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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

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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 on 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.

Key words: 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.inserco.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

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farmers' benefits (Seidavi *et al*., 2004c). There are three separated level 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. Hereditability of cocoon weight is between 0.03-0.49 and c hereditability 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 hereditability 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 origiual 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 mabshi 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, μ 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 genetical 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 nniform and invariable for related alleles. Thus unflavored alleles eliminated from population (Bhargava *et al*., 1995).

Table 1: Effect of individual selection on resistance, production and reproduction traits in three Japanese pure lines in successive generations[*]

	Pure line					
	31		103		107	
Traits	Individual	Random	Individual	Random	Individual	Random
Resistance traits						
Alive larvae(No.)	273.420000[a]	236.46000[b]	269.60000	378.70000	6.96163333	244.71000
Alive pupae (No.)	237.290000[a]	207.71000[b]	343.90000	217.90000	232.00000000	229.54000
Pupae vitality (%)	86.538000	85.84100	82.11000	80.38000	89.77400000	93.67000
Pupae vitality percentage in best cocoon (%)	91.877000	90.68600	87.69300	89.95900	94.41400000	97.35400
Pupae vitality percentage in middle cocoon (%)	80.224000	78.72300	68.79800	73.48800	85.63600000	90.48500
Production traits						
Produced cocoon (No.)	264.420000[a]	231.29000[b]	263.43000	252.17000	244.63000000	235.33000
Best cocoon (No.)	202.580000[a]	177.71000[b]	195.26000	196.63000	172.83000000	172.67000
Middle cocoon (No.)	45.625000	41.04200	48.82600[a]	35.66700[b]	53.25000000	45.41700
Low cocoon (No.)	7.083000	6.91700	12.91300	9.79200	7.12500000	4.91700
Double cocoon (No.)	9.125000[a]	5.62500[b]	6.43500[b]	10.08300[a]	11.41700000	12.33300
Best cocoon (%)	76.306000	75.72200	74.92800	77.88000	70.39400000	72.88600
Middle cocoon (%)	17.492000	17.75400	17.78200	14.47600	21.55000000	19.57400
Low cocoon (%)	2.771000	4.06500	4.84910	4.03170	3.42800000	2.15100
Double cocoon (%)	3.432500[a]	2.45920[b]	2.44000[b]	3.61080[a]	4.62750000	5.38920
Best cocoon weight (g)	330.070000[a]	280.63000[b]	322.33000	311.85000	252.43000000	241.53000
Double cocoon weight (g)	3.205220	3.16400	3.12130	3.23270	2.93170000	3.09710
Single best cocoon weight (g)	1.655460	1.59783	1.65900	1.63038	1.47296000[a]	1.42154[b]
10000 larvae cocoon weight (g)	17056.100000	16455.10000	17043.80000	16930.40000	15669.60000000[a]	15096.60000[b]
Larval duration (hr)	623.333000	623.87500	625.71740	625.25000	615.16670000[b]	618.50000[a]
Reproduction traits						
Hatched larvae (No.)	485.500000	477.13000	560.96000[a]	506.13000[b]	572.92000000	546.67000
Un-hatched eggs (No.)	64.960000	67.33000	26.82600	26.00000	14.29200000	17.62500
Unfertilized eggs (No.)	10.500000	23.87500	20.69600	13.29200	31.12500000	29.20800
Hatched eggs (%)	86.127000	83.82400	92.41600	92.81400	92.71920000	92.04380
Un-hatched eggs (%)	11.995000	12.00000	4.18040	4.81130	2.26960000[b]	2.97960[a]
Unfertilized eggs (%)	1.879000	4.17500	3.40090	2.37330	5.01210000	4.97750
Hatchability (%)	87.807000	87.63000	95.67300	95.09000	97.61960000[a]	96.85960[b]
Total produced eggs (No.)	560.960000	568.33000	608.48000[a]	545.42000[b]	618.33000000	593.50000

[*]There is significant difference between the numbers that are shown with the different letter(s) in each row for each pure line. Each group of data without any letter(s) has got no significant differences

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 of genetics parameters for silkworm breeding systems (Nagaraja *et al*., 1996; Devaiah 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 characteristic. High percentage of heterosis in productive characteristics could be illuminated with respect to the additive and non-additive genetical variance of cocoon characteristics (Mirhoseini *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

Bhargava, S.K., A. Venugopal, C.C. Choudhuri and M.M. Ahsan, 1995. Productivity in bivoltine breeds. Indian Textile J., 105: 112-114.

Datta, R.K., D. Raghavendra Rao, K.P. Jayaswal, V. Premalatha and R. Singh *et al*., 2001. Heterosis in relation to combining ability in multivoltine and bivoltine strains of the silkworm. Indian J. Seric., 40: 1-6.

Devaiah, M.C. and D.N. Reddy, 1999. Sericulture- An Overview. In: Advances in Mulberry Sericulture, Devaiah, M.C.K.C., V.G. Narayanaswamy, C.V.G. Maribashetty (Eds.). Publications Bangalore, Bangalore, pp: 1-6.

ESCAP., 1993. Principle and Techniques of Silkworm Breeding. 1st Edn., United Nations, New York.

Govindan, R., S.B. Satanahali, I.V. Goad, M.K. Guraraja and S.B. Magadam, 1991. Graphic analysis of gene action for some larval and cocoon traits in silkworm. Mysore J. Agric. Sci., 24: 474-481.

Jayswal, K.P., S. Masilamani, V. Lakshmanan, S.S. Sindagi and R.K. Datta, 2000. Genetic variation, correlation and path analysis in mulberry, *Bombyx mori*. Sericologia, 40: 211-223.

Li, W., 1992. Genetic path network among quantitative characters in silkworm. Sericologia, 32: 543-548.

Malik, G.N., M.A. Masoodi, A.S. Kamili and M. Aijaz, 1999. Combining ability analysis over environments in diallel crosses of bivoltine silkworm (*B. mori* L.). Indian J. Seri., 35: 22-25.

Mirhoseini, S.Z., A.R. Seidavi, M. Ghanipoor and K. Etebari, 2004. Estimation of general and specific combining ability and heterosis in new varieties of silkworm, *Bombyx mori* L. J. Biol. Sci., 4: 725-730.

Nagaraja, M., R. Govindan and T.K. Narayanaswamy, 1996. Estimation of combining ability in eri silkworm Samia Cynthia ricini Boisduval for pupal and allied traits. Mysore J. Agric. Sci., 30: 48-51.

Seidavi, A.R., M.R. Gholami and A.R. Bizhannia, 2004a. Estimation of heritability and response to selection of cocoon weight for some biological characters in silkworms. Proceedings of Biology in Asia International Conference, December 7-10, National Institute of Education and National University of Singapore, pp: 123-124.

Seidavi, A.R., M.R. Gholami and M.R. Biabani, 2004b. Evaluation of silkworm *Bombyx mori* breeds from Iran infected by white muscardine disease incidence. Sericologia, 44: 231-240.

Seidavi, A.R., M.R. Gholami, A.R. Bizhannia and M. Mavvajpoor, 2004c. Evaluation of heterosis, general and special combining ability for some biological characters in six silkworm lines. Proceedings of Biology in Asia International Conference, December 7-10, National Institute of Education and National University of Singapore, pp: 124-125.

Singh, T., Chandrasekharaiah and M.V. Samson, 1998. Correlation and heritability analysis in the silkworm, *Bombyx mori* L. Sericologia, 38: 1-3.