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Abstract: Aim of this research was investigation on improvement possibility of resistance, production and reproduction traits in 3P, 2P and P generations in three Japanese pure lines of silkworm Bombyx mori L., using individual selection in 3P generation parent’s level. At silk cocoon production process and silkworm breeding programs, reproduction traits supplies silkworm egg producers, cocoon quantitative and resistance traits supplies farmers’ benefits. Hence it must be noticed to these traits together. Furthermore, selection systems applied in 3P pure line levels. Reproduction, production and resistance characters have negative correlations probably in some varieties. Therefore, an experiment must be designed to investigation of effect of parent’s selection on the basis of cocoon weight on reproduction and resistance characters in 3P, 2P and P generations. At each pure line including 31, 103 and 107, it is recorded male and female cocoon weight and then 16 sire and dam parents were selected accordingly the most weight at each line. Furthermore, 16 sire and dam parents were selected by chance and without any selection at each line. These three pure lines were reared in 3P, 2P and P generations and investigated and compared their resistance, production and reproduction traits separately. From obtained results, it was showed that phenotypic trend for cocoon weight is positive and significant (p<0.01). It is showed that parental selection on the basis of single cocoon weight in 3P generation, had not decrease reproduction and resistance characters at next generations of 3P, 2P and P significantly (p>0.01). Hatchability, defected eggs percentage and pupae vitality were not declined significantly in three studied pure lines (p>0.01). These results could due non-negative correlations between these traits in three studied pure lines. From obtained results, parents would be selected on the basis of cocoon weight parameters in 3P generation. Also it is recommended that economical coefficients and genetical parameters are noticed for reproductive, resistance and quantitative cocoon characters together.

Keywords: Cocoon, insect, breeding, genetic improvement, offspring

INTRODUCTION

Iran produced 2543 tons fresh cocoon and 395 tons raw silk annually at 2006 based on International Sericultural Commission statistics ISC (http://www.isercco.org.uk/reglement.php?rub=2). Iranian farmers who reared silkworm included 50000 families. Thus Sericultural industry has criteria and important role in rural development.

At silk cocoon production process, three traits groups are important included reproduction traits which supplies silkworm egg producers, cocoon quantitative and resistance traits which supplies
farmers' benefits (Seidavi et al., 2004c). There are three separated levels in silkworm breeding centers as 3P, 2P and P generations. Most of breeding programs conducted in 3P generation due their small population size.

Govindan et al. (1991) and Seidavi et al. (2004a) were reported cocoon weight and cocoon shell weight traits are under additive and dominance gene effects. Furthermore, it is reported additive genetic variance in more than dominance genetic variance for these traits. Heredity of cocoon weight is between 0.03-0.49 and c heredity of cocoon shell weight is between 0.14-0.60 (Govindan et al., 1991; Malik et al., 1999; Seidavi et al., 2004b). Many researchers are emphasized on importance of correlation and heredity estimations for silkworm economical traits in order to improvement and optimization of selection systems in silkworm egg production (Govindan et al., 1991; Seidavi et al., 2004b).

At the present time, it is noticed to some traits e.g. cocoon weight, cocoon shell weight, pupae vitality, and hatchability percentage in total pure line systems. Parental generations are selected based on these traits. There are inconsistent reports from positive phenotypic correlations to negative phenotypic correlations between resistance, production and reproduction traits in different silkworm breeds (Datta et al., 2001; Seidavi et al., 2004a). Thus it must be investigated on effects of parental selection based on cocoon weight traits on resistance, production and reproduction traits in future generations i.e., 2P and P generations. These studies must conduct in different countries separately based on management and regional conditions of each country for total pure lines. From obtained result, producers can decide regarding selection system type in 3P pure line generation.

In fact, in Sericultural industry and silkworm breeding systems must emphasize on production, reproduction and resistance characters together and jointly. Because there is negative correlations between these production, reproduction and resistance characters in some commercial pure lines, hence individual selection of 3P parents based on cocoon weight traits must noticed based on their results in future generations i.e., 3P, 2P, P and hybrids. Purpose of this experiment was investigation on improvement possibility of resistance, production and reproduction traits in 3P, 2P and P generations in three Japanese pure lines of silkworm Bombyx mori L., including 31, 103 and 107 using individual selection in 3P generation.

MATERIALS AND METHODS

This study was conducted in Iran Silkworm Research Center (ISRC) from 2001 till 2005. It was constructed an original population included three Japanese of 3P pure lines of 31, 103 and 107 at first year of experiment. Cocoon weight, cocoon shell weight and cocoon shell percentage individually were recorded in male and female separately. Then per each pure line, two groups were constructed included selected and random groups. For this purpose in each pure line, 16 male and female individuals organized as selected group who had the highest cocoon weight amongst original population. These male and female individuals were mated. Then in each pure line, 16 male and female individuals organized as random group who had the moderate and average cocoon weight in compare with original population. These male and female individuals were mated also. Thereafter silkworm eggs were produced from two groups as inbreeding mating in each pure line separately. Their offspring were conserved under standard protocols for one year (ESCAP, 1993). In second year, 12 families were hatched and reared for each group and pure line. These offspring were reared under similar conditions. Total characters including resistance, production and reproduction traits were recorded and analyzed. Obtained moths were mated randomly in each group and pure line separately for 2P silkworm egg production. In third year of experiment, 12 families were hatched and reared for each group and pure line. These offspring were reared under similar conditions. Total characters including resistance, production and reproduction traits were recorded and analyzed. Obtained moths were mated randomly
in each group and pure line separately for P silkworm egg production. After silkworm egg hatching and rearing of P generation, total characters include resistance, production and reproduction traits were recorded and analyzed.

It was applied favorite conditions for moth emergence such as 25°C and 75% relative humidity. Pure lines were reared under standards protocols in all four years. It was used rice straw as mabsli for cocoon spinning in each replication (family) separately. After cocoon spinning development (seven days after starting of cocoon spinning), obtained cocoons gathered and sorted based on form, thickness, clarity etc to four classes include good, middle, double and low cocoons. It was calculated ratio of each class cocoon for each replication separately. Furthermore, it was investigated on health or disease of total obtained pupae and calculated ratio of each class cocoon disease for each replication separately. It was recorded cocoon weight for good and double cocoons. All records were conducted on 8th day of cocoon spinning. It was used for data analyzing from CRD model, GLM approach, and SAS software. Under model was used for data analyzing for each pure lines separately: \( y_{ij} = \mu + G_i + e_{ij} \) which \( y_{ij} \) was record or observation from trait, \( \mu \) was trait average, \( G_i \) was group effect (selected and random) and was \( e_{ij} \) residual effects. Furthermore, it was used appropriate transformation like angle transformation for those data which did not followed by normal distribution. DNMRT method was used for average compares.

RESULTS AND DISCUSSION

Table 1 present summary of obtained results during four successive generations. As expected, direct selection in all three pure lines resulted to cocoon weight improvement in three successive generations (3P, 2P and P generations). Other studies confirm these results previously. Hereditably of cocoon weight were reported between 0.03-0.49 (Singh et al., 1998; Jayswal et al., 2000; Seidavi et al., 2004b). Response to selection is followed by selection intensity, trait hereditably and phenotypic deviations.

From Table 1 is showed parental selection in 3P generation have not negative effects on reproduction, production and resistance characters in studied Japanese pure lines (p<0.05). Previously, Jayswal et al. (2000) reported similar results. These results can be for positive correlations between reproduction, production and resistance traits. In all pure lines, cocoon selection in 3P generation did not result to any significant decrease for hatchability percentage, unfertilized eggs percentage and pupae vitality (Table 1).

The earlier studies show that the variance of GCA in resistance characteristics (which represents additive genetic variance) is much higher in Japanese lines compared to Chinese lines. As a result in Chinese lines the non-additive genetical variance has a main role in diversity of resistance characteristics, while in Japanese lines the additive genetical variance for the number of survived larvae and pupae and the percentage of pupal survival were some times higher. The part of additive and non-additive genetical variance from the total variance of cocoon weight in Japanese lines was almost equal but in Chinese lines the cocoon weight was more affected by non-additive genetical effects. Also due to the results of research the cocoon shell weight and the percentage of cocoon shell weight are very much affected with non-additive genetical effects (Mirhoseini et al., 2004).

Individual selection correlated to vitality potential and gene flow from one generation to future generation. Natural selection in successive generations deleted and eliminated susceptible individuals. Hence, population becomes uniform and invariable for related alleles. Thus unflavored alleles eliminated from population (Bhargava et al., 1995).
Resistance is a quantitative trait with incessant distribution and affected by major genes and minor genes. It was demonstrated that silkworm resistance controlled by double dominance gene on un-sexual chromosomes. If there is random mates in successive generations of silkworm population, natural selection resulted to major genes and modifier genes.

Li (1992) suggested selection for each pure line is conducted separately. He recommended selection intensity were not same for all pure lines. At this research we understood obtained results were not similar in all three studies pure lines for hatchability percentage, unfertilized eggs percentage, pupae vitality, and other resistance, production and reproduction traits. It is due to the different heritabilities and phenotypic deviations in different pure lines. Therefore it is necessary estimating genetics parameters for silkworm breeding systems (Nagaraja et al., 1996, Devahah and Reddy, 1999).

In most of the varieties, the percentage of heterosis in the productive characteristics is higher than the percentage of heterosis for the survival of the larvae and the pupae. Between the cocoon characteristics, cocoon shell weight and cocoon shell percentage have the highest and the lowest amount of heterosis, respectively. This represents the high portion of non-additive effects in genetical control of this characteristics. High percentage of heterosis in productive characteristics could be illuminated with respect to the additive and non-additive genetical variance of cocoon characteristics (Mithosrini et al., 2004).

From obtained results, parents could be selected on the basis of cocoon weight parameters in 3P generation. Also it is recommended that economical coefficients and genetical parameters are noticed for reproductive, resistance and quantitative cocoon characters together.
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REFERENCES