

INVESTIGATIONS ON THE EVOLUTION OF PURE LINES OF SILKWORM FROM IMPORTED HYBRID SEED

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ABSTRACT

Inbreeding and selection were carried out conducted for 7-9 generation for the evolution of pure lines of silkworm from four hybrid populations imported from China. Two external morphological characters as the colour and pattern of the larve and shape of cocoon were taken into consideration for purification of the lines. With this method six pure lines, four of Chinese origin and two of Japanese origin, were evolved. All these lines were stable and bred true for the two characters. They were all suitable for rearing in the spring season.

INTRODUCTION

An increased yield of quality silk is the main objective of silkworm breeding. Hybrid silk seed for silk production in Pakistan is imported at great cost from abroad every year. Its genetic characteristics deteriorate when successively reared for two or more generations. This results in low silk production of inferior quality which is not used by the silk industry. For this reason, the silk industry is still in its inception stage in spite of the fact that the sericulture has been practiced in the country since 1947. In order to improve and enhance silk production in both quality and quantity, silk seed production should be based on sound scientific principles. For this purpose hybrid seed of desired characteristics would be needed. The production of hybrid seed depends upon the purity of the crossing parents. As no country well

developed in sericulture, is ready to part with the pure races, it has become necessary to evolve pure lines by breeding and maintaining a good breeding stock for seed production. For commercial egg production the pure lines of Chinese and Japanese origin are popularly used as crossing parents because they have more distant pedigree, greater genetic variations and exhibit a high hybrid vigour when crossed.

Work on the evolution of pure lines of silkworm is being conducted by silkworm breeders in the sericulturally advanced countries in the world. ABADZHIEVA and RADKA (1980) developed new silkworm lines by applying inbreeding and selection for 7-9 generations. The newly evolved lines were tested for combining ability and were proved to have high combining ability. YL'YASO (1977) obtained two new pure lines of silkworm by inbreeding with productivity and high qualitative as well as quantitative cocoon characters. Raising of inbred lines of silkworm and the change in their heterosis and the economic characteristics of interbred and interliner hybrids were investigated by GETSADZE et al in 1975. The comparison between the two hybrids revealed that the interliner hybrids were superior by a number of characteristics related to the formation of homogenous genotype in the lines while their crossbred lines gave better results related with the economic characteristics. VASELEVA et al (1973) studied the genetic effect on the cocoon and its shell weight, silk yield, length of fibre on a single cocoon and seed

production. All such characteristics showed tendency towards increase. The percentage of seed production and length of fibre decreased as the inbreeding degree increased. These tendencies were exhibited more in male progeny than in female progeny. NARAYANAN and TIKOO (1969) evolved new races of univoltine origin by physiological genetics. These races were selected out of eighty sublines of silkworm on the basis of their peak performance. The same author (1967) evolved a new silkworm race "The Mysore princess" with significant increase in silk content, reduced floss percentage, increased filament length, high percentage of reliability and 100% multivoltinism. All the cocoons thus produced were oval showing Chinese characters with the exception of the few having pointed ends.

MATERIALS AND METHODS

The studies were initiated in March, 1980. Four hybrid populations of silkworm naming Jiangsu 16 X Jiangsu 17, Jiangsu 17 X Jiangsu 16, Dongfei X Huahe and Huahe X Dongfei, imported from China, were used as breeding stock. Method of investigation used was pure line separation from a hybrid population through a long, continuous inbreeding and artificial selection. Selection was directed towards two conspicuous but primary traits related to external morphological character of colour and pattern of larva and shape of cocoon to differentiate each hybrid population into two distinct lines, the Chinese and the Japanese. Selection at larval stage was conducted after third developmental stage. All the undersize, sluggish and diseased larvae and those with undesirable racial characters were rejected. At cocoon stage all the deformed, thin, flossy, perforated and stained cocoons and those not conforming to the character of the race were discarded.

Rearing was conducted twice a year.

The four hybrid populations were allowed to breed. In the F1 of all the populations, all the offsprings were marked expressing the dominant character of one of the great grand parent. So selection was stressed only for the health and fitness of the larvae and cocoons. The selected offsprings of F1 were allowed to produce eggs in batches for second generation progeny or F2. In the four populations, line differences made their appearance in the F2 progenies. Both the dominant marked and the recessive plain bodied larvae expressing the contrast traits for the Japanese and Chinese grand parents, reappeared. A large number of fine individuals, visually identical to the two grand parents were selected and isolated. Thus each hybrid population was initially split up into two groups, one group consisting of marked larvae, the other of plain larvae. The two groups were separately reared upto cocoon stage. At this stage each group produced two types of cocoons with different shapes the peanut or constricted and the oval cocoons. Therefore, second selection was carried out in each group by keeping those cocoons which resembled their grand parents and discarding those having undesirable characters, as well as those which were deformed, thin, stained and perforated etc. The selection cocoons in each group were allowed moth emergence and egg production for the third generation or F3. Mating of moths was restricted to the members of the same group. Within each group mating was random. In F3 the larvae in marked as well as plain group were still mixed. However, the cocoon spun by both marked and plain larvae required segregation. Therefore, only fine individuals exhibiting the acceptable characters of the two grand parents at the larval and cocoon stages

were selected in two groups of four populations. The selected individuals in each group were used for egg production for next generation. In F4 and subsequent generations, the operations were usually similar to those of F3 generation. In each generation, of larvae and cocoons was done in each group. Such repeated selection and inbreeding reduced the genetic variability in each group. The degree of pureness of the two traits and their stability was improved each generation until the homozygosity reached fixation for the Chinese traits and near fixation for Japanese characters after seven generations. The fixation of Japanese characters for larval colour and cocoon shape required two additional generations of breeding. Thus each hybrid population was broken up into the distinct lines, the Chinese and the

Japanese after breeding and selection for 7-9 generations.

RESULTS AND DISCUSSION

The above mentioned breeding of hydride seed produced six pure lines instead of eight out of which four were of Chinese origin and two were of Japanese origins. The two Japanese pure lines developed from Jiangsu 16 X Jiangsu 17 and Jiangsu 17 X Jiangsu 16 could not be maintained. The pure lines and their racial characters are listed in table 1.

The lines resulting from inbreeding were differentiated by their external morphological characters only. They were homozygous and bred true for these two racial characters. Their economic characters were also studied and the details are given in table 2.

Table 1. Pure lines with their racial characters

Name of the pure lines	Racial Characters			
	Larvae		Cocoon	
	Colour	Pattern	Colour	Shape
PFI-207 (Chinese)	Bluish White	Plain	White	Oval
PFI-208 (Chinese)	Bluish White	Plain	White	Oval slightly, pointed at both ends.
AAC-205 (Chinese)	Bluish White	Plain	White	Oval with round ends.
AKC-206 (Chinese)	Milky White	Plain	White	Oval
AIJ-205 (Japanese)	Greyish Brown	Marked	White	Peanut (small)
NAJ-206 (Japanese)	Pinkish Brown	Marked	White	Peanut with round ends.

Table 2. Economic characters of pure lines of Silkworm, *Bombyx mori* L. for spring rearing season.

Name of the line	Practical hatchability (%)	Larval duration Days-Hours	Weight of single cocoon (gm)	Weight of single cocoon shell (gm)	Single cocoon shell ratio (%)	Mortality rate at spinning (%)
PFI-207	99.10	24 0	1.517	0.349	23.005	4.33
PFI-208	98.89	24 0	1.518	0.346	22.793	3.02
AAC-205	97.54	26 0	1.552	0.336	21.815	2.96
AKC-206	89.83	24 0	1.518	0.343	22.590	5.19
AIJ-205	94.44	24 4	1.565	0.327	20.894	2.96
NAJ-206	95.09	25 0	1.513	0.349	23.052	3.07

The data show almost identical characteristics of all the newly evolved lines viz, PFI-207, PFI-208, AAC-205, AKC-206, AIJ-205 and NAJ-206 for rearing in the spring except that the line AKC-206 (Chinese) showed the lowest hatchability of 89.83% and the highest mortality rate of 5.19% but its other characteristics like the larval duration of 24 days is the shortest duration. Its single cocoon weight of 1.518 grammes, single cocoon shell weight of 0.343 grammes and its shell ratio of 22.590% showed good performance. The rest of the lines, especially the lines NAJ-206 and PFI-207 exhibited best characteristics under study.

CONCLUSIONS

The investigations for evolution of pure lines from four hybrid populations indicated positive results suggesting the possibility of the

evolution of pure lines from hybrid population through inbreeding and selection for a number of generations. All the lines evolved by this method are morphologically homozygous and stable and are best adapted to the local climatic conditions. They are being preserved as parental stock for seed production of commercial value and are capable of enhancing silk production in the country.

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