

From sericultural research to "Research on biological functions in insects"

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1. History of sericultural technology development in the past 100 years in Japan

Sericulture contributed significantly to the modernization of Japan industry through the export of raw silk in the past 100 years. Raw silk export occurred for 40% of the total export from 1925 to 1930. The total amount of cocoon production peaked at 399,093t in 1930, before World War II.

At the end of the war, cocoon production reached 85,000 t, then increased slowly until 1955 and ranged between 100,000 and 120,000 t during 20 years. The maximum production of cocoons in these years was 121,000 t in 1968.

Thereafter, the cocoon production decreased gradually from 1975 onward, i.e. in 1978 cocoon production was about 100,000 t, and it decreased to half of this value in 1986. The decrease was drastic in these 5 years, and in the last year it was only 5,000 t, 1/20 of that of 1978's.

The decline of Japanese sericulture decrease was attributed to two main factors :

(1) since Japanese sericulture technology is highly labor-intensive, it was difficult to expand the management scale. (2) Owing to the import of cheaper raw silk and silk products, the price of domestic cocoons remained low as compared with that of other farm products.

Important sericulture technologies developed by the sericultural Experiment Station in the past 100 years are as follows :

- (1) Utilization of hybrid silkworm race(1906)
- (2) Sex determination based on the presence of larval spots(1941)
- (3) Development of denier detector(1955)
- (4) Development of yearly rearing system with mulberry shoots(1959)
- (5) Rearing system with artificial diet throughout

the larval stages(1960)

(6) Development of rearing system of young silkworms with artificial diet(1972)

(7) Development of "Hybrid silk"(1987)

(8) Development of polyphagous silkworm races and low cost artificial diet(1988)

2. Decrease of number of sericultural research staff

Along with the decline of the sericultural industry, the number of research staff in the field related to sericulture also decreased

(1) Reorganization of The Sericultural Experiment Station and decrease of the number of research staff in sericultural fields.

The number of research staff of the institute decreased from 500 to 250 in 1983.

The Sericultural Experiment Station was reorganized in the National Institute of Sericultural and Entomological science(NISES) and the number of departments concerned sericulture decreased from 4 to 2 in 1988. The departments concerned with "Insect function" research were firstly established at the same time.

NISES was again reorganized in 1994. The number of research staff in the field of sericulture further decreased.

Now about only 40 research staff are working in sericultural field.

(2) Decrease of number prefectural research institutes for sericulture

Twenty one institutes located in the prefectures were engaged in research activities in the field of sericulture independently of other agricultural research institutes in 1983.

Only 11 prefectural research institutes remained in 1996.

3. From sericultural research to "Research on biological functions in insects"

"Research on biological functions in insects" can be defined as the research conducted for the analysis of specific biological functions in insects and for utilization for human beings. "Research of biological functions in insects" when NISES was established in 1988 covered the following aspects :

- (1) Field oriented research
 - a) Development of new technology for the control of insect pests in agricultural fields
 - i) Development of new insecticides
 - ii) Control of insect migration
 - iii) Development of insect resistant crops
 - iv) Control of insect diapause and life cycle
 - v) Break down of insect defense mechanism
 - vi) Utilization of natural enemies and pollinators
 - b) Control of agricultural production
 - i) Development of crops resistant by utilizing insect resistant genes
 - ii) Development of insect bio-sensors for taste and smell of agricultural products
 - iii) Efficient production of useful bioactive materials in insects
 - iv) Utilization of insects as high-nutrient and healthy food
- (2) Research on non-agricultural fields
 - a) Development of biological sensors
 - b) Control of growth and aging
 - c) Development of high function computers and bio-robots
 - d) Development of new medicinal products

4. COE(Center of Excellence) research of NISES

COE promotion project by the Science and Technology Agency Japan(STA) using the Science and Technology promotion and Adjustment Fund was started in the fiscal year 1993. The STA aimed of establishing about 10 organization within 4 years.

This year our Institute became the 8th organizations with COE status for the research project titled : "Studies on utilization of insect functions".

The funds allocated for the implementation of the projects is amount to about ¥400 million(w 2.9 billion)/year for 5 years.

Within the framework of the project our institute aims of developing new insect research fields for insect industry

Research in the COE project covers two main fields, 1) Development of new materials utilizing biological functions in insects, and 2) Studies on insect bio-mimetic and utilization. The fund will be allocated to the former field principally.

The research field, "Development of new materials using biological functions in insects", is composed of three sub fields as follows :

- (1) Identification of new bio-materials in insects, structural analysis and clarification of bio-synthetic pathways.
 - a) Identification and characterization of new anti-bacterial substances
 - b) Analysis of anti-blood coagulating substances
 - c) Analysis of fibroin gene function
 - d) Fundamental studies for the development of insect factory
- (2) Modification of bio-materials evaluation and utilization
 - a) Modification of fibroin protein and evaluation of its function
 - b) Development of hybrid materials between insect bio-materials and others
 - c) Upgrading insect anti-bacterial substances by molecular modification
- (3) Development of mass production system of new bio-materials
 - a) Improvement of Baculovirus-silkworm system for the production of useful materials
 - b) Mass rearing system of the silkworm for production of useful bio-substances
 - c) Development of continuous material productive systems in vitro
 - d) Development of insect factory