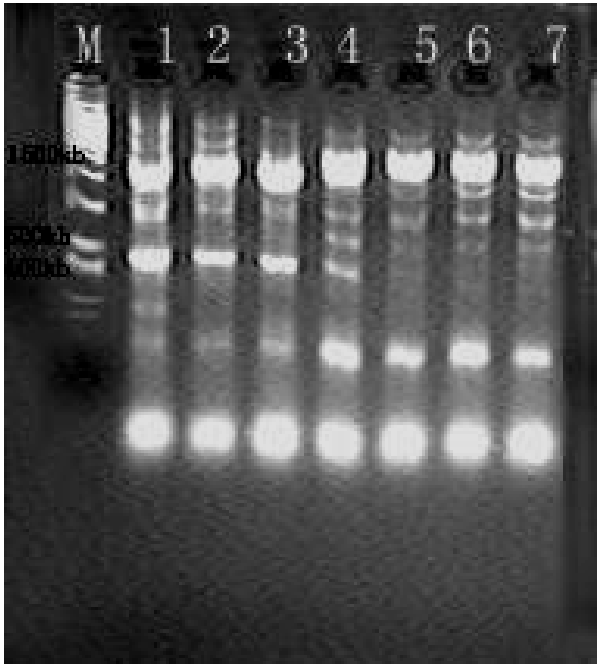


Fig. *Nosema bombycis* DNA electrophoresis

1：positive control；2：10^8个/mL spores；3:10^7个/mL spores；4:10^6个/mL spores；
5:10^5个/mL spores；6:10^4个/mL spores；7：10^3个/mL spores；M：100bp DNA Ladder。

PCR diagnostic techniques for silkworm pebrine —PCR Diagnostic kit

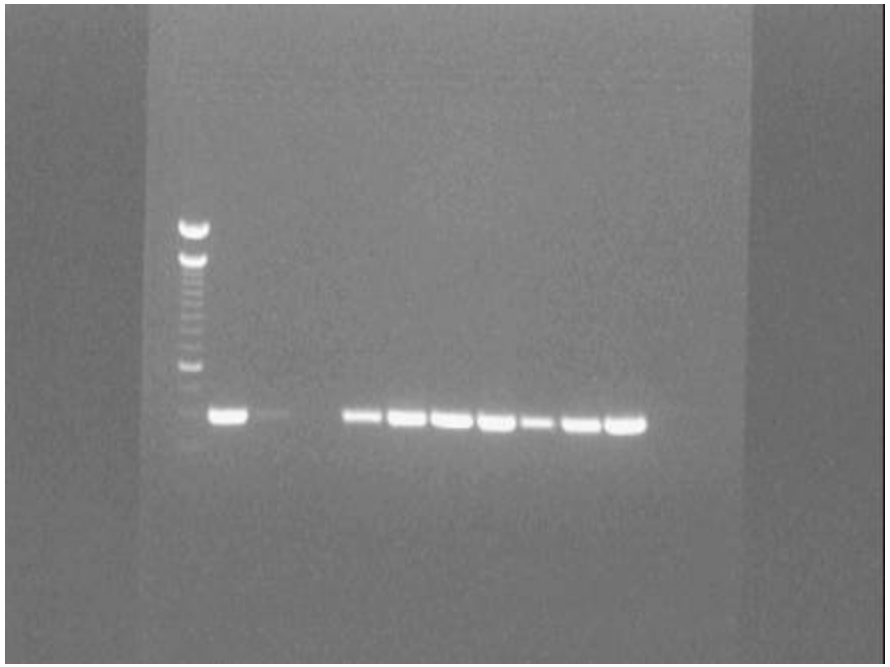
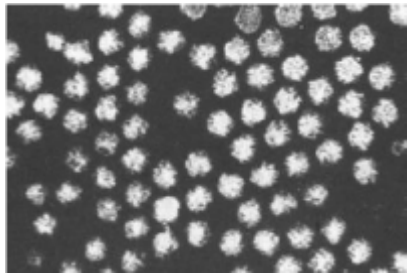


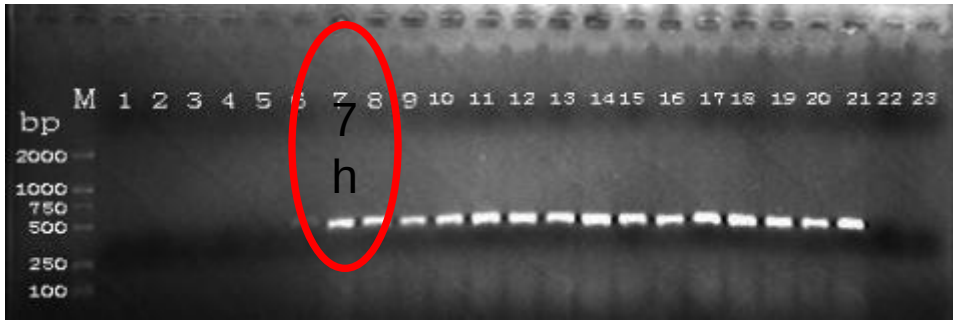
Fig. Sensitivity of PCR (primers V1f/530r) detection

Left： Diagnostic kit

Right：Several pathogenic microsporidia PCR amplification test results

PCR method for rapid detection of BmDNV



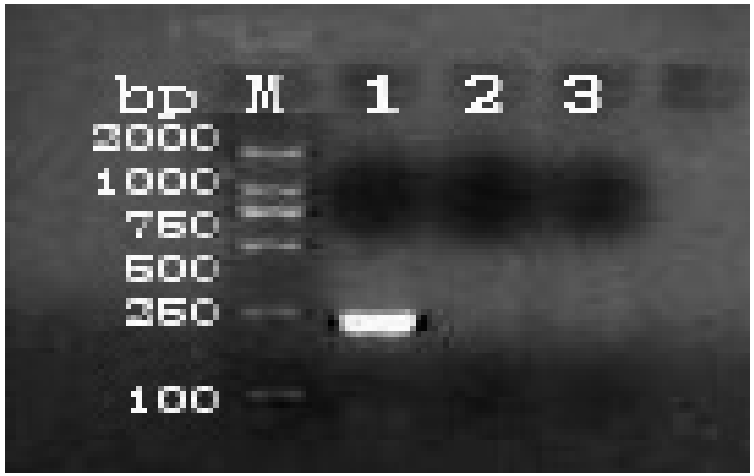


PCR detection Results

NB：M. DL2000 DNA 1～12 oral infected by BmDNV within1～12hrs；13～20: 18～60h（Sample time 6h）；21. BmDNV；22.silkworm；23. ddH_2O

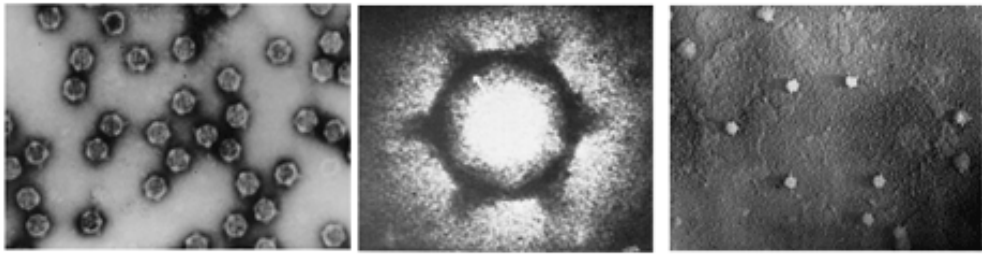
专利号ZL201010617198.X

RT-PCR method for rapid detection of BmCPV



Result of RT-PCR detection BmCPV

注：M. DL2000 DNA ; 1. BmCPV；2. silkworm； 3. ddH_2O



Detection of *Nosema bombycis by* Loop-mediated Isothermal Amplification

On the basis of separation, purification of *N.bombycis* and collection of microscopy samples of female moths, according to the pseudogene of *N.bombycis*, LAMP primers for detecting species-specific for *N.bombycis* were designed and screened, and the specificity, sensitivity and practicability of production samples also were tested.

LAMP kit

Detection of *Nosema bombycis by* Loop-mediated Isothermal Amplification (Idiotype)

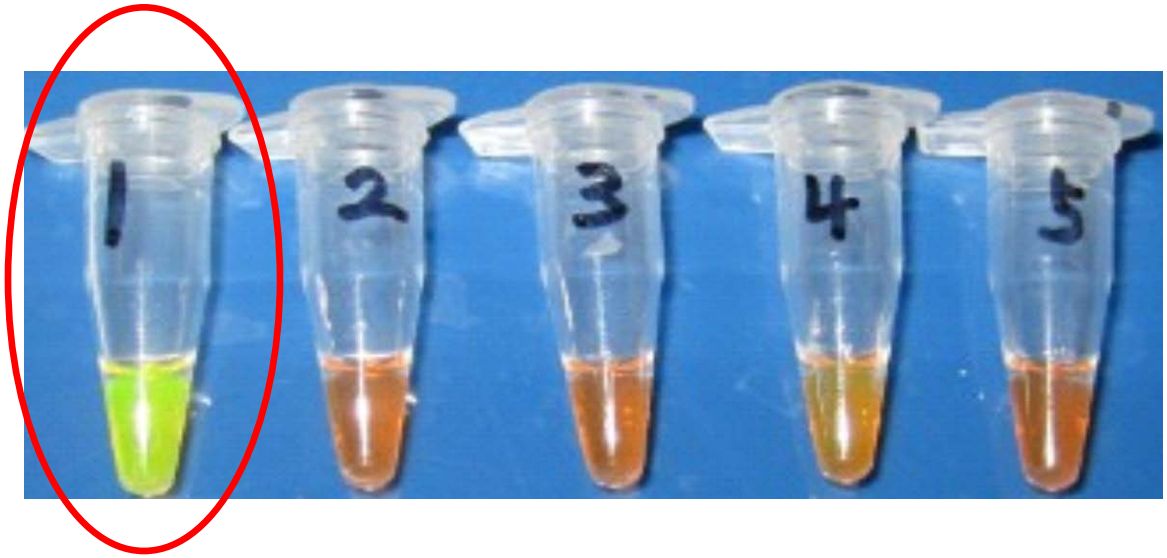


Fig. Primers FI2/BI2，F2/B2 LAMP detection

Note：1：N.b DNA；2：N.locustae spore DNA；3：N.a DNA；

4： Normal silkworm midgut DNA；5：ddH_2O

More.....

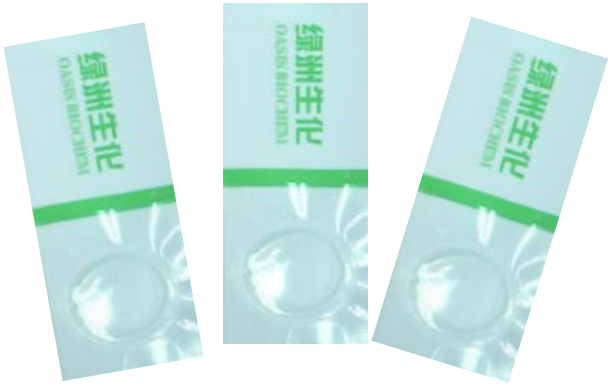
- **14.Liu,Ji-Ping, Yan，Y.W., Chen,W.,CN201410279224,The gene of Septin1 and its applying in detecting Nosema bombycis.**
- **15. Liu,Ji-Ping,Yan，Y.W, Chen,W., CN201410279223，Applying EB1 gene in identification of Nosema bombycis.**
- **16.Liu, Ji-Ping, Li,X.L.,CN201320717411， Culture device applicable to microorganism separation and purification.**
- **17.Liu，Ji-Ping, Microsporidian Gene Assemble Tool Software,(Registration No.2013SR065374)**
- **18.Liu，Ji-Ping, Cheng Wei, Yan Yu-Wei, Song Xiao-Jing, Yang Si-Jia. CN201410592811.5. One group of LAMP primers in identifying Nosema bombycis in silkworm eggs and its application in detecting the pebrine disease.**
- **19.Liu，Ji-Ping, Cheng Wei, Song Xiao-Jing, Yan Yu-Wei. CN201410592795.X， One group of LAMP primers in identifying Nosema bombycis in silkworm eggs and its testing kit.**
- **20.Liu，Ji-Ping, Song Xiao-Jing. CN201410755669.1，One group of universal primers in identifying microsporidia and its testing kit.**
- **21.Liu，Ji-Ping, Song Xiao-Jing. CN201410755670.4. The gene of HMG1 and its applying in molecular detecting silkworm microsporidiosis.**

4. Research and development of disinfection technology

1）**Temperature and humidity control and air purification of the production environment**

automatic controlling device for the air conditioning equips

2） Evaluation of disinfection effects——Effective chlorine of disinfectant testing



3) Hygiene disinfection system for silkworm rearing

Sanitation on Standard Operating Procedure (SSOP)

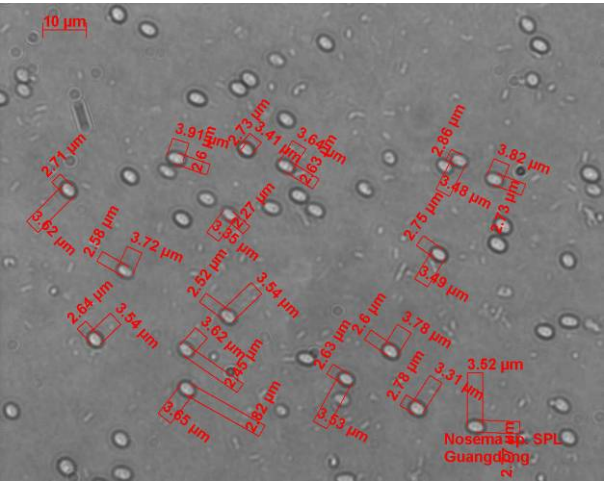
Disinfection on Standard Operating Procedure (DSOP)

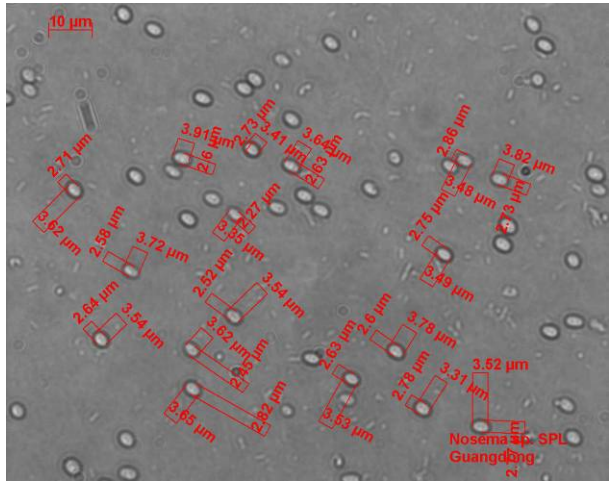
4）Disinfection instrument innovation application

- Air freshener
- Chlorine dioxide(CLO_2) air disinfection machine
- Ozone generator(O_3)

5、Pebrine treatment

- **Drug treatment**
- **Albendazol Tablets**
- **Carbendazim, Benlate**





6. Mulberry pest prevention and control

- **Solar insecticidal lamp**

***Doaphnia pyloalis*（Walker）**

7. To explore with appliying of the internet of things(IOT) technology

- Real-time monitoring of silkworm eggs protection
- Silkworm rearing temperature and humidity control
- Rearing environmental air quality monitoring and control
- Real time monitoring of water and fertilizer of mulberry field
- Mulberry pest real-time monitoring
- Real time monitoring of sericulture growth?

Acknowledgements

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and all my lab team in RSTCAP, etc..

Thank you for your attention !

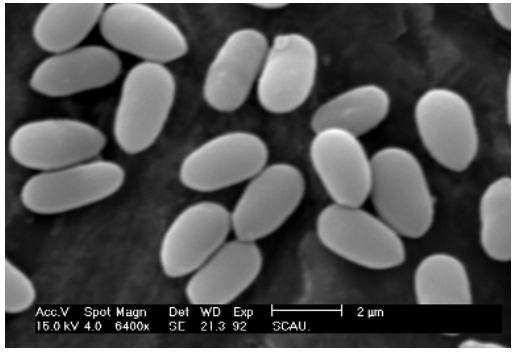
One Belt and One Road

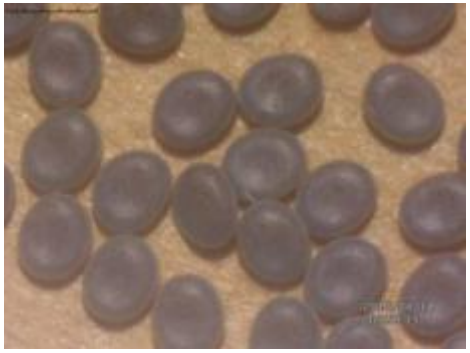
("Silk Road Economic Belt" and the "21st Century Maritime Silk Road")

Cooperation between RSTC and Institutes in Asia-Pacific

1. **Jointly implement the sericulture project in your country under the international funds**
2. **Feasibility report and agreement on cooperation**
3. **Training for trainers and training for farmers**
4. **Demonstration farm**
5. **Supply of silkworm eggs and Mulberry seeds/seedlings to the farmers**
6. **Technical extension**
7. **Cocoon and silk processing**

How to find me & RSTCAP





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