

THE EFFECTS OF HIGH HUMIDITY AND TEMPERATURE ON THE ECONOMIC CHARACTERS OF THE SILKWORM, *BOMBYX MORI* L.

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Abstract

The effects of high humidity and temperature on the economic characters in the 5th instar larvae of Chinese (C-102) and Japanese (J-101) varieties of the silkworm, *Bombyx mori* L. were investigated. The mean high humidity of 94% with the prevailing temperature of 23°C increased the larval weight by 11% each, cocoon weight by 20 and 13%, shell weight by 17 and 10%, fecundity by 8 and 11% and decreased larval mortality by 60 and 14% and pupal mortality by 16 and 62% for C-102 and J-101 respectively.

The mean high temperature of 30°C with the prevailing humidity of 58% decreased the larval weight by 13, cocoon weight by 18, shell weight by 24 and fecundity by 48% in case of C-102 while in J-101 the same characters were decreased, respectively, by 19, 29, 28 and 42%. This treatment caused high larval and pupal mortality of 82 and 25% in C-102 and 89 and 53% in J-101. However, C-102 proved to be better than J-101 in both the treatments.

Introduction

The bivoltine race of the silkworm, *Bombyx mori* L., is reared twice in a year, spring and autumn, generally for the seed and cocoon production. To obtain the high quality and quantity products the optimum meteorological conditions, proper sanitation and quality food in proper times are ensured during rearing. Fluctuation of temperature and humidity, poor sanitation and poor quality and quantity of food greatly influence the development of silkworm larvae, thereby adversely affecting the production of seed and yarn.

The maximum temperature of 25.8°C and the minimum of 23.9°C and relative humidity of 90.9% provide favourable conditions for the survival and development of larvae of silkworm and production of the best quantity and quality silk (Singh *et al.*, 1986). The modern double cross silkworm (*Bombyx mori*) is almost twice as productive as the older varieties when reared at the correct temperature of 21-24°C for the 1st to 4th larval instars and 24-25°C for the 5th larval instar and humidity of 60-70% with light and ventilation, and when fed with the correct quality and quantity of mulberry leaves at different stages of development (Cappelozza, 1988). The hybrids Hebur1 x Hebur2 and Kinshu x Showa of *Bombyx mori* L. can be reared in the 4th and 5th larval instars at temperature of 24°C with ration of 550kg mulberry leaves per box of eggs in 20 m² space during summer and autumn for the better yield (Karaivanov, 1988). The lower

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rearing temperature increases the rate of utilization of protein in the mulberry leaves thus at 20°C the average digestibility of protein in the 5th instar larvae of *Bombyx mori* is 2-3% units higher than that at 30°C (Shen, 1986).

The extreme fluctuation of temperature and humidity, low protein content of the mulberry leaves and diseases reduce the larval growth and increase larval mortality in the silkworm races of *Bombyx mori* (Behura & Panda, 1984). The productivity of silkworm like cocooning rate, cocoon characters and fecundity, is largely influenced by the combined effects of leaf quality (tender, medium or coarse) and rearing temperature (28, 30 and 32°C). The tender leaf fed at low temperature (28°C) results better yield (Kumar *et al.*, 1997).

In the present study the effects of high humidity with the prevailing temperature and high temperature with the prevailing humidity on the economic characters of the silkworm, *Bombyx mori*, have been compared and discussed.

Methods and Materials

The 5th instar larvae of Chinese (C-102) and Japanese (J-101) varieties of the silkworm, *Bombyx mori*, being reared at Pakistan Forest Institute, Peshawar, were taken for trial during autumn, 1999. Three rooms of 5x5 meters were maintained at (1) the mean high humidity of 94% with the prevailing temperature of 23°C (2) the mean high temperature of 30°C with the prevailing humidity of 58% and (3) the standard temperature of 25°C and relative humidity of 75% for rearing silkworm.

Hundred larvae each of C-102 and J-101 in three replications were maintained. Larvae were fed with the standard diet of the mulberry leaves daily for five times at 06.00, 10.00, 14.00, 18.00 and 22.00 hours. Larval mortality was recorded during the larval period. Larval weight of 10 larvae of each variety was taken on 6th day of the 5th larval instar. Observations on pupal mortality, cocoon weight and shell weight were recorded on 8th day of pupation by weighing 10 cocoons and 10 shells of females of each variety. Eggs of 5 females of each variety, taken on cards, were counted in the laboratory under binocular to find out fecundity of females.

Results and Discussion

Percent ratios of the values of the economic characters in the treatments and control were worked out for comparison of the positive and negative impacts. Results are given in Table 1. It indicates that, relative to the control, high humidity (94%) with the prevailing temperature (23°C) showed promising positive results and high temperature (30°C) with the prevailing humidity (58%) had strong negative effects on the economic characters of the silkworm, *Bombyx mori*. In the 1st treatment Chinese variety C-102 showed an average increase of larval weight of 11%, cocoon weight of 20%, shell weight of 17% and fecundity of 8% and a decrease of 60% in larval and 16% in pupal mortality. Similarly an increase of 11% in larval weight, 13% in cocoon weight, 10% in shell weight and 11% in fecundity and a reduction of 14% in larval mortality and 62% in pupal mortality occurred in Japanese variety J-101.

Table 1. Effects of high humidity and temperature on the economic characters of the silkworm, *Bombyx mori*.

Economic characters (Average values)	High humidity/prevailing temperature			High temperature/prevailing humidity		
	(% ratio)		% diff..	(% ratio)		% diff.
	Trea-ted.	control		Trea- ted.	control	
C-102						
Larval wt.	55.5	44.5	11(+)	43.7	56.3	13(-)
Cocoon wt.*	60.0	40.0	20(+)	41.0	59.0	18(-)
Shell wt.*	58.4	41.6	17(+)	38.0	62.0	24(-)
Fecundity	54.0	46.0	8(+)	26.0	74.0	48(-)
Larval mort.	20.0	80.0	60(-)	91.0	9.0	82(+)
Pupal mort.	42.1	57.9	16(-)	62.5	37.5	25(+)
J-101						
Larval wt.	55.6	44.4	11(+)	40.7	59.3	19(-)
Cocoon wt.*	56.4	43.6	13(+)	35.6	64.4	29(-)
Shell wt.*	55.0	45.0	10(+)	36.1	63.9	28(-).
Fecundity	55.7	44.3	11(+)	28.8	71.2	42(-)
Larval mort.	43.0	57.0	14(-)	94.7	5.3	89(+)
Pupal mort.	19.0	81.0	62(-)	76.3	23.7	53(+)

* = Females only

(+) = More than control

(-) = Less than control

In case of high temperature with the prevailing humidity, the larval weight, cocoon weight, shell weight and fecundity of C-102 decreased, by 13, 18, 24 and 48% and that of J-101 by 19, 29, 28 and 42%, respectively. High larval and pupal mortality of 82 and 25% in C-102 and 89 and 53% in J-101 was recorded in high temperature and prevailing humidity condition. The results of both varieties in the respective treatments are compared in Table 2.

Table 2 reveals that in high humidity and the prevailing temperature cocoon and shells of C-102 are heavier than that of J-101 but fecundity of the former is less than the latter. In the same treatment gain in the larval weight of both is the same but larval mortality in C-102 and pupal mortality in the J-101 is greatly reduced. Similarly in high temperature and prevailing humidity C-102, except in fecundity, was less affected as compared to J-101.

Table 2. Comparison of the results of C-102 and J-101 in the respective treatments

Variety	Larval wt.	Cocoon wt.	Shell wt.	Fecundity	Larval mort.	Pupal Mort.
	High Humidity (94%)/Prevailing Temperature (23°C)					
C-102	11 ⁺	20 ⁺	17 ⁺	8 ⁺	60 ⁻	16 ⁻
J-101	11 ⁺	13 ⁺	10 ⁺	11 ⁺	14 ⁻	62 ⁻
Variety	High Temperature(30°C)/Prevailing Humidity (58%)					
C-102	13 ⁻	18 ⁻	24 ⁻	48 ⁻	82 ⁺	25 ⁺
J-101	19 ⁻	29 ⁻	28 ⁻	42 ⁻	89 ⁺	53 ⁺

Based on the results the mean relative humidity of 94% and temperature of 23°C are recommended for rearing the silkworm, *Bombyx mori*, for obtaining the better cocoon and seed yields.

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