Biological Sciences Section

Pak. j. sci. ind. res., vol. 36, no. 4, April 1993

FACTORS CONTRIBUTING TO COCOON YIELD IN *BOMBYX MORI* L. IN BANGLADESH

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(Received September 23, 1992; revised February 13, 1993)

Effect of four different temperature ranges viz. 23 ± 1^0, 26 ± 1^0, 28 ± 1^0 and 30 ± 1^0 on rearing and their relative contribution different cocoon yielding factors of mulberry silkworm were observed under laboratory conditions at 78 ± 1% relative humidity. Increase of temperature range beyond 23 ± 1^0 had adverse effect on larval and cocoon characteristics including larval disease and mortality. For commercial rearing of indigenous races temperature range 26 ± 1^0 was considered for better performance. Cocoon-shell ratio was the most important factor of cocoon yield of mulberry silkworm with highest coefficient of correlation (0.848, $P < 0.01$) followed by maximum direct effect (0.687) and maximum contribution (71.93%) followed by cocoon weight, larval disease and larval weight.

Key words: Temperature,Larval and cocoon characteristics, Correlation matrix, *Bombyx mori.*

Indtroduction

Temperature plays a vital role on the rearing of mulberry silkworm, *Bombyx mori* L., a main source of natural silk in Bangladesh. According to Krishnaswami *et al.* [1], both low and high temperature directly affected the health of worms. Islam [2] reported that aged larvae were more sensitive to temperature than the young ones. Khan [3] found that optimum temperature ensured the normal growth of silkworm larvae. Talukder *et al.* [4] studied the Nistari race of mulberry silkworm at 28 ± 1^0 temperature and 78 ± 1% relative humidity. Rahman [5] suggested that the optimum rearing temperature range for indigenous Nistari races was from 23 to 30^0. Pillai and Krishnaswami [6] observed reduced survival rate, pupation rate and cocoon quality due to high temperature. Krishnaswami *et al.* [7] observed that the quality of cocoons was dependent on the prevailing rearing room temperatures and high temperature caused an increased mortality rate of worms.

Determination of correlations among cocoon yield and yield contributing factors and path coefficient analysis on mulberry silkworm have hardly been attempted in Bangladesh. Such approaches are, however practiced on a large scale by agronomists and plant breeders [8,9]. Therefore, this investigation was undertaken to investigate the effect of different temperature ranges on some larval and cocoon characteristics, disease incidence and to interelationships between cocooon yield and yield contributing factors.

Materials and Methods

Experiments were carried out at Sericulture Project Laboratory of the Bangladesh Agricultural University, Mymensingh. An indigenous race of mulberry silkworm namely, Nistari 114 with four different ranges of temperature viz. 23 ± 1^0, 26 ± 1^0, 28 ± 1^0 and $30 \pm 1^\circ$ was tested in a completely randomized design (CRD) with ten replications. Eggs were hatched and young larvae were reared at four different temperature ranges with 78 ± 1% relative humidity on a 30 cm diameter bamboo tray. At the beginning of 3rd instar the larvae were transferred to trays (30 x 30 x 15 cm in size) with 100 larvae per tray and reared upto pre-spinning stage. Food was offered four times a day and bed cleaning was done once a day according to method of Islam [2]. Ripen larvae were picked up and put on the bamboo made mountage (chandraki) and cocoons were harvested on the 5th day of mounting.

Larval mortality and disease incidence were recorded by counting dead and diseased larvae from rearing trays once a day upto pre- spinning stage. Larval weights were measured from the average weight of 20 newly ripen larvae of pre-spinning stage. Cocoon and shell characteristics were measured and cocoon-shell ratio [C-S Ratio = (shell weight/cocoon weight) X 100] were calculated after harvesting of cocoons in the same way. Collected data were statistically analyzed using ANOVA and their mean values were compared using Duncan's Multiple Range Test (DMRT). The extent of interrelationship among cocoon yield and larval characteristics (except larval mortality) were investigated using a correlation matrix for all possible data combinations. Correlation coefficients were further partitioned into components of direct and indirect effects by path coefficient analysis [10, 11]. Cocoon yield was the the resultant variable.

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Results and Discussion

The data on the yield of cocoon as influenced by temperature are presented in Table 1. Interrelationships among cocoon yield and larval and cocoon characteristics of

TABLE 1. EFFECTS OF TEMPERATURE ON THE LARVAL AND COCOON CHARACTERISTICS OF NISTARI 114 (AT 78±1 % RELATIVE HUMIDITY) IN LABORATORY CONDITION.

Temperature ranges(°C)	Rate of disease incidence (%)	Average larval morta-lity(%)	Average larval wt. before spinning(g)	Average weight of a single cocoon(g)	Cocoon-shell ratio(%)	Yield of concoons/ 100 dfl (kg)
23±1°	15.20 a	17.00 a	1.95 b	0.83 b	16.20 b	17.89 c
26±1°	18.41 b	21.40 b	2.07 a	0.98 a	16.84 a	22.25 a
28±1°	24.40 c	28.60 c	1.75 c	0.98 a	16.78 a	21.30 b
30±1°	35.15 d	40.60 d	1.37 d	0.96 a	14.28 c	15.72 d

In a column, the figures having different letters differ significantly at 5% level of probability. dfl = Disease free layings.

mulberry silkworm (race Nistari 114) are presented in Table 2, 3 and 4.

Effectts of temperature. The results in Table 1 showed that temperature had significant effects on larval and cocoon characteristics as well as cocoon yield. The rate of larval mortality and incidence of diseases significantly increased with the increase of temperature. Both the larval mortality and disease incidence were lowest at 23±1° temperature and significantly highest at 30±1° range. But , in case of average larval weight, highest weight (2.07 g) was obtained at 26±1°, where as 30±1° range produced the least weight of silkworm larvae (1.37 g). Krishnaswami *et al.* [1] observed the adverse effect of lower and higher temperature on larvae.

Cocoon characters over yield showed a different sitution. In most of the cases, 26±1° range revealed the best results. Highest cocoon weight (0.98 g), cocoon-shell ratio (16.84%) and cocoon yield (22.25kg/100 dfl) were found at the same temperature range. These results supported the views of Pillai and Krishnaswami [6] and Krishnaswami *et al.* [7].

Quantitative relationships. In Table 2, cocoon yield showed positive correlations with cocoon-shell ratio (0.848, $P < 0.01$), larval weight (0.640, $P < 0.01$) and cocoon weight (0.381, $P < 0.05$) but negative correlations with disease incidence (-0.496, $P < 0.01$). Among the yield contributing factors, disease incidence showed significant negative correlations with larval weight (- 0.882, $P < 0.01$) and cocoon-shell ratio (-0.726, $P < 0.01$) and in case of larval weight with cocoon weight (-0.180). The positive trends were observed in case of cocoon-shell ratio with larval weight (0.816, $P < 0.01$) and cocoon weight (0.047).

Path coefficient analysis in Table 3, reveals that cocoon-shell ratio had the maximum positive direct effect (0.687) on yield of cocoon of Nistari 114 followed by cocoon weight (0.503). The indirect effect of cocoon-shell ratio on yield through larval weight was negative (-0.150) bu through disease incidence and cocoon weight it was positive.

Relative contribution of yield factors. Following the step-up- wise regression programme, cocoon yield of silkworm

TABLE 2. CORRELATION MATRIX BETWEEN COCOON YIELD AND LARVAL AND COCOON CHARACTERISTICS OF NISTARI 114.

Characters	Larval weight	Cocoon weight	Cocoon-shell ratio	Yield of cocoon
Disease incidence	-0.882**	0.470*	-0.726**	-0.496**
Larval weight	–	-0.180	0.816**	0.640**
Cocoon weight	–	–	0.047	0.381*
Cocoon-shell ratio	–	–	–	0.848**

* Significant at $P = 0.05$; ** Significant at $P = 0.01$

TABLE 3. PATH COEFFICIENT ANALYSIS OF VARIOUS CHARACTERS CONTRIBUTING TOWARDS COCOON YIELD OF NISTARI 114.

Characters	Indirect effects through				Total
	Disease incidence	Larval weight	Cocoon weight	Cocoon shell ratio	correlation with yield
Disease incidence	<u>-0.397</u>	0.162	0.237	-0.499	-0.496**
Larval weight	0.350	<u>-0.184</u>	-0.086	0.561	0.640**
Cocoon weight	-0.186	0.031	<u>0.503</u>	0.032	0.381*
Cocoon-shell	0.288	-0.150	0.024	<u>0.687</u>	0.848**

Residual effect = 0.384; * Significant at $P = 0.05$; ** Significant at $P = 0.01$.
N.B. Underlined figure denotes the direct effect of the characters on the yield of cocoon.

TABLE 4. STEP-UP-WISE REGRESSION EQUATIONS FROM EACH STEP FOR FINDING OUT RELATIVE IMPORTANCE OF CONTRIBUTION TOWARD COCOON YIELD.

Step/regression equation	R^2	F value computed
Step 1: $Y = -14.469 + 2.107^{**} X_1$ (0.214)	0.7193	97.399**
Step II: $Y = -26.766 + 2.067^{**} X_1 + 13.812^{**} X_2$ (0.166) (2.701)	0.8355	93.933**
Step III: $Y = -22.244 + 1.618^{**} X_1 + 18.746^{**} X_2 - 0.084 X_3$ (0.305) (3.877) (0.048)	0.8482	67.055**
Step IV: $Y = -21.042 + 1.694^{**} X_1 + 19.898^{**} X_2 - 0.125 X_3 - 1.423 X_4$ (0.320) (4.132) (0.069) (1.707)	0.8512	50.038**

Figures in parentheses below the regression coefficients show the standard errors of the estimated value; ** , Significant at 1% level; Y =Yield of cocoon, X_1 = Cocoon-shell ratio, X_2 = cocoon weight, X_3 = Larval disease, X_4 = Larval weight.

was regressed separately with each factor. Selection of the first factor was then accomplished by employing the criteria of coefficient of determination (R^2) and F-test [12]. The relative importance of influencing factor was cocoon-shell ratio (X_1) as per step I (Table 4). Its relative contribution towards cocoon yield was 71.93%. According to step II, cocoon weight (X_2) was the next important factor influencing on the cocoon yield in association with cocoon-shell ratio. According to step III, larval disease (X_3) was entered as third important yield contributing factor among the tested factors in association with cocoon-shell ratio and cocoon weight. Larval weight (X_4) were the last in order of importance, as revealed by step IV. F-test showed that the contributions of all tested factors were significant at 1% level. Results revealed that the maximum contribution toward the cocoon yield was made by the cocoon-shell ratio (71.93%) followed by cocoon weight (11.63%), larval disease (1.27%) and larval weight (0.30%).

Summing up the influence of temperature on larval and cocoon characteristics and correlations between cocoon yield and yield contributing factors of Nistari 114, it may be concluded that temperature ranges above 28±1° adversely affect the larval and cocoon characteristics and disease incidence as well as yield of cocoons. For better performance of silkworm rearing may be done in 26±1° temperature range in case of indigenous race. Again, cocoon-shell ratio, cocoon weight and larval weight showed the positive correlation with yield. Cocoon-shell ratio had the maximum direct effect and contribution toward the cocoon yield of Nistari 114. Thus, cocoon-shell ratio and cocoon weight played a positive and disease incidence played a negative role in cocoon yield production of mulberry silkworm.

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