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Influence of Temperature and Relative Humidity on the Rearing Performance and Disease Incidence in CSR Hybrid Silkworms, *Bombyx mori* L.

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Fifth instar larvae of the new bivoltine hybrid (CSR2 x CSR5) were reared under different temperature and humidity viz., 20°C and 85 ± 5% R.H (T1), 25°C and 70 ± 5% R.H (T2-Optimum), 30°C and 80% ± 5 R.H (T3) and 35°C and 50 ± 5% R.H (T4). The cocoon yield, cocoon characters and disease incidence were studied in normal (non infectious source, i.e control) rearing as well as in 1% infectious source of rearing. The results indicated that V instar larval duration was prolonged and cocoon weight was improved in T1. ERR and shell ratio were significantly improved and disease incidence was minimised in T2. Further significant difference was observed among the treatments with regard to spread of diseases.

Key words : Normal rearing, 1% Infectious source of rearing, Cocoon characters, Grasserie, Flacherie

Introduction

The silkworm, *Bombyx mori* L. is a poikilothermic insect and it is the main source of quality silk. The environmental factors such as temperature, humidity, light and air current during rearing have an intimate influence on the growth of the silkworm larvae and ultimately on cocoon quality. Among the various environmental factors which influence the cocoon crop, the most important are the atmospheric temperature and humidity prevailing at the time of rearing. These two parameters play a significant role and influence the growth and productivity of silkworm (Benchamin and Jolly, 1986; Sen *et al.*, 1993; Kogure, 1933; Ueda and Lizaka, 1962). Fourth and fifth instar silkworms are known to be sensitive to high temperature and with the rise in temperature, the metabolic activities are accelerated while they slacken, as the temperature goes down. It is known that late age silkworms prefer relatively lower temperature than the young age (Krishnaswami, 1994). Temperature higher or lower than 25°C acts as a stress factor and increases the susceptibility of silkworm to viral infections (Steinhaus, 1958).

Humidity also plays vital role and influences directly the physiological functions of the silkworms especially during early instars. Humidity jointly with the temperature largely determines the satisfactory growth of the silkworm and success of a rearing (Kenten, 1955; Tazima, 1978). Indirectly humidity also influences the rate of withering of leaf in the rearing beds.

This paper presents the result of studies on the combined effect of temperature and humidity on economic characters of the new productive bivoltine hybrid CSR2 x CSR5 on the incidence of diseases during rearing.

Materials and Methods

New bivoltine hybrid (CSR2 x CSR5) eggs were received from Bivoltine silkworm Breeding Laboratory, CSRTI, Mysore and incubated at optimum conditions. The larvae were brushed and reared following standard practices up to 4th moult.. Immediately after 3rd moult few larvae were inoculated with BmNPV (1×10^7 polyhedra/ml/100 larvae) and continued to rear separately till the fourth moult to get grasserie infected larvae to introduce in the healthy larval bed after 4th moult. In another batch few larvae were inoculated with BmIFV (1 ml of 10% inoculum/100 larvae) and again with pathogenic Streptococcus sp. bacteria (1×10^7 bacterial cells/ml/100 larvae) and reared separately till the 4th moult to get flacherie infected larvae to introduce in the healthy larval bed after 4th moult.

The remaining uninoculated large number of larvae was

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reared upto 4th moult. On the resumption of 4th moult the larvae were devided into 3 sets. In first set the larvae were grouped into four batches (T1-T4) with 3 replications of 200 larvae each and reared under different temperature and humidity viz; 20°C and 85% RH (T1), 25°C and 70% RH (T2), 30°C and 80% RH (T3), 35°C and 50% RH (T4) upto spinning. This first set of 4 batches was served as controls for the 2nd, 3rd sets of 4 batches each.

In second set, larvae were grouped into again 4 batches (T1-T4) with 3 replications of 200 larvae each and introduced 1% infectious source of grasserie (2 grasserie infected larvae/200 healthy larval bed) and reared at different temperature and humidity as mentioned above upto spinning. In the third set also larvae were grouped into 4 batches (T1-T4) with 3 replications of 200 larvae each and introduced 1% infectious source of flacherie (2 flacherie infected larvae/200 healthy larval bed) and reared at temperature and humidity as mentioned above upto spinning. All the three sets of larvae having 4 batches with 3 replications each were fed with same quality and quantity of mulberry leaves. The matured larval weight was recorded on 5th day prior to spinning and the incidence of grasserie and flacherie were recorded upto spinning and also on mountages in all the batches. After completion of spinning cocoons were harvested on 6th day and assessed the effective rate of rearing, single cocoon weight and shell ratio. The experiment was repeated thrice and the data subjected to suitable statistical analysis.

Results

The combined effect of temperature and humidity in 5th instar on the rearing performance is depicted in the Table 1 and 2 and disease incidence in Fig. 1 and Fig 2. The 5th instar larvae reared at different temperature and humidity showed a decrease in larval weight, effective rate of rearing and cocoon characters.

Larval weight and larval duration

In normal rearing the larval weight in T1, T2, T3 and T4 was 50.90 46.74 , 39.21 and 30.71 g respectively. The larval weight decreased in case of 1% infectious source of rearing (Table 1 and 2). It clearly shows that larval weight was low in 1% infectious source of grasserie and flacherie. Among the treatments, larval duration was found sig-

Table 1. Effect of temperature and humidity on rearing performance of silkworm under normal conditions (control) and 1% infectious source of grasserie

Treatment	10 Larval weight (g)		Larval duration (h)		ERR				Cocoon Wt (g)		Shell Wt (g)		SR (%)	
					By/No.		By/ Wt (Kg)							
	Normal	IFS	Normal	IFS	Normal	IFS	Normal	IFS	Normal	IFS	Normal	IFS	Normal	IFS
T1: 20°C & 85±5%	50.90	38.28	176	205	9451	5644	18.486	8.706	1.992	1.546	0.455	0.340	22.87	21.99
T2 : 25°C & 70±5%	46.74	42.25	132	157	9605	4600	17.216	7.584	1.870	1.640	0.437	0.364	23.40	22.15
T3 : 30°C & 80±5%	39.21	35.91	131	156	7792	2200	12.169	3.336	1.625	1.521	0.360	0.322	21.98	21.18
T4 : 35°C & 50±5%	30.71	28.71	126	154	6245	1311	8.592	2.276	1.456	1.446	0.319	0.305	21.84	21.12
C.D. at 5%	3.616		8.49		555		1.735		1.117		0.034		0.759	

Control: Normal rearing without infectious source.
IIFS : 1% Infectious source of grasserie rearing.

Table 2. Effect of temperature and humidity on rearing performance of silkworm under normal conditions (control) and 1 % infectious source of flacherie

Treatment	Larval weight (g)		Larval duration (h)		ERR				Cocoon Wt (g)		Shell Wt (g)		SR (%)	
					By/No.		By/ Wt (Kg)							
	Control	IFS	Control	IFS	Control	IFS	Control	IFS	Control	IFS	Control	IFS	Control	IFS
T1: 20°C & 85±5%	50.90	39.28	176	205	9451	6188	18.486	9.696	1.992	1.571	0.455	0.338	22.87	21.55
T2 : 25°C & 70±5%	46.74	43.40	132	168	9605	5411	17.216	8.813	1.870	1.644	0.437	0.364	23.40	21.99
T3 : 30°C & 80±5%	39.21	36.38	131	155	7792	2666	12.169	3.975	1.625	1.509	0.360	0.318	21.98	21.06
T4 : 35°C & 50±5%	30.71	28.59	126	148	6245	1977	8.592	2.927	1.456	1.442	0.319	0.301	21.84	20.86
C.D. at 5%	3.616		8.49		555		1.735		1.117		0.034		0.759	

Control: Normal rearing without infectious source.
IIFS : 1% Infectious source of flacherie rearing.

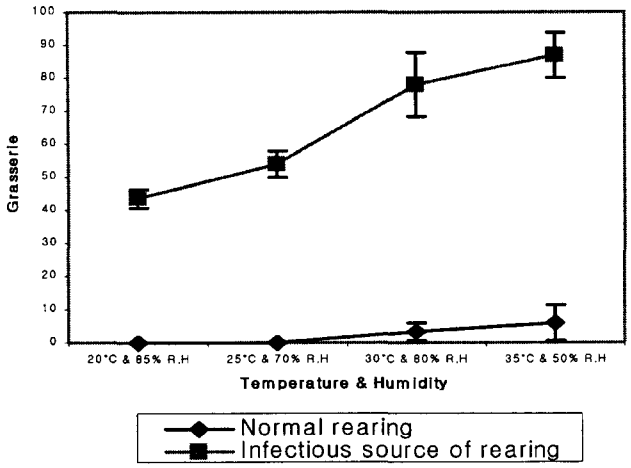

Fig. 1. Influence of Temperature and humidity on the incidence of grasserie under normal and 1% infectious source of grasserie rearing.

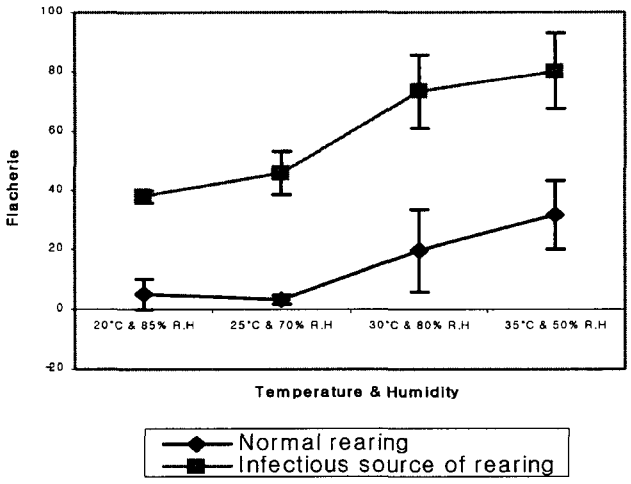

Fig. 2. Influence of Temperature and humidity on the incidence of Flacherie under normal and 1% infectious source of flacherie rearing.

nificantly reduced in T4 (126 hrs), T3 (131 hrs), T2 (132 hrs) due to high temperature where as in T1, larval duration was prolonged (176 hrs) due to low temperature and high humidity. The results indicated that the larval duration decreased with the increase of temperature irrespective of humidity. But in 1% infectious source of rearing larval duration was prolonged due to disease incidence.

Effective rate of rearing

The ERR was highly significant in T1 and T2 (9451,9605) and drastically decreased at higher temperature and low humidity T3 and T4 (7792, 6245). The same trend was observed in the presence of 1% infectious source of grasserie and flacherie. The survival rate was markedly lowered in T3 and T4 both in normal rearing and also in 1% infectious source of grasserie and flacherie rearing. The ERR by weight significantly improved in T1 (18.486 kg) and minimum ERR by weight was recorded in T3 and T4 (Table 1 and 2) of all sets of rearing.

Cocoon characters

In normal rearing the cocoon traits viz., single cocoon weight, shell weight were significantly higher in T1 (1.992 g, 0.455 g). These characters were drastically decreased at T4 (1.456 g, 0.319 g). The same observation was also found in 1% infectious source of grasserie and flacherie rearings. The shell ratio significantly improved in T2 than the high temperature and low humidity (T3 and T4). The present study revealed that the larvae reared at T1 and T2 showed improvement in larval weight and survival rate with minimum incidence of grasserie and flacherie (0.0%, 3.31%) in normal rearing and highest incidence of flacherie was observed in T3 (19.70%) and T4 (31.80%). Whereas in 1% infectious source of grasserie and flacherie, a significant difference was observed between treatments. In 1% infectious source3 of grasserie (Fig. 1) batches the incidence of grasserie was 43.6, 54.0, 78.0 and 86.90 % in T1, T2 , T3 and T4 respectively. In 1 % infectious source of flacherie (Fig. 2) batches the incidence of flacherie varied from 38.11 (T1) to 80.22 % (T4).

Discussion

The present investigations revealed that the larval weight was drastically decreased in infectious source of grasserie and flacherie, as compared to normal rearing and there was a significant difference among the treatments. As the temperature increases the larval weight was decreased. These results are compared with the earlier investigators by Takeuchi *et al.* (1964). The same observations were reported in 1% of infectious source of grasserie and flacherie. The low larval weights were obtained in T3 and T4. Due to the high temperature, leaf withering occurred in the rearing bed due to which silkworm larvae cannot feed more time on the leaf. From the data it is evident that the larval growth was affected at high temperature (Fye and Poole, 1971), where as in T1 and T2 larval weights were improved because of low temperature and high humidity. The larval weight influences the cocoon crop. This indicates possible inhibition on the growth of the larvae at high temperature (Rajashekar *et al.*, 1997).

The result clearly shows that the larval duration prolonged at low temperatures (T1 and T2) and shortens at the higher temperature (T3 and T4). This is also a way for larvae to escape from drastic changes in environment

(Basavaraju *et al.*, 1998). Exposure of 5th instar larvae to high temperature causes decline in their survival rate (Kato *et al.*, 1989). However, decrease in survival rate with the increase of temperature suggests that the high temperature did not favour the productivity. Even though high temperature tends to wither off the mulberry leaves which were fed to the silkworms, there by reducing the feeding quantity of the leaf. Due to this high temperature accelerates the growth rate but leading to poor cocoon quality (Venugpala and Pillai, 1980). Cocoon weight improved at low temperature (T1 and T2) and declined at higher temperature (T3 and T4) temperature produced small cocoons, and causes the silkworm to get disease easily (Anonymous, 1972) and higher temperatures and low humidity accelerates the withering of leaf leading to lower rate of ingestion by the silkworm. The silkworm larvae can not eat more period on the provided leaf and it leads to decline in the cocoon weight (Gangawar *et al.*, 1993). Too low temperature (T1) on the other needs more labour for rearing and enhanced the cocoon weight and but shell ratio was lowered than the optimum temperature and humidity (T2). If temperature and humidity are extremely high the susceptibility of silkworm larvae to viral infections (Venugopala Pillai and Krishnaswami, 1980) increases. The same observations were recorded in normal rearing and also in 1% infectious source of grasserie. Vago (1959) reported that the thermal shock causes cellular metabolic deviation in the host that induces multiplication of viruses already present in the cell.

Hence the CSR2 x CSR5 newly evolved hybrid has shown its productivity and reduced disease incidence at optimum temperature and humidity (T2) in normal rearing than in 1 % infectious source of grasserie and flacherie.

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