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[Short Communication]

Key principles for breeding spring-and-autumn using silkworm varieties: from our experience of breeding 873×874

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ABSTRACT
The successfully breeding of the hybrids 873×874 had settled the problem that the yield was not uniform to the silk quality in silkworm varieties. In this paper, we illuminated the key technology, principle, hints and methods for selection in breeding spring-and-autumn rearing silkworm varieties were analyzed using the procedure of breeding the hybrid of 873×874 as example.

Keywords: Breeding, 873×874, key technology

INTRODUCTION

By reviewing the development history of China's silkworm industry in recent decades and its current situation, it is not difficult to see that, with the sericultural production experiencing twists and turns, ups and downs, there are many problems waiting to be solved. Accordingly, in order to realize the great goal of silkworm industry in the 21st century, we must strengthen the position of agriculture as the foundation of national economy, meet new challenges, comply with changes of situation, be initiative, and realize new turning of the industry. Silkworm varieties are the most important items for development of silk industry. They are the key factor determining quality of silkworm eggs.

Meanwhile, they directly influence the initiative of silkworm raisers and the quality of cocoon and silk. Through years of efforts made by breeders of our research team, our breeding techniques have been improved a lot. In 1981~1985(the "sixth five-year plan period"), we bred an adversity-resistant variety Su_3·Qiu_3 × Su_4 for summer-autumn rearing; in 1985~1990(the seventh five-year plan) period, we bred the first pair of fluoride-tolerant variety Fengyi × 54A for summer-autumn rearing and the first pair of adversity-resistant and hypersilkgeneous variety 57A·57B × *24*·46 for spring and autumn rearing; in 1991 - 1995(the eighth five-year plan) period, we bred three adversity-resistant and hypersilkgeneous varieties 873 × 874, 317 × 318, and 415× 416, the first one being for spring and autumn rearing and the other two for summer-autumn rearing; and in1996 - 2000 (the ninth five-year plan)period, we bred 873 × 874, 953 × 954 and SG × 54A with superfine silk size.

The breeding and popularization of these high-quality varieties not only benefited farmers a lot but also brought in billions of foreign exchange earnings for China. However, with the rapid development of township-village enterprises in silkworm rearing areas in Jiangsu, Zhejiang, Guangdong and other provinces, and the adjustment of economic structure in rural areas, mulberry leaves in some areas have been polluted by fluoride, severely deteriorating the ecological environment in silkworm raising areas.

In addition, since farmers were not careful enough to handle the worms and to disinfect the silkworm rearing environment, nuclear polyhedrosis, fungal diseases and other silkworm diseases have become rampant. At present, in Zhejiang province, silkworm varieties for autumn rearing are rared in spring because of serious fluoride pollution, while in Jiangsu province, varieties for spring rearing are

raised in autumn for the purpose of increasing yields.

Thus, it is important to the farmers in Jiangsu, Zhejiang, Anhui, Sichuan, Shandong and other provinces to breeding a new silkworm varieties that are fluoride-tolerant, disease-resistant, adversity-resistant and hypersilkgeneous for rearing in both spring and autumn seasons.

Since mid 1980s, popularization of hyper-silkgeneous varieties for spring and autumn rearing has been carried out gradually in the Yantze River valley and in the northern part of China. To date, we have bred and popularized the following silkworm varieties for spring and autumn rearing: 57A·57B×24·46, 873×874, 86A·86B×54A, Chuancan No.11, Su·Ju×Ming·Hu, 873×874, 781·881×782·882 and so on.

How to keep the compatibility among the cocoon quality, the adversity-resistance and fecundity has always been a difficult problem in breeding. Application of high-quality silkworm varieties that adapt to the local environment is an important method for improving cocoon quality, increasing cocoon yield and enhancing the profit. Differences in climatic conditions of different areas across the country, including the significant distinctions in temperature and humidity, the significantly different silkworm rearing environment in spring and autumn seasons and the frequent outbreak of silkworm diseases, require that the silkworm variety should be both hypersilkgeneous and adversity-resistant. When breeding of silkworm varieties, it should be taken into account not only the benefits of silkworm raisers and silk mills but also those of parent eggs production farm. The application of silkworm varieties is directly affected by the following factors: the vigor of parent silkworms, the number of eggs laid by the parent moth, and the percentage of good eggs, all of which can be reflected from the yield of good cocoons that can be used to produce eggs.

An adversity-resistant and hypersilkgeneous variety 873 × 874 was bred through cross breeding combined with pedigree selection by He Simei et al. in Sericultural Research Institute, Chinese Academy of Agricultural Sciences. 873 was crossed by using C2 with high silk yield as female parent, and 57B with good comprehensive characters as male parents. 874 was single-crossed by using 872 with strong vigor and comprehensive characters as female parent, and Mingzu germplasm line with good combining ability as male parent. The variety was identified jointly nationwide in 1997 and 1998, and appraised by National Mulberry and Silkworm Appraising Committee. The obtained results are as follows: filament length is 1200-400 meters, raw silk rate 17.42-20.68%, neatness 94-96 points, egg production 4.2 cases / kg cocoons in spring and 3.6-4.9 cases / kg cocoons in autumn , and cocoon crop, cocoon shell weight and raw silk weight per 10 000 larvae is higher than those of the control variety by 7-12%, 11-18% and 9-20%, respectively. It is a high-quality and hypersilkgeneous variety with great potential in increasing production, excellent silk quality, fluoride tolerance and high fecundity.

The variety was approved by National Mulberry and Silkworm Appraising Committee in 1999. And in 1998 regional test and popularization experiment were carried out nationwide with remarkable achievement accomplished.

The general feedback was that, its parent silkworm has the following characters: uniformity in development, thick and strong body, eating fast, good health, high cocoon yield and so on; and in egg production period, it is characterized by strong pupa body, high rate of healthy pupa, uniformity in emergence, good mating ability, high number of eggs laid a moth, low rate of poor eggs, strong resistance to high temperature, high fecundity and so on. The variety is easy to rear on large scale in rural areas because of its strong resistance both to diseases and adversities.

Under the same conditions, unit production and unit value of the variety are much higher than those of the control varieties, thus the variety is welcomed by farmers, parent eggs production farms and silk mills . This variety has become one of the major varieties being reared in Sichuan, Jiangsu and Shandong provinces.

Meanwhile, it has begun to be popularized on large scale in Anhui, Henan, Shaanxi and Shanxi provinces and on small scale in Zhejiang, Yunnan, Guangdong and other provinces. So far, more than 1.5 million cases of F1 hybrid eggs of the variety have been popularized with an economic benefit of over 1 billion Yuan. In the spring of 2000 alone, nearly 28 thousand egg layings of grand parent moths, over 9 thousand cases of parent eggs and 700 thousand cases of F1 hybrid eggs were popularized. The successful popularization of the variety shows that its breeding has solved the long-lasting problems in the breeding of silkworm varieties that it is difficult to eliminate the incomepatibility between adversity-resistance and silk quality and yield.

With experience in the successful breeding of 873 × 874, we consider that the following keys of breeding techniques should be followed in order to breed adversity-resistant and hypersilkgeneous varieties for spring and autumn rearing:

1. THE SELECTION OF PARENTS

When selection of two parents, some characters should be matched to each other, including high silk yield, adversity-resistance, good combining ability, excellent silk quality and fluoride tolerance. so that hybrids bred have good characters of both parents. In order to breed a variety that are both adversity-resistant and hypersilkgeneous, we should take into account both a balanced development of major economic characters and improvement of individual characters such as adversity-resistance and silk quality in the whole course of breeding. For example, in order to improve fluoride-tolerance, apart from choosing fluoride-tolerant parents, we should make use of the influences of environment on the tolerance by choosing mulberry fields rich in fluoride, and not washing mulberry leaves rich in fluoride for the accumulation of fluoride-tolerant genes through natural selection and directional selection. In early and middle stages, we should begin to establish small lines by selecting excellent batches from excellent systems, eliminating batches and systems that fail to meet breeding goal, and making batches and systems with good characters that can be inherited stably reproduce. Pedigree selection used in such a way not only makes kinship clear but also makes it easy to distinguish changes caused by environmental conditions from genetic variations.

In order to exclude the influences of environment, cocoons that are extremely big or extremely small are generally eliminated, while those between, namely slight above the average, are selected to reproduce. Breeding in such a way takes less time to fix characters, thus shortening breeding cycles.

2. MAINTAIN VARIETY PURITY

Attention should be paid to maintain variety purity, because characters such as voltinism, moultinism, uniformity in molting, marking and egg color will influence major economic characters to play their role and the popularization of varieties bred.

These characters are markings of purity, and can serve as bases for eliminating impure individuals. Morphological characters such as marking, cocoon shape and cocoon color should be selected mainly in early generations. Those below should be eliminated: Eggs with abnormal color, silkworms with abnormal marking, colored cocoons, flossy cocoons, spherical cocoons, cocoons thin at both ends, and cocoons with multi-layers.

Morphological characters are characters whose variations are obvious, and affected little by environment, so selection effect is very evident by the selection of batches complemented by individual selection when segregation is the most obvious. In early stage, batches are mixed to rear and individual selection is emphasized, and then batches are reared individually. In middle stage, standard cocoon shape should be fixed with cocoons of Chinese strains being oval, and those of Japanese strains being slightly peanut-shaped. Moreover, cocoon color should be white, cocoon should be uniformly shaped, and marking and egg color should be uniform. As for quantitative characters that are affected greatly by environment, we should create specific breeding environment, increase the number of batches, establish small lines, and then mainly select excellent batches from excellent lines. In particular, characters related to yield stability and silk quality are selected more strictly, and at the same time great attention should be paid to the selection of comprehensive characters. Quantitative character, such as cocoon weight, shell weight, shell ratio and filament length etc, is jointly controlled by multiple genes and environmental factors, so that it is difficult to distinguish the effect of multiple genes from that of environmental factors. However, we can conduct the selection according to the actual performance or the predicted identification data of the silkworm lines. Take the selection of cocoon quality for example, we can choose 80-120 (half male and half female) cocoons with standard shape from excellent batches, and then weigh them individually.

Cocoons with cocoon weight about 0.1 g plus or minus the average of batches and with both shell weight and shell ratio above the averages of varieties, are kept as parents for reproducing offspring.

In a batch, the following should be required: uniformity in developing and molting, high rate of reelable cocoon, uniformly shaped cocoons, long length of non-broken cocoon filament, high neatness, pupation rate above the average of varieties, and death rate below the average of varieties. In the whole course of breeding, importance should be attached to a balanced

development of all economic characters. However, top priority should be given to different characters in different strains. For example, in Chinese strains, we give top priority to weight of cocoon filament and cocoon filament length, while in Japanese strains, top priority is given to silk quality. In late generations, emphasis should be laid on the uniformity of each character.

3. BREEDING ENVIRONMENT

According to the breeding goal, cross breeding combined with system selection was adopted, and in view of weather conditions in Yangtze River valley of China, we created an environment with high temperature (28-32□) and humidity (relative humidity 85-90%) in which the variety was bred through generations. In addition, the temperature for young larvae should be a little lower than that for grown larvae, and nylon film should be covered in all instars to maintain relative humidity. In order to obtain both high vigor and excellent silk quality, an alternating temperature between high temperature and normal temperature should be carried out. It is better to breed four generations within a year, and the last generation in late autumn should be bred in normal temperature to restore the quality of cocoon, silk and egg.

Phenotype is the joint product of genotype and environment. According to the breeding goal, we should combine good characters of the parents by setting up specific breeding environment and carrying out breeding experiments mainly in spring and autumn seasons. Environmental conditions have a great influence on the effectiveness of selection, so do the selections that take advantage of seasons' different characteristics.

In spring, selection of quantitative characters such as cocoon weight and filament length should be stressed because weather and fodder are so favorable, while in summer and autumn when high temperature and humidity or high temperature and low humidity occur, when the quality of fodder is poor, priority should be given to the selection of characters related to adversity-resistance so as to improve the ability of a variety to survive adversity.

Especially, high temperature and humidity in summer and autumn provides a favorable condition for the selection of reelability, and makes batches with poor reelability fully exposed, thus making it easier to achieve the goal of selection. Due to genetic complementation, F1 hybrid should be prepared by crossing parent silkworms with great genetic diversity and distant blood relationship, so as to enhance heterosis and eliminate the incompatibility between vigor and the quality of cocoon and silk. (Chinese strains are mainly for obtaining high weight of cocoon filament, while Japanese strains are mainly for obtaining high vigor and silk quality.) This enables a directional selection under high temperature and humidity condition while maintaining high vigor for the variety.

Breeding results show that, if silkworm is reared in temperature above 32□, the quality of cocoon and silk will decrease markedly, more cocoon shapes will occur, eggs will attach egg cards badly, and the number of poor eggs will increase. While reared below 26□, adversity-resistance can not be improved. Our conclusion is that the range of effective rearing temperature is between 28°C and 32°C, and that it is better to rear silkworms in an alternating temperature between high temperature and normal temperature for the improvement of both vigor and the quality of cocoon and silk.

4. HETEROSIS PRINCIPLE SHOULD BE APPLIED TO OBTAIN OPTIMUM COMBINATION

Varieties popularized currently should be used as basic materials. Parent silkworm should be crossed by using different varieties in the same geographical line, having close blood relationship and with little genetic diversity for the purpose of minimizing the heterosis of parent silkworm, while F1 hybrid should be crossed by using parent silkworms in the different geographical line, having distant blood relationship and with great genetic diversity so as to maximize the heterosis of F1 hybrid.

It is effective to identify combining ability in early and middle stages when major economic characters are basically stable. We can not only determine general combining ability of purebred but also select the optimum hybrid combination by adopting incomplete diallel crossing combination, thus reducing the range of materials needed to be identified.

In the whole breeding process, major breeding targets should always be kept in mind and specific combining ability should be identified so as to accelerate breeding progress. Selection of cross progenies: any phenoltype is the joint product of genes (genotype) and environment. However, being the endogenic factor, genes play the major role, while environment, as an exogenic factor, just influences the expressivity of genes. That is, the same genotype can produce different

phenotypes in different environments. Accordingly, we should try our best to exclude the interference of environments by following the rule below: in spring, we should give priority to the selection of silk and cocoon quality with consideration to vigor, while in summer or autumn, we should attach great importance to the selection of adversity-resistance, and at the same time take silk and cocoon quality into account. By doing so, we can bring into full play of the qualitative characters (silk and cocoon quality) and adversity-resistance, thus facilitating the fixation of good characters through artificial selection.

Although China started late in breeding adversity-resistant silkworm varieties for spring and autumn rearing, much progress has been achieved. Evaluation showed that all economic characters of 873 × 874 have met the technical and economic requirements set by the state, its adversity-resistance is almost as good as that of the control varieties popularized currently, and that its weight of cocoon filament increases a lot. It is a variety that eliminates to some extent the incompatibility between vigor and weight of cocoon filament.

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REFERENCES

He, S.M. *et al.,* Breeding of summer-autumn using silkworm varieties 415 and 416 and the preparation of their hybrids. *Acta Sericologica Sinica,* 1998, **24(4),** 215-220.

He, S.M. *et al.,* Breeding of vigorous and hypersilkgeneous silkworm varieties 871 and 872. *Acta Sericologica Sinica,* 1998, **24(2),** 86-90.

He, S.M. *et al.,* Breeding of vigorous and hypersilkgeneous silkworm varieties 871 and 872. A report of the 9th Five Year Plan on Silkworm Breeding. June 2000.

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