RELATIVE RESISTANCE OF SOME SILKWORM, *BOMBYX MORI* L. STRAINS AGAINST BACTERIAL FLACHERIE UNDER HIGH TEMPERATURE AND RELATIVE HUMIDITY CONDITIONS

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Abstract

Eight exotic bivoltine silkworm strains, four of Japanese origin (J-99, J-101, 205-MKD, 206-MKD), and four Chinese (C-102, 206-PO, 207-PO, 208-PO) were screened for their relative resistance against bacterial flacherie. In addition, effect of high temperature and relative humidity (rH) on the resistance of silkworm strains was also studies. The results revealed that at 25±1°C and 72±2% rH, overall mortality was significant (P0.05). 205-MKD strain was the most resistant while C-102 the least resistant with 4.0% and 10% mortality, respectively. However, difference among 205-MKD, J-99, J-101 and 208-PO was statistically non-significant. Overall mortality at higher temperature and relative humidity (30±1°C and 80±2% rH) was highly significant (P0.01). Mortality was escalated in all the test strains except 206-MKD and 206-PO. Mortality increased in an array of 205-MKD (125%) > J-101 (116.67%) > 207-PO & 208-PO (66.67%)> C-102 (50%)> J-99 (33.33%)> 206-MKD & 20-6P-O (0.0%). The least susceptible strains were J-99 and 206-PO contrarily to C-102 and 207-PO, the most susceptible ones. Moreover, high temperature and relative humidity showed strong positive correlation with mortality. Outcome of the trials also indicates that Japanese silkworm strains were comparatively more resistant to bacterial flacherie than that of Chinese. On the basis of these results it is suggested that resistant silkworm strains like 205-MKD, J-99, J-101 and 208-PO should be reared at 25±1°C and 72±2% rH to override losses of cocoon crops due to bacterial flacherie.

Keywords: Silkworm, Resistance, J-99, J-101, 205-MKD, 206-MKD, C-102, 206-PO, 207-PO, 208-PO, Temperature, Relative humidity, Microbial diseases, Flacherie, Bacteria, Integrated disease management

Introduction

Profitable practice of silkworm rearing is limitary of many factors. The menace of microbial diseases is the prime one. The principal infectious diseases of silkworm are flacherie, muscardine, pebrine and nuclear & cytoplasmic polyhedrosis. Among these flacherie is severe and wide spread, causing big blow to silkworm production (Inoue and Tanada, 1977; Hashimoto and Kawase, 1983; Sridar, *et al.*, 2000).

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Heavy losses of silkworm cocoon crops have been attributed to flacherie invariable in all countries wherever sericulture is practiced. For instance, Chitra *et al.* (1974), Shyamala *et al.*, (1987), Bajwa and Ashiq (1999), Sridar *et al.*, (2000) have reported 20-40%, 17-27%, 5-20%, 10-15% loss of cocoon crops, respectively due to bacterial flacherie. Likewise, Samson *et al.*, (1990) have recorded 57.22% incidence of bacterial flacherie of the total disease occurrence. However, incidence and severity of the disease is subjected to many factors. For example, silkworm rearing temperature (Aruga and Tanaka, 1968; Kobayashi *et al.*, 1981; Rehman *et al.*, 2000), environmental factors (Jafri *et al.*, 1979), susceptibility of silkworm strains (Watanabe and Maeda, 1981) quality of food (Basavarajappa and Savanurmath, 1996) and moisture on mulberry leaves (Sivaprakasam *et al.*, 1996).

Natural resistance of silkworm against microbial diseases is a vital tool for integrated disease management program. However, natural resistance is influenced by many intrinsic and extrinsic factors. The most important extrinsic factor is temperature. In as much as temperature extremes act as stress which give impetus to bacterial epizootic (Madox, 1994). Keeping in view the importance of the disease, resistance of silkworm against the disease and effect of temperature on the resistance, present study was conducted.

Material and Methods

Eight bivoltine exotic strains of silkworm, *Bombyx mori* L. i.e. J-99.J-101, 205-MKD, 206-MKD (Japanese) and C-102, 206-PO, 207-PO, 208-PO (Chinese) were screened for their resistance against bacterial flacherie during the spring rearing season, 2004. Also effect of high temperature and relative humidity on natural resistance of the strains was worked out. Batch-I of silkworm strains was reared at 25±1°C and 72±2% relative humidity (standard rearing temperature and humidity conditions) while Batch-II at 30±1°C and 80±2% rH.

On first day of 3rd instar, 100 larvae for either experiment were taken at random from mass rearing lot for each strain. The larvae were fed mulberry leaves (*Morus alba* cultivar PFI-I) five times daily, namely at 0600, 1000, 1400, 1800 & 2200 hours. Wooden rearing trays (30x20x2.5 cm) were cleaned daily at 1000 hours. Sick larvae were sifted at the time of cleaning on the basis of physioco-morphic etiological symptoms. Final confirmation of the disease was ascertained after the death of the larvae with the help of light microscope. Mortality was jotted down in 3rd, 4th, 5th spinning and pupal/cocoon stages and converted in to percentage.

The trials were carried out in randomized complete block design with four replications. Overall mortality was statistically analyzed through two-way analysis of variance (ANOVA) and difference among individual strains by least significant difference (LSD) test. Whereas, significance of difference between means of mortality, temperature and relative humidity of two batches was ascertained with the help of pooled estimate of variance.

Results and Discussion

The mean rearing temperature of batch I and II, i.e. 25±1°C and 30±1°C were statistically significant between themselves (T: 9.433; prob. $6.55E^{-08}$). Likewise, the mean rearing relative humidity of batch I & II, viz. 72±2% and 80±2% differed significantly (T: 7.823; prob. $2.564E^{-06}$), table –1. .

In batch-I (25±1°C and 72±2% rH), overall percent mortality in the test strains varied significantly (P 0.05). Minimum (4.0%) and maximum (10.0%) mortality was displayed in 205-MKD and C-102, respectively. The difference in mortality among 205-MKD, J-99, J-101, 208-PO; J-99, J-101, 206-MKD, 206-PO, 207-PO, 208-PO; C-102, 206-PO, 207-PO, 206-MKD was statistically non-significant. Comparatively overall mortality was less in Japanese strains than that of Chinese except 206-MKD.

In batch-II (30±1°C and 80±2%rH), overall percent mortality was highly significant (P0.01). With marginal variation same trend of mortality was noticed among all under trial silkworm strains. Minimum (8.0%) and maximum (15.0%) mortality was recorded in J-99 & 206-PO and C-102 & 207-PO, respectively. Mortality difference among C-102, 207-PO and J-101 was statistically non-significant. Similarly, mortality among J-101, 205-MKD, 206-MKD, 208-PO; J-99, 205-MKD, 206-MKD, 206-PO, 208-PO was non-significant. With the raise up of temperature and relative humidity, mortality due to bacterial flacherie was escalated considerably in all test strains except 206-MKD and 206-PO. Pooled estimate of variance test proved this increment highly significant (T: 2.822, prob. $6.784E^{-03}$). On raised rearing temperature and humidity Japanese silkworm strains showed less mortality as compared with Chinese counterpart.

Table 1: Percent mortality of different silkworm strains due to bacterial flacherie and effect of high temperature and relative humidity.

Strains	Overall mortality (%)			Temperature (° C)		Relative humidity (%)	
	Batch I	Batch II	Time (Hours)	Batch I ± SD	Batch II ± SD	Batch I ± SD	Batch II ± SD
J- 99	6.0* bc	8.0** c	0600	24.0± 0.817	29.357± 1.082	70.031± 4.64	80.351± 4.717
J-101	6.0 bc	13.0 ab	1000	25.538± 1.808	30.286± 0.726	72.385± 2.725	82.008± 3.816
205-MKD	4.0 c	9.0 bc	1400	25.692± 1.068	31.0± 0.855	71.615± 4.292	81.429± 2.311
206-MKD	9.0 ab	9.0 bc	1800	26.0± 1.214	29.429± 0.979	72.23± 2.47	78.429± 2.674
C-102	10.0 a	15.0 a	2200	24.0± 1.354	30.071± 0.829	74.0± 3.148	78.0± 2.119
206-PO	8.0 ab	8.0 c	Mean	25.046± 0.675	30.027± 0.969	72.052± 1.433	80.043± 1.779
207-PO	9.0 ab	15.0 a					
208-PO	6.0 bc	10.0 bc					
LSD	3.825	4.476					
T-values	2.822 prob. 6.784 E^{-03}			7.823 prob. 2.564 E^{-05}		7.823 prob. 2.564 E^{-05}	

*Significant at 0.05 level, ** significant at 0.01 level. – Figures in a column having same alphabets are non-significant among themselves.

There are different mortality levels in eight silkworm strains at standard rearing temperature and relative humidity, i.e. 25±1°C and 72±2% rH. This reveals inherited capability of each strain to withstand against bacterial flacherie. These results are in corroboration with Bajwa and Ashiq (1999). At 30±1°C and 80±2%rH mortality is increased from 0 to 125 percent (Fig.1). However, mortality response remains indifferent in 206-MKD and 206-PO.

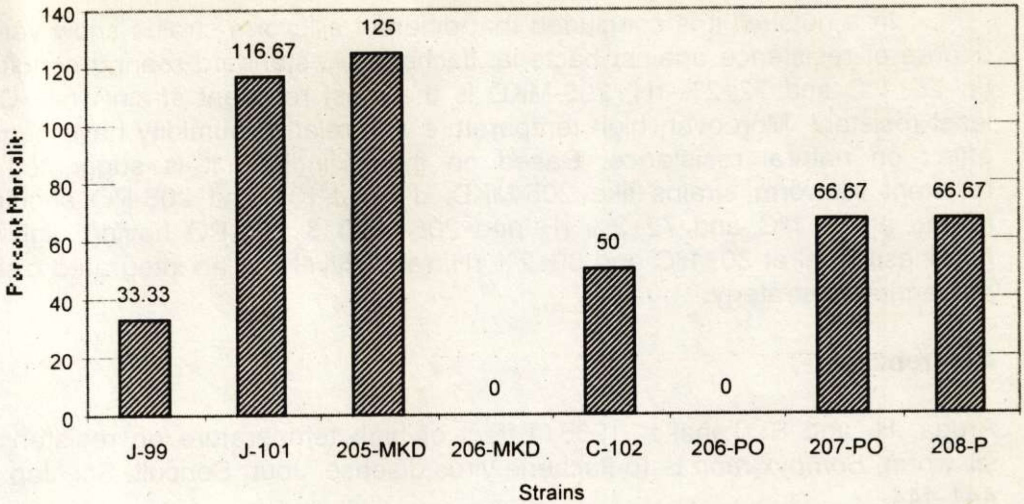

Fig1: Percent increment of mortality in different silkworm strains at 30 ± 1^0C and 80 ± 2%rH.

The results indicate a strong positive correlation between temperature & relative humidity and mortality. This has also been reported by Lacey *et al.*, (1978). Similarly, Rehman and his colleagues in 2000, found 82 & 25 % and 89 & 53% larval & pupal mortality in C-102 and J-101, respectively at 30°C and 58% rH. However, this discrepancy in the results might be due to only high temperature and low humidity.

Increased mortality indicates that high temperature and relative humidity in-combination act as a stress factor, which may have diminished the natural resistance in silkworm strains under discussion. For stress factors like temperature extremes, other pathogens, parasites and poor quality of food can boost bacterial infection (Madox,1994). Another possible reason of high mortality may be that the feeding rates might increase with rising temperature resulting in the ingestion of greater quantities of toxins per unit time. Also the rate of dissolution and absorption of the crystal toxin is likely to be increased at higher temperature. Wraight *et al.* (1981) also found these reasons in the effects of temperature on the efficacy of *Bacillus thuringiensis* var. i*sraelensis* and *B. sphaericu*s strain 1593 against *Aedes stimulans*. The results also display that Chinese silkworm strains are more susceptible to bacterial flacherie as well as have low heat hardiness level.

Conclusion

In a nutshell it is concluded that different silkworm strains show variable degree of resistance against bacterial flacherie. At standard rearing conditions, i.e.-25±1°C and 72±2% rH, 205-MKD is the most resistant strain while C-102 least resistant. Moreover, high temperature and relative humidity have negative effect on natural resistance. Based on these findings it is suggested that resistant silkworm strains like 205-MKD, J-99, J-101 and 208-PO should be reared at 25±1°C and 72±2% rH and 206-MKD & 206-PO having high heat hardiness level at 30±1°C and 80±2% rH, respectively as an integrated disease management strategy.

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