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Effect of temperature and relative humidity on spinning behaviour of silkworm (*Bombyx mori*.L)

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The rate of spinning of silkworm larva (*Bombyx mori*.L) was slow at 22°C and fast at 38°C. The time taken for completion of cocoon was longest at 98±2% and least at 40± 2% RH. However, good quality cocoons were spun at 22°C and 65±5% RH, hence it would be advantageous to maintain this temperature and relative humidity at the time of cocoon spinning in the case of CB race of silkworm.

The spinning of silk which determines the cocoon traits, its reelability and therefore its quality depends not only on the silkworm variety, but also to a great extent on the care taken at the time of cocoon spinning[1]. Factors which are known to influence spinning include temperature, humidity, light and physical disturbance. It is therefore, very important to provide the optimal conditions at the time of spinning to ensure spinning of good cocoons. These optimal conditions need not necessarily be the same for all races and under all circumstance. Amongst the environmental factors, temperature is a major one. Various aspects of insect activities like locomotion, flying and respiration are known to be influenced by changes in environmental temperature[2]. Humidity is another environmental factor which can influence insect behaviour and metabolism[3]. Sudden rise in temperature or humidity causes abrupt thinning and thickening of the silk filament[4]. In the present communication, we report on the quality of the cocoon formed under different temperature and relative humidity levels using multivoltine cross breed silkworms (*Bombyx mori*.L.).

In the present investigation *in vivo* studies were carried out on the silkworm *Bombyx mori* cross breed (PM x NB4D2). The larvae were maintained in the laboratory of Zoology department, Bangalore University at 26± 2°C and 65±5% RH. These larvae were fed with coarse mulberry leaves (M5 variety). The early fifth instar larvae were used for the studies. The same batch of larvae were kept under normal conditions and used as controls where ever it was necessary.

Effect of temperature—The mature fifth instar larvae were shifted to standard bomboo mountages with a spinning space of 4 cm width and 4 cm depth. The larvae were allowed to spin under three different temperature viz., 22°, 25° and 28°C, to study the effects of temperature on spinning. During these studies, the relative humidity was maintained around 65±5% and normal light dark cycles (12L: 12D). Under each condition 250 larvae were allowed to spin. The effect of temperature on spinning behaviour was observed carefully. For determining the time taken for the completion of spinning, 8 cocoons were randomly picked up at intervals of 5 hr on the first day and 2 hr on the second day of spinning. In these samples a square window (1.0 cm x 0.5 cm) was made by carefully cutting open the shell already formed without causing much mechanical disturbances. Through this window, the movements of the spinning larvae could be monitored. The characteristics of the cocoon spun and time taken for completion of spinning was examined under these conditions.

Effect of humidity—Mature larvae (250) were mounted on standard bamboo mountage and allowed to spin under three different relative humidity level viz., 40± 2, 65± 5 and 98± 2%. The humidity was decreased using lime powder and increased by placing wet sponge bits. Normal light dark cycle (12L : 12D) was provided, at 25°±3°C. The spinning behaviour was examined under these conditions. The cocoon characteristics and time taken for spinning the cocoon was determined as explained under effect of temperature.

Statistical analysis—Statistical significance of the results obtained for effect of temperature and RH on spinning of cocoons in silkworm was tested using Karl Pearson coefficient of correlation (r).

The results are presented in Tables 1 and 2.

Temperature is known to have profound influence on silkworm spinning[4,5]. The rate of spinning increased with rise in temperature. But this fastening effect of temperature on spinning is not desirable as it causes abrupt thining and thickning of the silk filament. The thickness of the filament was highly variable at higher temperature showing the mechanism involved in controling the thickness of the filament is in some way affected. The cocoon spun at higher temperature were not reelable due to multiple drop ends showing that the spinning is not continuous at this temperature. On the other hand, at lower temperature the cocoon spun could be reeled very easily and there were no drop ends. Considering the other cocoon characters such as filament length, shell weight, silk ratio, renditta and denier, they were more advantageous at 22°C than at 25° or 38°C. Studies on bivoltine race of *Bombyx mori* have shown that temperature between 22° and 23°C is ideal for cocoon spinning[5], which could be one of the reasons for the better performance of the silkworm maintained at hill station.

Insects are known to be extremely sensitive to atmospheric humidity[6]. Insects in which a physiological mechanism of prime importance is conservation of water which is achieved in a variety of ways exhibit a variety of responses to changes in the humidity[7,3]. In the present study the cocoon spun under high humidity were un reelable and amount of floss was more. The other cocoon characters such as shell weight, filament length, silk ratio, renditta and

Table 1—Cocooning and characteristics of cocoons spun at different temperatures.
[Values are mean ± S D of 20 silk worm cocoons]

	Temperature (°C)			(r)*
Cocoon character studied	22	25	38	
Time taken for spinning cocoon (hr)	50 ± 2	42 ± 2	36 ± 2	-0.909*
Weight (g)	0.964 ± 0.07	0.954 ± 0.09	0.618 ± 0.07	-0.988*
Floss weight (g)	0.040 ± 0.0	0.020 ± 0.0	0.027 ± 0.0	-0.341
Shell weight (g)	0.245 ± 0.05	0.244 ± 0.05	0.232 ± 0.02	-0.994 *
Silk filament length (meters)	847.40 ± 76.85	496.4 ± 10.8	---	-0.969*
Silk weight (g)	0.187 ± 0.013	0.112 ± 0.02	---	-0.973*
Silk ratio (%)	19.39 ± 3.04	11.60 ± 3.74	---	-0.972*
Renditta	5.15 ± 0.63	9.82 ± 4.8	---	-0.782*
Denier	2.01 ± 0.29	1.95 ±0.38	---	-0.988*

(r)—Karl Pearson coefficient of correlation
*all values are significant

Table—2 Cocooning and characteristics of cocoons spun at different relative humidities
[Values are mean ± SD of 20 silkworm cocoons]

	RH (%)			(r)*
Cocoon characters studied	40±2	65±5	98±2	
Time taken for spinning cocoon (hr)	34±2	40±2	50±2	0.997*
Weight (g)	1.00±0.16	1.22±0.19	1.206±0.22	0.790*
Floss weight (g)	0.021±0.0	0.022±0.0	0.035±0.0	0.928*
Shell weight (g)	0.175±0.02	0.145±0.02	0.141±0.02	0.879*
Silk filament length (meters)	586.00±17.8	461.00±87.78	182.00±79.1-	0.990*
Silk weight (g)	0.134 ± 0.008	0.109±0.02	0.049±0.025	0.988*
Silk ratio (%)	14.26±2.45	8.74±1.16	3.60±1.87	0.994*
Renditta	7.16±1.08	11.6±1.53	24.19±6.16	0.981*
Denier	2.1±0.28	2.11±0.55	2.35±0.87	0.917*

(r) - Karl Pearson coefficient of correlation
* all values are significant

deneir were better at low humidity. Humidity may affect spinning by its influence on the physiology of the larva. Thus, high humidity at the time of spinning is known to result in diuresis and staining of cocoon[8]. It may also have a direct effect on the silk filament formation because silk filament while it is formed and exuded out of the spinneret is in liquid form and solidification takes place only after it gains access to the atmosphere.[9]

The difference in temperature and relative humidity was found to influence the temporal aspects of spinning as well as the quality of the cocoon spun. Good quality cocoons were spun at 22^0C and 65±5% RH.

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