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THE EFFECT OF DIFFERENT STRESS FACTORS ON THE SPREAD OF VIROSIS AND PEBRINE DISEASES IN TASAR SILKWORM REARING

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ABSTRACT

Presence of the pathogens induces diseases in tasar silkworm rearing there after several ecological and nutritional factors influence diseases spread in general. There is no specific study on the spread of the diseases of tasar silkworm in different stresses. In the present study, Daba B.V was reared under different stress conditions involving temperature and humidity, larval density and leaf maturity in presence of infectious source of Virosis disease caused by *Antheraea mylitta* cytoplasmic polyhedrsis virus (AmCPV) and Pebrine disease caused by *Nosema mylittansis* in tasar silkworm rearing. These factors significantly influenced the spread of Virosis and Pebrine. The effect of environmental factors (temperature and humidity) as stress factor, the incidence of Virosis and Pebrine were low in control batches where as high in 1% source of diseases. The spread of Virosis was to the extent from 41.33% (T_1) - 84.83% (T_4) and Pebrine ranged from 36.00% (T_1) – 79.83% (T_4). Larval density as stress factor, as the number of larvae/sq. ft increased the incidence of Virosis and Pebrine was also significantly increased from 56.3% to 90.5% and 47.0% to 87.7%, respectively. Leaf maturity as a stress factor, in the treated lots as the maturity of the leaf increased from 90 days to 150 days, there was significant increase of mortality in comparison with control. Mortality due to Virosis and Pebrine ranged from 48.3% (T_2) to 65.5 % (T_4) and 40.3 % (T_2) to 62.2 % (T_4) respectively.

INTRODUCTION

In the tasar silkworm the diseases in silkworm is primarily due to pathogens there after certain stress factors have been identified to be most crucial factors influencing the disease development in silkworm rearing. The environmental factors such as temperature and humidity largely determine the growth of the silkworm and success of rearing (Kenten, 1955 and Tazima, 1978). Silkworms have adapted to a temperature of 26-28^0 C and any increase of decrease in the temperature influence the susceptibility of silkworm with temperature acting as stress (Steinhau, 1958a and Watanabe, 1964). There are also reported that crowding exerts a stress on the members of the population and influences the incidence of the diseases (Steinhaus, 1958b). The nutritive quality and its maturity of mulberry leaf, the exclusive food of silkworms determined the success of silkworm crops (Datta *et al*., 1996). For exploiting the full potential of the breed, it is important to understand the role of stress factors on the performance of the Daba B.V. This paper presents the results of studies on the effect of different stress factors on the spread of virosis and Pebrine diseases in tasar silkworm rearing.

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MATERIALS AND METHODS

Daba B.V eggs were prepared and incubated under optimum conditions. The larvae were reared outdoor conditions on the *Terminalia tomentosa* leaves till 3rd moult. Immediately after the 3rd moult 100 larvae were inoculated with AmCPV ($1x10^7$ polyhedral/ml) and reared separately till the fourth moult. Another set of 100 larvae after 3rd moult were inoculated with *Antheraea mylittansis* spores ($1x10^7$ spores/ml). These larvae were reared till the fourth moult and used as carriers of the pathogen. The larvae were introduced as infectious source of Virosis and Pebrine at the beginning of final instar during experimentation. The remaining larvae were reared till the beginning of final instar and divided into three sets and these sets of larvae were used for investigation of the effect of environmental factors, larval density and leaf maturity as stress factors on the rate of spread of Virosis and Pebrine

Environmental factors (Temperature and humidity)

In this experiment, the larvae at the beginning of final instar were made into two groups. First group formed the control for treatments in second group and larvae were subjected to respective experimental temperature and humidity viz., 20^0 C and 85±5% R.H. (T_1); 25^0 C and 70±5% R.H. (T_2); 30^0C and 80±5% R.H. (T_3) and 35^0C and 50±5% R.H. (T_4). The second group of larvae were subjected to different experimental temperature and humidity (T_1 - T_4) as stress factors and introduced the carrier larvae at 1% level into the population. One set of the second group was used for the introduction of carriers of infectious source of Virosis and another set for Pebrine infectious source. Each treatment and control had three replications of 200 larvae each. Both the sets were reared till cocooning separately and recorded the disease incidence in each of them.

Larval Density

The final instar larvae at the beginning of the instar were divided into two groups. First group formed the control for treatments (T_1 – T_6) in second group. The first group larvae densities viz., T_1: 50; T_2: 60; T_3: 70; T_4: 80; T_5: 90; and T_6: 100 larvae/ 9sq.fts. as required the experiment. The second group the larvae were reared in different larval densities as required by the experiment. The second group the larvae were reared in different larval densities as required by the experiment and introduced the carrier larvae at 1% level into the population. One set of second group was used for introduction 1% infectious sources of Virosis larvae and another 1% infection source of Pebrine. Each treatment had three replications with 200 larvae/replication. The larvae of all treatments were reared till spinning. The larvae were fed with equal quantity of mulberry and disease incidence was recorded during the rearing as wells as in spinning period.

Leaf maturity

As in the previous experiment the final instar larvae at the beginning were divided into two groups. First group larvae formed control for four treatments (T_1-T_4) in second group. The larvae were fed with leaf of different maturity after pruning viz., T_1 : 60; T_2:90; T_3 : 120; and T_4 :150 days as required in the treatment in second group. The second group of larvae were subjected to rearing with leaf different maturity as required by the experiment (T_1-T_4) and introduced the carriers at 1% level. One set of the second group was used for introduction of infectious source of Virosis and another infectious source of Pebrine. Each treatment and control had 3 replications of 200 larvae each and reared till spinning. The larvae were fed with equal quantity of *Terminalia tomentosa* and disease incidence was recorded during the rearing and in spinning.

Statistical analysis

The experiment was repeated thrice and the data was subjected to Statistical package SPSS 14.0. The Analysis of variance (ANOVA) was carried out between different treatments.

RESULTS AND DISCUSSION

The effect of environmental factors (temperature and humidity) as stress factor on the spread of Virosis and Pebrine in a silkworm rearing is presented in Table-1. The results of the study revealed that the incidence of Virosis and Pebrine were low in control batches (normal rearing condition) and high in treatments with 1% source of pathogens. In control batches (T_1-T_3), there was no incidence of Virosis and Pebrine while in T_4 2.00% and 2.83% of Virosis and Pebrine was recorded, respectively. However, the spread of disease viz., Virosis and Pebrine was high in 1% source of diseases. As the temperature increases and humidity decrease, there was significant increase in the spread of disease. The spread of Virosis was to the extent from 41.33% (T_1) - 84.83% (T_4) and Pebrine ranged from 36.00% (T_1) – 79.83% (T_4). The increase in rate of spread of disease may be due to adverse environmental conditions such as high temperature which possibly weaken the larvae resulting in the high susceptibility as reported by Watanabe (1964), Aizawa (1953, 1953), Kobayashi *et al.* (1981) and Inoue and Tanada (1977).

Table 1. Effect of temperature and humidity as stress factor on the rate of spread of Virosis and Pabrine in silkworm rearings

Sl. No.	Treatments	Source	Mortality due to the Disease	
			Virosis %	Pebrine %
1	T_1 = 20^0C & 85+5% RH	IFS	41.33 (40.01)	36.00 (36.87)
		Control	0.00 (4.06)	0.00 (4.06)
2	T_2 = 25^0C & 70+5% RH	IFS	47.17 (43.38)	42.17 (40.49)
		Control	0.00 (4.06)	0.00 (4.06)
3	T_3 = 30^0C & 80+5% RH	IFS	67.50 (55.26)	61.00 (51.36)
		Control	0.00 (4.06)	0.00 (4.06)
4	T_4= 35^0C & 50+5% RH	IFS	84.83 (67.09)	79.83 (63.33)
		Control	2.00 (8.09)	2.83 (9.63)
C.D. at 5%		Treatment	(1.27)	(1.08)
		Source	(0.90)	(0.76)
		T x S	(1.80)	(1.53)

Parenthesis value indicates ARC Sine transformation
IFS: Infectious Source

The effect of larval density as stress factor on the spread of Virosis and Pebrine in a silkworm rearing is presented in Table-2. The incidence of Virosis and Pebrine were significantly lower under normal rearing condition compared to 1% infectious source of pathogens. As the number of larvae/sq. ft increased the incidence of Virosis and Pebrine was also increased. In the case of control the increase in Virosis was from 0.5 % (T_1) to 2.2 % (T_4) and the increase in Pebrine was from 0.7 % (T_1) to 2.3 % (T_4). In the presence of 1% source of pathogen as the number of larvae increased from 5-10 larvae/sq. ft. there was significant increase in Virosis and Pebrine diseases. Highest rate of spread of Virosis 90.5% and Pebrine 87.7% were recorded in larval density of 10 larvae/sq. ft. The highest spread of the diseases in the high density rearing may be due to the closer proximity of the host population to the pathogen which leads to higher rate of communication of the feed and disease spread. This mean larger number of individuals feeding on contaminated food and getting diseased. In low density rearing the proximity of the host to the pathogen is not a closer as is in higher density rearing. As such the rate of contamination and the spread will be comparative low. Higher density rearing also results in insufficient supply of feed leading to starvation and weakness.

Table 2. Effect of Larval density as a stress factor on the rate of spread of Virosis and Pebrine in silkworm rearings

Sl. No.	Treatments	Source	Mortality due to the Disease	
			Virosis %	Pebrine %
1	T_1 = 5 larvae /sq.ft	IFS	56.3 (48.64)	47.0 (43.28)
		Control	0.5 (4.06)	0.7 (4.62)
2	T_2 = 6 larvae/sq.ft	IFS	59.5 (50.48)	50.7 (45.38)
		Control	0.7 (4.62)	0.8 (5.18)
3	T_3= 7 larvae/sq.ft	IFS	66.7 (54.74)	61.3 (51.55)
		Control	0.7 (4.62)	0.8 (5.18)
4	T_4 =8 larvae/sq.ft	IFS	77.3 (61.58)	71.8 (57.95)
		Control	1.0 (5.74)	1.2 (6.17)
5	T_5= 9 larvae/sq.ft	IFS	86.0 (68.04)	79.7 (63.20)
		Control	1.7 (7.40)	1.5 (6.97)
6	T_6 = 10 larvae/sq.ft	IFS	90.5 (72.05)	87.7 (69.49)
		Control	2.2 (8.45)	2.3 (8.78)
	C.D. at 5%	Treatment	(0.83)	(1.25)
		Source	(0.48)	(0.72)
		T x S	(1.18)	(1.76)

Parenthesis value indicates ARC Sine transformation
IFS: Infectious Source

The environment will also be uncongenial for growth and health of individuals in the population. The conditions become very much severe in presence of infection source in the colony leading high rate of spread of disease. Similar observations have been made by Sarma (1991) who have found that, the number of larvae increase from 200 to 700 in a recommended rearing space meant for 200 silkworm larvae, there was an increase in the incidence of nuclear polyhedrosis under natural and infectious source of rearing. Jaques (1962) also reported that rearing under crowded condition increased the susceptibility of *Trichoplusia ni* to nuclear polyhedrosis virus.
The effect of leaf maturity as a stress factor in the spread of Virosis and Pebrine in a tasar silkworm rearing is presented in Table-3. In normal rearing, the mortality due to the Virosis was ranged from 2.3% to 3.2% in all the treatments where as in the case of mortality due to the Pebrine was ranged from 1.8% to 3.5%. In the case of 1% source of disease treatment, the Virosis incidence was low (48.3%) in silkworm reared on mulberry leaves of 90 days maturity (T_2).

As the maturity of the leaf increased from 90 days to 150 days and there was significant increase of Virosis from 48.3% (T_2) 65.5 % (T_4) and in case of pebrine mortality increased from 40.3 % (T_2) to 62.2 % (T_4). The increase in the disease level may be due to poor nutritive value of leaf which weaken the silkworm and increases the susceptibility to disease. The quality of leaf viz., the protein, sugar and cellulose level in mulberry plays important role in enhancing the defence response of silkworm (Watanabe and Imanishi, 1980; Watanabe *et al., 1989*). Hence feeding on premature or over matured mulberry leaves enhanced incidence of diseases. It is observed from the results that tasar silkworms are sensitive to stress factors such as temperature, humidity, and nutrition and population density. These factors make the silkworm weak and susceptible to diseases. There may low level of defence response and the larval IC dosage reduces resulting in high incidence of diseases in silkworm rearing.

Table 3. Effect of Leaf maturity as a stress factor on the rate of spread of Virosis and Pebrine in silkworm rearings

Sl. No.	Treatments	Source	Mortality due to the Disease	
			Virosis %	Pebrine %
1	T_1 = 60 days old leaf	IFS	52.3 (46.34)	46.2 (42.80)
		Control	3.2 (10.15)	1.8 (7.66)
2	T_2 = 90days old leaf	IFS	48.3 (44.05)	40.3 (39.43)
		Control	2.3 (8.47)	2.5 (8.90)
3	T_3= 120 days old leaf	IFS	54.5 (47.58)	50.8 (45.48)
		Control	3.0 (9.83)	3.5 (10.77)
4	T_4 = 150 days old leaf	IFS	65.5 (54.04)	62.2 (52.04)
		Control	2.3 (8.70)	2.0 (7.35)
	C.D. at 5%	Treatment	(2.03)	(2.37)
		Source	(1.43)	(1.68)
		T x S	(2.87)	(3.35)

Parenthesis value indicates ARC Sine transformation
IFS: Infectious Source

REFERENCES

Aizawa, K. 1953. Multiplication mode of the silkworm jaundice virus. I. On the multiplication mode in connection with the latent period and LD50-time curve. *Bull. Seric. Exp. Stn. (Tokyo). 14:201.*

Aizawa, K. 1963. The nature of infections caused by Nuclear Polyhedrosis Viruses. In : Insect pathogen Ed. E.A. Steinhaus. *An advanced Treatise,* Vol-1, Academic press, New York. pp.381.

Datta, R.K.; Basavaraja, H.K. and Mano, Y.K. 1996. Manual on Bivoltine rearing maintenance and multiplication, pp. 14.

Inoue, H. And Tanada, Y. 1977. Thermal therapy of flacherie virus disease in Silkworm, *Bombyx mori. J. Invertebr. Pathol,* 29:63.

Jaques, R.P. 1962. Stress and nuclear polyhedrosis in crowded population of *Trichoplusia ni* (Hubner). *Jour, Insect. Pathol.*, 4:1-22.

Kenten, J. 1955. The effect of photoperiod and temperature on reproductive in *Acrthosiphonepism* (Harris) and forms produced. *Bull. Entomol. Res*. 49:599-624.

Kobayashi, M.; Inagaki, S. And Kawase, S. 1981. Effect of high temperature on the development of nuclear polyhedrosis virus in the silkworm. *Bombyx mori L.J. Invertebr. Pathol.* 38:386.

Sarma, B. J. 1991. studies on nuclear polyhedrosis of silkworm, Bombyx mori L. And its prevention. Disseration submitted to CSRti., mysore for the award of Diploma in Specilization in Tropical Sericulture.

Steinhaus, E.A. 1958a. Stress as a factor in insect disease, Proc. 10th Int. Compr. Entomol. 1956, 4:725.

Steinhaus, E.A. 1958b. Crowding as possible stress factor in insect diseases. Ecology, 39:503-514.

Tazima, Y. 1978. Spermatogenesis. In: *The silkworm an important laboratory tool*. Ed., Kodensha Ltd., Tokyo, Japan. Pp.12-15.

Watanabe, H. 1964. Temperature effects on the manifestation of susceptibility to oral infection with Cytoplasmic polyhedrosis in silkworm, *Bombyx mori* L.J. Seric. Sci. Jpn. 33:286.

Watanabe, H. and Imanishi, S. 1980. The effect of the contents of certain ingradients in an artificial diet in the susceptibility to virus infection in the silkworm, *Bombyx mori*. J. Sericult. Sci. Jpn. 49:404-409.

Watanabe, H.; Nagata, M. Nd Wang Y. X (1989) The effect of protein content of an artificial diet to protease and anti viral activities of the gut juice of the silkworm, *Bombyx mori* (Lepidoptera: Bombycidae). *Appl. Entomol. Zool.* 25:150-152.

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