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Genetic Analysis of Different Quantitative Characters in Silkworm, *Bombyx mori* L. Due to N-Nitroso-N-Ethylurea (NEU)

[1]Md. Rezuanul Islam, [2]Md. Matiur Rahman, [3]Dipak Kumar Paul and [4]Shaheen Sultana
[1]Department of Biotechnology, Islamic University, Kushtia, Bangladesh
[2]Department of Zoology, Kushtia Government Collage, Kushtia, Bangladesh
[3]Department of Applied Nutrition and Food Science,
Islamic University, Kushtia, Bangladesh
[4]Department of Zoology, Rajshahi University, Rajshahi, Bangladesh

Abstract: Present investigation was carried out on two quantitative characters of the mulberry silkworm, ***Bombyx mori*** L. viz., total number of eggs laid per female and filament length of treated eggs with four doses (Control, 2.0, 2.5, 3.0%) of N-nitroso-N-ethylurea (NEU) under the following experiments: Genetic variability, heritability and genetic advance were estimated in different doses separately. A wide range of variation was recorded for both the characters and the major portion of the total variance was inherited with the phenotypical variance. The maximum heritability was recorded for total number of eggs laid per female and filament length showed a high genetic advance at all the doses. A high heritability with high genetic advance was also noted for the total number of eggs laid per female and filament length at all the doses.

Key words: *Bombyx mori*, N-nitroso-N-ethylurea (NEU), genetic analysis

Introduction

The production of silk from the Mulberry silk worm ***Bombyx mori*** L. handed down from generation to generation in the history of Bengal. Sericulture is a high labour - intensive agro-industry, which is ideally studied to the socio-economic conditions of the rural Bangladesh. ***Bombyx mori*** L. is an interesting monophagous insect from the viewpoint of genetical studies.

Now-a-days about 3.5 million chemicals are used all over the world. But very little of them have been established with the experiments in ***Bombyx mori*** L. as the test system. The genetic analysis of quantitative characters in silk worms have been carried out by a number of researchers (Krishnaswami ***et al.***, 1964; Sen ***et al.***, 1976; Rahman ***et al.***, 1978; Murakami ***et al.***, 1989; Govinda ***et al.***, 1990.)

To boost up the silk production the Bangladesh sericulture Research and Training Institute, Rajshahi, introduced exotic and developed high yielding multivoltine and bivoltine varieties of silk worm from time to time. But the detail genetic analysis of quantitative characters of the available varieties of ***Bombyx mori*** L. has not yet been investigated. Very little attempts have been made this regard (Rahman ***et al.***, 1984; Saleh ***et al.***, 1990)

In a population, if the variability largely is of genetic nature with least environmental effect, the probability of isolating superior genotype is high (Petkov and Yolov, 1980) Since Silk yield is a complex entity and polygenically controlled, it depends on a number of characters and their interactions. The present investigation was undertaken to estimate the genetic variability, heritability and genetic advance with sixteen genotypes of ***Bombyx mori*** L treated with N-nitroso-N-ethylurea (NEU).

Materials and Methods

The materials for present investigation comprised of the (Nisstario M, Nistari-greenish, RB-112, BSRI-801) four multivoltine varieties and indigenous breed of the silk warm ***Bombyx mori*** L. collected from the germ plasm Bank of the Bangladesh Sericulture Research and Training Institute (BSRTI), Rajshahi, standard rearing techniques were followed.

Treatment of the eggs

For the present investigation One-day-old eggs were treated by N- nitroso -N-ethylurea (NEU) solution. Three doses of the mutagens viz., 2.0, 2.5 and 3.0% were prepared by mixing 20 mg, 25 mg and 30 mg of NEU ml^{-1} distilled water, for each treatment 10 egg cards from each variety were placed in the desiccator and was left for 12h at 25°C. For control line 1 ml distilled water was placed in a desiccator containing 10 egg cards. The experiments were conducted through parental to F1-generations. During the investigation the room temperature was recorded as 24.0±2.0°C. The total number of eggs laid by the individual female moth was counted. A mean of 10 laying for each replication was used for statistical analysis.

The filament length was measured in meters. The cocoons were taken at random and individual length of filament of each cocoon shell per replication was taken with the reeling machine. The mean of filament for 10 cocoons of each replication was used in the statistical calculation.

Results

Results on the mean performance of two characters under study viz., total number of eggs laid per female and filament length of 16 genotype of silk worm ***Bombyx mori*** L. treated with three doses (2.0, 2.5 and 3.0%) of NEU and controls are presented in Table 1 and 2.

The mean performance of total number of eggs laid per female has been presented in Table 1. The highest total number of eggs laid per female were found in P_3XP_4 (552.33+2.642), P_3XP_4 (579.47±1.676), P_2XP_3 (553.55±3.890) and P_2XP_4 (566.37±2.300) genotypes for 0 (Control), 2.0, 2.5 and 3.0 NEU, respectively.

In Table 2, the highest filament length were exhibited in P_4XP_3 genotype for 0 (Control) (549.71±3.895), 2.5 (703.70±4.734) and 3.0 (654.46±9.317) and in genotype P_1XP_3 for 2.0% (620.10±11.647) NEU, respectively. In both characters genotypes showed highly significant effects ($P< 0.001$).

The range of variation, the mean with standard error (S.E), components of variances of two characters at different doses of NEU are shown in Table 3.

Table 1: Indicating the mean performance of total number of eggs laid per female of *Bombyx mori* L.

	Mean±S.E.			
Genotypes	O(Control)	2.0%	2.5%	3.0%
P_1	387.26±3.501	397.21±1.098	407.29±2.803	409.56±3.000
P_2	376.19±2.621	399.04±5.063	416.57±3.647	414.73±3.000
P_3	408.22±4.419	412.34±6.464	417.62±6.329	423.00±3.612
P_4	415.63±2.616	431.53±6.011	426.13±3.000	425.49±2.670
P_1XP_2	422.60±7.657	441.41±7.404	433.31±3.369	463.53±2.549
P_2XP_1	430.81±6.065	464.04±1.843	425.37±3.479	443.85±2.763
P_1XP_3	479.22±6.530	515.83±7.526	500.79±1.445	504.95±9.023
P_3XP_1	468.48±6.042	519.36±4.647	516.74±2.988	508.83±4.046
P_1XP_4	433.62±2.887	475.35±7.011	452.80±3.560	471.03±2.109
P_4XP_1	441.01±2.775	474.44±3.959	466.39±3.277	479.07±5.369
P_2XP_3	489.77±7.558	506.46±3.635	553.55±3.890	537.45±2.641
P_3XP_2	492.83±3.642	522.29±3.427	539.53±2.375	525.50±3.115
P_2XP_4	503.49±6.856	553.35±5.375	517.04±2.884	566.37±2.300
P_4XP_2	518.46±1.394	545.07±3.231	523.90±3.653	555.44±2.323
P_3XP_4	552.33±2.642	579.47±1.676	539.04±2.173	547.46±2.560
P_4XP_3	547.83±4.621	571.65±1.849	533.01±3.502	518.07±3.075

Table 2: Indicating the mean performance of filament length of *Bombyx mori* L.

	Mean±S.E.			
Genotypes	O(Control)	2.0%	2.5%	3.0%
P_1	367.45±6.456	361.76±1.7222	402.06±13.109	401.83±8.144
P_2	401.50±14.127	374.30±8.774	418.23±7.560	413.00±9.011
P_3	566.86±11.231	563.06±16.341	598.20±9.884	537.56±7.080
P_4	571.45±16.861	573.10±11.312	571.76±13.502	604.10±8.815
P_1XP_2	398.92±6543	500.46±8.098	489.23±50.052	445.13±8.369
P_2XP_1	390.42±10.907	493.10±8.138	427.90±7.352	510.50±9.572
P_1XP_3	412.63±15.734	620.10±11.647	524.86±10.057	484.93±9.895
P_3XP_1	431.98±5.727	501.23±8.647	569.63±6.797	528.83±5.526
P_1XP_4	469.72±2.826	592.90±5.225	617.80±17.901	582.63±11.052
P_4XP_1	447.31±3.826	577.70±10.173	621.86±2.456	552.50±9.566
P_2XP_3	497.28±4.150	558.63±15.416	611.50±8.256	510.96±17.109
P_3XP_2	509.66±5.530	607.70±9.612	544.36±7.427	555.13±11.236
P_2XP_4	521.40±7.005	597.10±13.473	574.43±3.497	503.23±5.531
P_4XP_2	501.63±8.075	535.00±9.520	553.30±9.456	527.60±5.907
P_3XP_4	533.42±3.971	610.00±17.618	684.00±5.190	603.10±5.647
P_4XP_3	549.71±3.895	571.50±13.832	703.70±4.734	654.46±9.317

Note: P_1= Nistari-M, P_2= Nistari-greenish, P_3= RB-112, P_4= BSRI-801

The range of variation was very much pronounced in both the characters at all the doses of NEU. The phenotypic variations (δ^2_p) were always greater than the genotypic (δ^2_g) and environmental (δ^2_e) variations. In case of the total number of eggs laid per female, the maximum phenotypic variance was recorded at 2.0% NEU (3671.526) and gradually decrease with

Table 3: Analysis of the range of variation, the mean with standard error, components of variances of two characters at different doses of NEU

Characters	Treatments(%)	Range	Mean	S.E.	δ^2_p	δ^2_g	δ^2_e
TEL	0(control)	371.40-556.19	460.48	7.73	2997.67	2923.35	74.32
	2.0	392.17-581.99	486.59	8.55	3671.52	3596.68	74.84
	2.5	401.91-552.02	479.32	7.55	2847.51	2827.98	19.53
	3.0	403.61-565.19	487.17	7.53	2838.93	2800.92	38.01
FL	0(Control)	359.28-598.70	473.20	9.66	4401.66	4145.09	256.56
	2.0	358.10-642.72	539.83	11.22	6281.58	5946.24	335.34
	2.5	382.90-712.80	552.88	12.86	8284.07	7520.82	763.25
	3.0	386.72-670.12	525.97	9.88	4888.65	4642.07	246.58

Table 4: Analysis of the phenotypic, genotypic and environmental coefficients of variabilities

Characters	Treatments(%)	CV_p	CV_g	CV_e	H%	GA	GA%
TEL	0(Control)	11.88	11.74	1.87	97.52	109.99	23.88
	2.0	12.45	12.32	1.77	97.96	122.27	25.12
	2.5	11.13	11.09	0.92	99.31	109.17	22.77
	3.0	10.93	10.83	1.26	98.66	108.29	22.22
FL	0(Control)	14.02	13.60	3.38	94.17	128.70	27.19
	2.0	14.68	14.28	3.39	94.66	154.55	28.62
	2.5	16.46	15.68	4.99	90.78	170.22	30.78
	3.0	13.29	12.95	2.98	94.95	136.76	26.00

Note: TEL = Total no of eggs laid ; FL = Filament length

the increasing doses of NEU. On the other hand, for filament length, controls showed the lowest (4401.664) and 2.5% NEU showed the highest (8284.077) phenotypic variances.

The phenotypic, genotypic and environmental coefficients of variabilities (CV_p, CV_g and CVe) have been presented in Table 4.

The highest phenotypic coefficient of variability was recorded for total number of eggs laid per female at 2.0% (12.452) and for filament length at 2.5% NEU (16.462), respectively.

The heritability estimates, in a broad sense on the variance components, are present in Table 4 For the total number of eggs laid per female higher heritability were recorded at al the doses of which 2.5% NEU (99.314%) dose showed the highest and 0 (Control) showed the lowest (97.52) values. While in filament length heritability, estimates were the maximum for all the doses. Here 2.5% NEU showed the lowest (90.786%) and 3.0% NEU the highest (94.956%) heritability.

Genetic advance (GA) and genetic advance as percentage (GA%)of mean are shown in Table 4. The highest genetic advance of 122.27 and 170.22 were recorded at 2.0 and 2.5% NEU for total number of eggs laid per female and filament length, respectively.

Discussion

In the present investigation, it was found that the characters total number of eggs laid per female and filament length were economically important and quantitative in nature, controlled by polygener. The mean performance of parents and their hybrids at different doses of NEU indicated the dose effects on different genotype. Estimates of mean performances revealed that the most favourable dose of NEU was 2.0% for total number of eggs laid per female and 2.5% for

filament lengths. The variation in the mean performances at different doses also indicated the importance of dose for the expression of these characters.

Analysis of variance conducted on the mean performance of different characters at various doses of NEU separately showed that the item genotypes were found highly significant for both the characters at all the doses. It means that a wide range of genetic diversity existed among the genotype this suggests that NEU and the genotype can be employed for breeding purposes.

A high heritability was recorded for the total number of eggs laid per female and filament length. The present findings are in partial agreement with some researchers (Petcov and Yolov, 1979) who reported a higher heritability for total silk content and noted a variation in the estimate with the changing of feeding method.

The estimation of heritability and genetic advance give the position of variation, which are heritable. In the present investigation in general, high heritability estimates with high genetic advance were recorded for total number of egg lad per female and filament length in all the doses of NEU.

From the fore going discussion it may be concluded that high genotype coefficient of variability and high heritability estimates along with high genetic advance in different doses of NEU indicated a wide range of genetic diversity existed which possessed high potentiality as a source of material for breeding programs. It also indicated the importance of additive gene effects in these characters and phenotypic selection would be effective to improve high-yielding varieties of silkworm, ***Bombyx mori*** L.

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