

Effect of different temperatures on the incubation period and hatching of eggs of bamboo locust, *Choroedocus illustris* Walker (Orthoptera: Acrididae)

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Abstract: The paper deals with the role of different temperatures on incubation period and hatching of eggs of bamboo locust, *Choroedocus illustris* under laboratory conditions. The egg-pods exposed to different temperatures, 10°C, 25°C, 30°C, 35°C and 45±1°C had average number of eggs/pod as 33.90, 30.75, 34.15, 35.10 and 34.00, respectively. The average lowest percentage of eggs hatched (60.15%) was at 25±1°C and the average highest percentage of hatching was 76.35% at 35±1°C. Likewise, the average incubation period was the longest (51.14 days) at 25±1°C and the shortest (24.17 days) at 35±1°C; there was no hatching at 10±1°C and 45±1°C, respectively. It clearly indicates that 35±1°C is the most suitable temperature for hatching with minimum time (24.17days) for incubation, while 25±1°C was observed to be least favoured for hatching with the incubation period of 51.14days. Furthermore, the fastest development of eggs/day was recorded (4.13%) at 35°C, while the developmental rate was slowest (1.95%) at 25°C. It is noteworthy to mention that no hatching was observed at 10±1°C and 45±1°C; indicating that these temperatures were unfavourable and 25°C to 35°C were the most favourable temperatures for hatching and development. The observations recorded under controlled conditions corresponded to that of natural conditions, where the hatching was maximum when the atmospheric temperature was around 30°C with 70% R.H.

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1. Introduction

Choroedocus illustris, commonly called as bamboo locust, is a pest of forest plantation like bamboo (*Bambusa arundinacea*), teak (*Tectona grandis*), Sal (*Shorea robusta*), sheesham (*Dalbergia sisso*), and other cultivated crops like guava (*Psidium guajava*), maize (*Zea mays*), jowar (*Sorghum vulgare*), bajra (*Pennisetum typhoideum*), rice (*Oryza sativa*), millet (*Pennisetum typhoides*), groundnut (*Arachis hypogaea*), sandal (*Santulum album*), and sugarcane (*Saccharum officinarum*). In the last few years, it has become a major pest of these plantations in and around Aligarh and major parts of north India. On many occasions it was found attacking such crops with a gregarious behaviour. Since the bionomics, ecology, colour pattern, behaviour and damaging potential of this economically important pest is not known in detail except few occasional observations made by several workers, therefore, comprehensive study of ecology, life-history, copulation, oviposition, feeding behaviour, morphometrics, reproductive behaviour, crop damage and its control strategies with more emphasis on natural enemies is urgently needed with special reference to the Indian sub-continent.

Keeping the above facts in mind, there is no comprehensive information available on bionomics, ethology and damaging potential of this species to

some cash crops as well as other economically important crops in North India, where it is assuming the status of one of the major pests on these cultivated crops. Besides, there are no data sets available regarding the role of temperature on various body parameters, species richness and its correlation with pest status in major crops in North India. However, this paper mainly deals with one of the important parameter of the species under study viz., the role of temperature on the incubation period and hatching of eggs of this occasionally gregarious grasshopper.

2. Material and Methods

Mature adults and immature stages of *Choroedocus illustris* Walker, were collected from different areas of Aligarh, Lat. 27 ° 34' 30" N and Long. 78° 4" 26' E. They were reared in wooden cages, each measuring 53 x 40 x 30 cms. Three sides of the cages were made of wood while the front side was further divided into two parts, the upper and the lower. The upper part was fixed and made of glass, measuring 31x 31cm, while the lower part, measuring 31 x 12cm, formed a wooden window for cleaning. The three wooden sides contained the windows fitted with wire guaze. At about 40cm from the top of the cage, a false floor of wire guaze was provided with six holes each measuring 3.5cm in diameter. The metallic

tubes, each measuring 11cm in length and 3cm in diameter were filled with moist sterilized sand (8.00ml distilled water for 100gm of sand). These tubes were inserted into the holes of the false floor and provided a pseudoearth for oviposition. The wooden roof was provided with a lid measuring 13 x 13cm for transferring the insects and food etc. These cages were not thermostatically controlled but the heat could roughly be regulated by changing the number and wattage of the electric bulb in the cage which served two purposes, such as heat and photoperiod. Each cage was provided with a number of sticks for perching and moulting and also for basking. A petridish of water covered with perforated zinc sheet was kept in each cage and refilled as often as necessary, to keep the humidity at the desired level.

3. Results

The egg pods laid were taken out from the cages and transferred in glass jars (15 x 20cm), covered with muslin cloth and put in B.O.D. cabinets. They were subjected to different temperatures of 10°C, 25°C, 30°C, 35°C and 45°C with relative humidity of 70±5%. The egg pods were moistened daily with few drops of water and were used for studying incubation period and hatching period at varying temperatures.

The egg – pods exposed to different temperatures, 10°C, 25°C, 30°C, 35°C and 45±1°C had average number of eggs/pod as 33.90, 30.75, 34.15, 35.10 and 34.00, respectively. The average lowest percentage of eggs hatched (60.15%) was at 25±1°C and the average highest percentage of hatching was 76.35% at 35±1°C. Likewise, the average incubation period was the longest (51.14 days) at 25±1°C and the shortest (24.17 days) at 35±1°C; there was no hatching at 10±1°C and 45±1°C. It clearly indicates that 35±1°C is the most suitable temperature for hatching with minimum time (24.17days) for incubation, while as 25±1°C was least favoured for hatching with the incubation period of 51.14days (Table 1). Furthermore, the fastest development of eggs/day was recorded (4.13%) at 35°C, while the developmental rate was slowest (1.95%) at 25°C. Interestingly, no hatching was observed at 10±1°C and 45±1°C, indicating that these temperatures were unfavourable and 25°C to 35°C are the most favorable temperatures for hatching and development (Table–1). The observations recorded under controlled conditions corresponded to that of natural conditions, where the hatching was maximum when the atmospheric temperature was around 30°C with 70% R.H.

Table: 1. Effect of different temperatures on the incubation period and hatching of eggs of *Choroedocus illustris* Walker at 70 ± 5% R.H.

Temp. (°C)	10	25	30	35	45
Total no. of egg-pods	25	30	45	40	30
Average no. of eggs/pod	33.90	30.75	34.15	35.10	34.00
Total no. of egg counts	840	921	1530	1400	1020
Incubation period (Days)	-	51.14	33.50	24.17	-
Development of eggs/day (%)	-	1.95	2.98	4.13	-
No. of eggs hatched	No hatching	554	1009	1069	No hatching
Hatching (%)	-	60.15	65.94	76.35	-

4. Discussions

The adults of *Choroedocus illustris* inhabits long grasses, dense bush and cultivated ground, migrate into cotton, sugarcane, rice, maize or vegetable crops for feeding purposes but return to grasses for shelter and egg – laying. It is a pest of forest plantations. Recently it has assumed a status of being a serious pest of bamboo in Aligarh. Hussainy (1951) reported it as a damaging pest on sugarcane at Coimbatore, South India.

Locusts and grasshoppers mainly lay their eggs in the ground, below the surface and once the eggs are deposited, their survival depends upon the four main factors viz. temperature, moisture content, oxygen availability and ability to withstand adverse conditions. Further, temperature has a direct effect upon all the biological activities especially on the rate of development which was studied by Bhatia (1957),

who recorded dark coloured nymphs of *Schistocerca gregaria* at low temperature and were heavier than the nymphs hatched at the higher temperature. Ahmad (2007) recorded the gregarious behavior in *Choroedocus illustris* hoppers under different ecological factors. The economic importance of short horned grasshoppers viz., *Choroedocus illustris* and *Acrida exaltata* with prime focus on role of food plants, cannibalistic behavior, pest status and various important crops being damaged and their safety measures by means of biocontrol agents and other integrated pest management strategies has been described in comprehensive detail by various authors. (Ahmad, 2008, 2009; Ahmad & Nabi, 2012; Ahmad, 2012).

The incubation period and hatching time in acridoids in general were recorded by Bernays (1971) for *Schistocerca gregaria* which are of great

significance for study in other grasshopper pests. The temperature, moisture and food have been reported to play an important role in successful hatching. Similar observations were made by Ackonor (1988) on the role of soil moisture and temperature on hatching and survival in *Locusta migratoria migratorioides*. Amatobi (1996) studied egg development and nymphal emergence of *Kraussaria angulifera* in relation to rainfall which has been supportive of the fact that the species under study also has influence of rainfall and conversely on its hatching.

Bernays (1971b) provided details about hatching process with reference to temperature, moisture and food for *Schistocerca gregaria*. Temperature, moisture and food were reported to play an important role in successful hatching (Dempster, 1963). The incubation period of eggs in *Chrotogonus* has been inversely proportional to temperature and moisture, but moisture affects the viability of developing eggs as noticed by Grewal and Atwal (1968). Church & Salt (1952) studied the normal development of *Melanoplus bivittatus* at 12°C, while Hunter-Jones (1964) observed the reduction in hatching percentage at temperature extremes. Parihar & Pal (1978) attached significance to temperature on the development of eggs of surface grasshopper.

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