

Biology of the Introduced Ladybird Beetle, *Curinus coeruleus* Mulsant (Coleoptera: Coccinellidae)

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ABSTRACT

The biology of the coccinellid *Curinus coeruleus* Mulsant, introduced for the control of subabul psyllid *Heteropsylla cubana* Crawford was studied in the laboratory. The development period of *C. coeruleus* was completed in 33.2 to 40.3 days. Adult males lived for 54.3 to 123.8 and females for 37.9 to 112.6 days. The average fecundity was 715.8 eggs. The female to male sex ratio was 1:1.14.

Key Words : Biology, *Curinus coeruleus*, *Heteropsylla cubana*

Ladybird beetles form most important predators of the Homoptera. The subabul psyllid *Heteropsylla cubana* Crawford has posed serious threat to the cultivation of *Leucaena leucocephala* (Lam.) de Wit all over the tropics (Napompeth, 1990). In India, the pest was first noticed at Kattupakkam, Chengalpattu district of Tamil Nadu during February, 1988 (Gopalan *et al.*, 1988). The coccinellid predator, *Curinus coeruleus* Mulsant is a native of Mexico and has recently been introduced into India (Jalali and Singh, 1989). Nakahara *et al.* (1987) reported that *C. coeruleus* took 30.5 days to complete its life cycle under laboratory conditions in Hawaii, while Jalali and Singh (1989) observed the life cycle under constant temperature of $24 \pm 1.5^{\circ}\text{C}$ and *C. coeruleus* took 40-46 days from egg to adult. Since the available literature was scanty, this study was carried out on the biology of *C. coeruleus* and the results are presented.

MATERIALS AND METHODS

Adult beetles were collected from the subabul fields of the University of Agricultural Sciences, Bangalore and were kept in glass jars (9x18.5 cm) along with *H. cubana*-infested subabul twigs. The jars were covered with muslin cloth. Corrugated cards (4.5 x 2.5 cm) were

given for oviposition as suggested by Shands *et al.* (1970). This was necessary since the beetle prefers to lay eggs only in cracks or crevices. Eggs laid on the same day were kept in vials (15x75 mm) covered with muslin cloth and incubated under laboratory condition.

When the eggs hatched, the first instar grubs were fed with field-collected psyllid eggs and nymphs on subabul twigs. The feed was changed daily until the grubs pupated. The egg, larval and pupal periods were recorded. When the adults emerged, they were sexed. The last visible abdominal sternite of male is notched while in female it is not. (Fig. 1). A pair of male and female was kept in glass bottle (5x11 cm) and they were fed with psyllids. The precopulation, preoviposition, oviposition, postoviposition periods and longevity were recorded. Fecundity was calculated by taking daily egg count of five pairs of beetles by providing corrugated cards. Throughout the experiment maximum, minimum temperatures and relative humidity were monitored in the laboratory. Temperature ranged from 18°C to 31°C and relative humidity from 43% to 92% during the study. Life history was studied four times at different periods. The temperature ef-

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Table 1. Developmental period of immature stage. (In days \pm standard deviation) of *Curinus coeruleus* and prevailing room temperature and relative humidity during different rearing periods

Season	Stage	Egg	I instar larva	II instar larva	III instar larva	IV instar larva	Prepupa	Pupa	Egg to adult	Mean temperature ($^{\circ}$ C)	Relative humidity (%)
I. May-June (1989)		4.0 \pm 0.00	4.0 \pm 0.00	3.1 \pm 0.57	3.4 \pm 0.70	3.4 \pm 1.42	2.8 \pm 1.39	7.5 \pm 0.53	33.2 \pm 1.55	25.84 \pm 1.40	67.44 \pm 10.80
		10.8 \pm 0.63	2.5 \pm 0.53	4.5 \pm 1.51	4.9 \pm 0.74	7.7 \pm 0.67	2.2 \pm 0.42	7.7 \pm 0.48	40.3 \pm 2.36	22.83 \pm 2.25	51.21 \pm 6.99
III. May-June (1990)		7.1 \pm 0.32	4.6 \pm 0.83	3.0 \pm 0.47	4.0 \pm 0.00	7.0 \pm 0.67	2.0 \pm 0.00	6.9 \pm 0.32	34.6 \pm 0.97	24.84 \pm 1.63	69.77 \pm 3.66
		6.8 \pm 1.03	3.9 \pm 1.29	3.4 \pm 0.52	4.7 \pm 0.82	7.7 \pm 0.48	2.4 \pm 0.70	7.1 \pm 0.32	36.0 \pm 2.75	23.63 \pm 1.69	75.49 \pm 2.96
C.D(P=0.05%)		0.55	0.71	0.77	0.57	0.78	0.71	0.37	1.78		

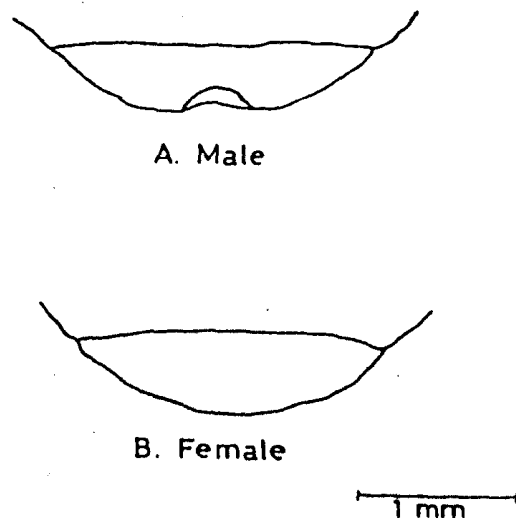


Fig. 1. Sexing in *Curinus coeruleus*: Figure shows eighth abdominal sternite

fect on different life stages was statistically analysed following Cochran and Cox (1950).

RESULTS AND DISCUSSION

The egg was smooth and elongate oval in shape. Freshly laid eggs were cream coloured but before hatching they became blackish. The egg measured 0.09 to 1.1 mm in length ($n = 10$) and 0.3 to 0.4mm in breadth ($n = 10$). Females oviposited in cracks and crevices on the sub-abul tree in the field. In the laboratory, eggs were laid in groups with eggs overlapping. Each group contained 1 to 41 eggs. The incubation period varied from 4 to 10.8 days (Table 1). This observation is in agreement with that of Jalali and Singh (1989) Who reported an egg period of 8 to 9 days.

First instar larvae were grey in colour. Head capsule black with lyrifiform ecdysial line. Pronotal shield with grey band on either side of the median line which is connected to the lateral bands by a transverse anterior marginal band. Pronotum with two senti (Sentus Sl-elongated cone-like projection of the body wall; bearing a few short stout setae on its trunk) on caudo-lateral margins on either side and with few setae. Mesonotum with two pairs of senti; metathorax with a pair of senti and

abdominal segments one to eight with three pairs of senti. Fifth to eighth abdominal sterna with three pinacula (Pinaculum sl.-a small flat chitinized area bearing one to four setae) arranged in a transverse row on either side. The inner pairs have two setae and the others bear one seta each. The ninth sternum has four pinacula, each bearing one seta. Spiracles are placed between sub-lateral and lateral senti on mesothorax and abdominal segments one to eight. Length varied from 1.4 to 2.1 mm and the breadth from 0.5 to 0.7 mm. This instar occupied 2.5 to 4.6 days.

Second instar larva was very similar to the first instar larva. The pronotal shield has a pair of blackish submedian longitudinal stripes, the apices of which extend laterally on the anterior margin connecting the lateral marginal stripe of the same colour. Pronotum has a pair of senti on either side with several setae (30). Fifth to eighth abdominal sterna have three pinacula arranged in a transverse row on either side. The outer and inner pairs of pinacula have two setae and the other pinacula bear one seta each. The ninth sternum has four pinacula, each bearing two setae. Larvae measured 2.7 to 3.2 mm in length and 0.7 to 0.8 mm in breadth. This instar took 3.0 to 4.5 days.

The third instar was darker than the second instar larva. The integument was roughened and the raised portions were piceous. The median line from prothorax to the ninth abdominal segment pale. The basal half of some of the senti, namely, sub-lateral of the first abdominal segments paler. Each abdominal segment has a depression between sub-median and sub-lateral senti. The pinacula on the sterna bear two to six setae. Larvae measured 4.4 to 4.7 mm in length and 1.5 to 1.7 mm in breadth. This instar occupied 3.4 to 4.9 days.

The fourth instar (final instar) varied in colouration from dirty white to dark brown with yellow and white patches. The setae which are numerous are black. In the darker specimens, the median line is paler, a spot on either side of median line mesad of sub-lateral senti on

mesothorax is yellow surrounded by dark brown. A sub-lateral longitudinal line from abdominal segment one to four, posteriorly connected by a transverse white band enclosing the posterior margin of third and anterior margin of fourth segment is present. Length varied from 5.3 to 6.7 mm and the breadth 1.8 to 2.2 mm. This instar occupied 7.0 to 8.4 days.

The final instar larva stopped feeding and searched for a suitable place where it remained stationary. This formed the beginning of prepupal stage. The caudal region was firmly attached to the substratum, the body was shrunken and curved. Length varied from 3.9 to 4.7 mm and breadth 2.3 to 2.5 mm. This instar occupied 2.0 to 2.8 days.

Pupa remained within the last larval exuvium for the most part which had split lengthwise dorsally but was not shed and was held in position by the eversible sucker like process on the last abdominal segment of the larva. The pupa was orange with segmentally arranged dark brown patches on its exposed area. The pupa has a pair of spiracles each borne on a reddish conical process one on either side of the first abdominal segment. The pupal length varied from 4.2 to 4.5 mm and breadth 3.1 to 3.4 mm. Pupal period lasted for 6.9 to 7.7 days. The average period required for completion of a life cycle was 33.2 to 40.3

Table 2. Adult longevity of *Curinus coeruleus* (in days \pm standard deviation) on *Heteropsylla cubana*

Rearing period	Longevity in days	
	Male	Female
Jun - Aug (1989)	94.2 \pm 6.25	74.1 \pm 6.08
Feb-April (1990)	54.3 \pm 4.57	37.9 \pm 5.13
Jun - Aug (1990)	123.8 \pm 7.24	112.6 \pm 6.47
Aug - Oct (1990)	88.9 \pm 8.20	69.1 \pm 7.75
C.D (P = 0.05 %)	5.93	5.64

Table 3. Duration of different reproductive stages, fecundity and hatchability of *Curinus coeruleus* on *Heteropsylla cubana*

Reproductive parameters	<i>H. cubana</i>
Precopulation period (days)	6.4 ± 1.34
Preoviposition period (days)	8.4 ± 1.67
Oviposition period (days)	50.0 ± 4.06
Eggs / female	715.8 ± 218.59
Eggs / female / day	14.15 ± 3.23
Hatchability %	87.32
Postoviposition period (days)	4.0 ± 2.35

days, the findings are similar to that of Jalali and Singh (1989).

Elytra of freshly emerged adults were white in colour and soft. After three to four hours, they hardened and turned metallic blue. The male measured 5.0 mm in length and 4.45 mm in breadth. Males lived for 54.3 to 123.8 days (Table 2). Female measured 5.25 mm in length and 4.41 mm in breadth. Females lived for 37.9 to 112.6 days. The female to male sex ratio was 1:1.14 in the laboratory.

Precopulation period varied from 5.0 to 8.0 days in females (Table 3). Preoviposition period varied from 7.0 to 11.0 days and post-oviposition period from 2.0 to 7.0 days. Fecundity of the female ranged from 504 to 1049 eggs. The mean number of eggs laid per female was 715.8. The maximum number of eggs laid per female per day was 41. The average hatchability was 87.32 per cent.

The present findings are in agreement with the previous work on this predator (Jalali and Singh, 1989; Rauf *et al.*, 1990). The morphological description presented in this paper will help in identification of the grubs in the field. The study also revealed that the predator had good attributes like high fecundity, high hatchability, longer adult longevity etc., which will be helpful in controlling the pest.

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