Research Article

Effect Of Temperature And Relative Humidity On The Survival Of Adults And Development Of Eggs Of *Estigmena chinensis* Hope. (Coleoptera: Chrysomelidae)

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ABSTRACT
Estigmena chinensis Hope (Coleoptera: Chrysomelidae) has been recorded damaging green standing bamboos in natural stands and plantations. The borer damage is frequent in solid bamboos of small dimensions and solid parts or thick walls of large hollow bamboos. The effect of temperature and relative humidity on the development of eggs and survival of adults was studied in the laboratory. Results revealed that the population of bamboo borer *E. chinensis* is greatly affected by the variations in temperature and relative humidity. At 30°C temperature and 70% relative humidity mean longevity of males and females was 11.5±0.23 and 13.5±0.20 days respectively. The study also concluded that the development of eggs was most favorable at 30°C temperature and 70% relative humidity.

KEYWORDS: *Estigmena chinensis*; Temperature; Relative Humidity; Incubation Period; Hatching Percentage.

1. INTRODUCTION

The Hispine Beetle - *Estigmena chinensis* is the most important pest of bamboos in India and Burma. Cotes [1] first called attention to it. Stebbing [2] gave a sketchy account of its life history. Its food-plants and the damage it caused have been referred to by Beeson [3], Chatterjee and Bhasin [4]. Deogan [5] and Beeson [6] gave a brief and essentially accurate account of its life history, but many aspects remain unstudied.

According to Beeson [6]; Browne [7] and Roonwal [8] in bamboo species *Schizostachyum pergracile, Dendrocalamus strictus,* and other thick-walled bamboos though the incidence and extent of damage appear to be most frequent. The young beetle damage leads to congestion in bamboo clumps. The bamboo borer has been recorded damaging green standing bamboos in natural stand and plantations. All 75 genera and 1250 species of bamboo are woody and fast-growing (Soderstrom and Ellis [9]). Bamboo is highly susceptible to insect damage and is attacked by 212 insect species in India belonging to the insect orders Coleoptera, Homoptera, Isoptera, Lepidoptera, and Thysanoptera. Bamboos are prone to insect attack by various groups right from seeds to finish products, which have been categorized as nursery pest (5), defoliators (48), sapsuckers (90), culm and shoot borers (12), termites (13), and borer of felled and dried bamboo (44). Coleoptera forms the largest order in the animal kingdom and contains nearly a quarter of a million known species, which is equivalent to about 40% of the insect fauna of the world. The young beetle damage leads to congestion in bamboo clumps. Considered in terms of the number of injurious species this order is of greater importance than others to forestry; it also includes the potentially most important single pest species. During the hot dry period, the beetles take shelter in dense and split culms. Deogan (1937) and Beeson (1941) suggested that the attacked culms of bamboos should be sorted out from the sound ones and exposed to the sun to kill *E. chinensis*.

2. MATERIALS AND METHODS

Investigations on the effect of temperature and relative humidity on the development of egg and survival of adults of *E. chinensis* was carried out in Insectary, FRI. Adults were reared in zinc cages and subjected to exposures at different combinations of temperature and relative humidity using a BOD incubator and seven sets of experiments were maintained. The temperature viz. 10°C, 15°C, 20°C, 25°C, 30°C, 35°C and 40°C ± 2°C were maintained with corresponding relative humidity levels at 90%, 85%, 80%, 75%, 70%, 65% and 60% ± 5%. In each set of experiment, 5 pair of newly emerged adults of *E. chinensis* was kept in glass chimney cages and the open end covered with a piece of muslin cloth and tied with a rubber band. These cages were kept inside different chambers of the BOD incubator where the desired temperature and relative humidity were maintained. The experiment was replicated three times. Observations were taken for each set of experiment and the changes in the development of eggs along with survival/mortality of adult was recorded.

3. RESULTS AND DISCUSSION

3.1. EFFECT OF DIFFERENT LEVELS OF TEMPERATURE AND HUMIDITY ON SURVIVAL OF ADULTS (TABLE 1)

Five pairs of newly emerged adults were kept at seven sets of experiments. Data recorded at different combinations of temperature and relative humidity revealed that at 10°C temperature and 90% relative humidity and at 15°C temperature and 85% relative humidity, there was no survival of adults. At 20°C temperature and 80% relative humidity one male and two females survived and the mean longevity of males was 2.00 days and in the case of females, it was 3.12±0.51 days. At 25°C temperature and 75% relative humidity three males and four females survived and the mean longevity was 7.2±0.21 days in males and 8.1±0.34 days in a female. At 30°C temperature and 70% relative humidity five males and five females survived and the mean longevity of males and females was 11.5±0.23 and 13.5±0.20 days respectively. At 35°C temperature and 65% relative humidity four males and four females survived and the mean longevity of males was 9.2±0.47 days and in females, it was 10.5±0.12 days. At 40°C temperature and 60% relative humidity neither male nor female survived.

3.2. EFFECT OF DIFFERENT LEVELS OF TEMPERATURE AND RELATIVE HUMIDITY ON THE DEVELOPMENT OF EGG (TABLE 2)

At 10°C temperature and 90% relative humidity and 15°C temperature and 85% relative humidity no egg-laying was observed. At 20°C temperature and 80% relative humidity, average eggs laid by five pairs of beetles were 03.00±0.12. Out of these, one egg was

hatched. The hatching percent of eggs was 33.33. The maximum incubation period i.e. 38 days was observed in this set of experiments. At 25°C temperature and 75% relative humidity, there was a comparative increase in the number of eggs laid which were 10.00±0.35 eggs. Out of which 08.00±0.28 eggs were hatched and the percentage of hatching was 80.00. The incubation period was 25.00±0.11 days.

Table 1. Effect of different levels of temperature and humidity on adult survival.

Temperature (°C)	Relative humidity (%)	No. of Adults (pair)		No. of adult survived		Adult Longevity (days)	
		Male	Female	Male	Female	Male	Female
10	90	5	5	-	-	-	-
15	85	5	5	-	-	-	-
20	80	5	5	1	2	2.0±0.00	3.12±0.51
25	75	5	5	3	4	7.2±0.21	8.1±0.34
30	**70**	**5**	**5**	**5**	**5**	**11.5±0.23**	**13.5±0.20**
35	65	5	5	4	4	9.2±0.47	10.5±0.12
40	60	5	5	-	-	-	-

At 30°C temperature and 70% relative humidity, the numbers of an egg laid were 19.00±0.45. Out of which 18.00±0.15 eggs hatched with an average of 94.7 % egg hatching. The incubation period at this combination was 19.00±0.36 days. At 35°C temperature and 65% relative humidity, 14.00±0.85 eggs were laid, out of which 12.00±0.14 eggs developed to first instar larva and 03 eggs did not show any development, the hatching percentage was 90.10%. During this temperature the recorded incubation period was 22.00±0.47days. At 40°C temperature and 60% relative humidity no egg was laid.

4. CONCLUSION

It is concluded that the survival and longevity of adults of bamboo borer - *E. chinensis* is affected by the variations in temperature and relative humidity. Singh [10] studied the effect of temperature and relative humidity on the survival and development of *Ascotis imparata.* He concluded that the best-suited temperature for the survival and development of *A. imparata* was 25-30°C with 70-75% relative humidity. The current study revealed that adults of *E. chinensis* at 10°C and 90% relative humidity and at 15°C and 85% relative humidity and 40°C and 60% relative humidity, there was no survival. Hence, these temperatures and relative humidity combinations are not favorable for the survival of adults. The adult exhibited the longest life span (longevity) at 30°C temperature and 70% relative humidity. It was also observed from the experiment that the female lived longer than the male**.** The study also concluded that at 10°C and 90% relative humidity and at 15°C and 85% relative humidity and again at 40°C and 60% relative humidity no egg-laying was observed. Hence, these temperature and relative humidity combinations are not at all favorable for the development of eggs of *E. chinensis*. The number of eggs laid and the percentage of egg hatching was maximum at 30°C temperature and 70% relative humidity, whereas the incubation period was minimum at the same set of experiment.

AUTHOR CONTRIBUTIONS

Both authors contributed equally to this study.

CONFLICT OF INTEREST

None.

Table 2. Effect of different levels of temperature and relative humidity on egg development.

Temperature (°C)	Relative humidity (%)	No. of pairs	Avg. no. of eggs laid/pair	Avg. no. of hatched eggs	% of hatched eggs	Avg. incubation period (days)
10	90	05	-	-	-	-
15	85	05	-	-	-	-
20	80	05	03.00±0.12	01.00±0.00	33.33	38.00±0.00
25	75	05	10.00±0.35	08.00±0.28	80.00	25.02±0.11
30	**70**	**05**	**19.00±0.45**	**18.00±0.15**	**94.7**	**19.00±0.36**
35	65	05	14.00±0.85	12.00±0.14	85.71	22.00±0.47
40	60	05	-	-	-	-

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