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Procedures for Breeding Management of The Mulberry Silkworm

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Abstract: This article presents information on the methods, conditions, and timing of breeding rearings in the breeding zones of grainage factories that produce hybrid silkworm eggs. For this purpose, grainage factories receive elite silkworm eggs from breeding sericulture stations, incubate them, and distribute the hatched larvae to sericulture units for rearing. The article also discusses the suitability of farms for conducting breeding rearings, emphasizing that such farms should be selected in areas with the most favorable natural and climatic conditions to ensure the productive development of the mulberry silkworm. To guarantee the systematic delivery of cocoons to grainage factories and synchronize the emergence of moths from the breeds and hybrids intended for crossing, breeding rearings are carried out according to established procedures and schedules.

Keywords: Selection, breed testing, reproduction, family rearing, super-elite stock, elite stock, breeding management, cocoon, silkworm eggs (grena), moth, family line, breed development, zoning, viability.

Introduction: Breeding Management in Sericulture. Breeding management in sericulture is a complex system of activities aimed at the creation, improvement, reproduction, and hybridization of silkworm breeds, with the objective of obtaining the most productive first-generation hybrids. This system includes:

1. Development of new breeds and improvement of existing ones, selection of suitable breeds for crossing to obtain highly productive first-generation hybrids, and competitive testing of newly developed breeds and hybrids.

2. State competitive and production testing of new breeds and hybrids in comparison with regionally approved breeds. Based on the results of these tests, silkworm breeds and hybrids are zoned according to the climatic regions of the country. These activities are carried out by the State Commission for Variety Testing of Agricultural Crops through specialized testing stations.

3. Multiplication of silkworm breeds and maintenance of their economically valuable traits at a high level, as well as limited improvement of breeds, in order to supply grainage factories with high-quality purebred elite (breeding) silkworm eggs. These activities are generally conducted at specialized

breeding sericulture stations and, in some cases, by dedicated departments within grainage factories.

4. Conducting breeding rearings of pure silkworm breeds and carrying out mass selection of live cocoons for breeding purposes, followed by the crossing of breeds to produce regionally approved hybrid silkworms. These activities are performed by grainage factories.

Each of the first three stages of silkworm breeding work requires several years to complete. The fourth stage—hybridization of regionally approved breeds—takes one year, since grainage factories receive new elite silkworm eggs annually from breeding sericulture stations and produce first-generation hybrid eggs each year for commercial rearing.

Thus, the development of a new silkworm breed is a long-term process that may require many years of continuous breeding work.

Breeding Work. Every silkworm breed approved for commercial production after proper testing originates from a relatively small amount of initial breeding material. Consequently, all individuals within a breed are related to one another to some degree through distant common ancestry.

For this reason, when newly developed breeds are multiplied on a large scale under farm conditions—often in environments less favorable than those in which they were originally developed—they may gradually degenerate. This degeneration is expressed through a decline in economically valuable traits and overall viability. To prevent such deterioration, breeding sericulture stations conduct maintenance selection, aimed at protecting breeds from degeneration and genetic contamination. These pure breeds are subsequently used by grainage factories for industrial hybridization.

The principal objectives of breeding sericulture stations are to preserve the economically valuable characteristics, breed traits, and viability of approved mulberry silkworm breeds at a high level, while also making minor improvements in secondary characteristics. For example, if a breed produces both adhesive and loose egg batches, the station's objective may be to improve the breed so that it consistently produces only adhesive egg batches.

However, fundamental improvements in major traits—such as silk filament fineness, reelability, cocoon silk content, and related characteristics—are not the responsibility of breeding stations. Such work is carried out by specialized scientific research institutions.

Each year, breeding stations supply grainage factories with high-quality elite breeding eggs. To achieve this, a carefully planned and strictly sequential breeding cycle is conducted with each breed over a period of two or three years.

For breeds exhibiting a high degree of genetic stability (trait consolidation) and when the production target for elite eggs is relatively small, the required breeding cycle can be completed within two years. For breeds with lower trait stability, or for highly stable breeds when a large volume of elite eggs is required, the breeding cycle is extended to three years. This systematic approach ensures the preservation of breed purity, genetic stability, and high biological productivity, thereby supporting the sustainable development of the sericulture industry.

Breeds with High and Low Genetic Stability. Breeds with a high degree of consolidation (genetic stability) are characterized by a high level of uniformity among all individuals, including cocoons, eggs, and larvae. Their economically valuable traits are consistently transmitted to subsequent generations, even when slight variations occur in rearing conditions. Such breeds are considered stable and reliable for breeding purposes.

In contrast, breeds with a low degree of consolidation produce less uniform cocoons and tend to lose some of their economically valuable characteristics and viability in subsequent generations when rearing conditions change even slightly. These breeds are regarded as less stable and possess lower hereditary conservatism.

Family Rearing and Super-Elite Silkworm Eggs. Regardless of the breeding cycle employed, family rearing of silkworms is always conducted. This stage, commonly referred to as the family nursery, involves rearing and evaluating silkworm families separately. During this process, super-elite silkworm eggs are produced.

The term super-elite (derived from the Latin word super, meaning “above” or “beyond”) refers to a generation that precedes the elite generation and possesses superior genetic and productive qualities. Super-elite stock serves as the foundation for producing elite breeding eggs of the highest quality.

Two-Year and Three-Year Breeding Cycles

The breeding work conducted with each silkworm breed may follow either a three-year or a two-year cycle, depending on the stability of the breed and production requirements.

In a three-year breeding cycle, family rearing is carried out, super-elite eggs are produced, and a series of selection and multiplication stages are completed over three consecutive years.

In a two-year breeding cycle, cocoons obtained from family rearing are used directly to produce super-elite eggs instead of producing the intermediate PR generation. Consequently, all breeding operations scheduled for the second year in the three-year cycle are replaced by those normally performed during the third year.

To compensate for the shorter breeding period, a slight reduction in selection intensity is permitted during the first year. For example, instead of selecting 40–50 breeding cocoons from each family, 80–100 cocoons may be retained for breeding purposes. This approach helps maintain sufficient genetic diversity while ensuring the production of high-quality elite breeding material within a shorter timeframe.

Thus, the choice between a two-year and a three-year breeding cycle depends on the genetic stability of the breed and the scale of elite egg production required, while both systems are designed to preserve breed purity, productivity, and viability.

Table 1

Year of Work	Stages of Breeding Work	Quantity
1st	Incubation of silkworm egg batches.	180-200 Egg batches
	Selection of larvae from the first two days of hatching from egg batches that showed the highest and most uniform emergence.	100-110
	Family rearing of silkworm larvae (family nursery).	100-110
	First evaluation of families based on larval viability and cocoon morphological characteristics, followed by the selection of the best families according to these traits.	50-60 Families
	Second evaluation of families based on average cocoon weight and shell percentage, with the selection of superior families.	20-30
	Selection of cocoons for individual analysis from the best 20–30 families, choosing 70–80 cocoons of each sex.	140-160 **Cocoons per Family**
	Selection of cocoons after individual analysis, retaining 40–50 cocoons of each sex from the previously selected 70–80.	80-100 **Cocoons per Family**
	Selection of the best cocoons from the best families, choosing 10 cocoons of each sex for the preparation of eggs in the family nursery.	20 **Cocoons per Family**
	Production of Preliminary Reproduction Eggs (PR eggs), with female moths selected from different families to ensure genetic diversity.	800-1500 Egg batches
	Grouping of PR egg batches into lots containing 80–100 egg batches each.	10-15 Batches
2nd	Incubation of PR eggs separately by lots, followed by the selection of larvae two days after hatching for super-elite rearing.	10-15
	Super-elite rearing of silkworm larvae under high zootechnical standards.	10-15
	Selection of the best super-elite cocoon lots based on productivity, cocoon quality, and average cocoon weight.	6-12 Batches
	Selection of breeding cocoons within each super-elite lot, retaining no more than 30% of the cocoons.	6-12 Batches
	Production of super-elite eggs, using male and female moths selected from different lots.	10-25 Boxes
3rd	Incubation of super-elite eggs for elite silkworm rearing.	10-20 Boxes

	Elite rearing of silkworm larvae under high zootechnical standards.	10-20 Boxes
	Selection of the best elite cocoon lots based on productivity, quality, and average cocoon weight.	800-1000 кг Cocoons
	Selection of the best cocoons within each superior elite lot, retaining no more than 50% of the cocoons.	400-500 кг
	Production of elite eggs through within-breed crossing of cocoon lots by selecting male and female moths from different lots.	800-1500 Boxes

Breeding sericulture stations are required to supply elite silkworm eggs to grainage factories every year. Therefore, breeding work is carried out continuously, with successive breeding cycles overlapping one another. As a result, under a three-year breeding cycle, each breeding sericulture station annually produces silkworm eggs of four categories:

1. Selection eggs for family rearing;
2. Preliminary reproduction (PR) eggs;
3. Super-elite eggs;
4. Elite eggs.

Under a two-year breeding cycle, eggs of only three categories are produced, namely all of the above except the preliminary reproduction eggs.

Selection eggs intended for family rearing of silkworms are commonly referred to as the initial breeding material, since the entire breeding cycle begins with these eggs. They serve as the genetic foundation for the subsequent stages of selection, evaluation, multiplication, and improvement of silkworm breeds. Through this continuous and systematic process, breeding stations maintain breed purity, preserve valuable economic traits, and ensure a stable supply of high-quality elite eggs for grainage factories and commercial silk production.

During the first year of breeding work with a silkworm breed, the breeding station receives the initial breeding material from scientific research institutions. In all subsequent years, however, the stations prepare the initial breeding material themselves on an annual basis.

CONCLUSION

The organization and timely implementation of breeding rearings at the breeding sections of grainage factories play a crucial role in obtaining high-quality cocoons suitable for breeding purposes. Therefore, the step-by-step incubation of silkworm eggs and the rearing of breeding larvae in accordance with a pre-established breeding schedule ensure the successful accomplishment of breeding objectives. Proper planning, systematic selection, and adherence to breeding procedures contribute to the production of healthy and productive breeding stock, thereby supporting the efficient operation of grainage factories and the sustainable development of the sericulture industry.

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