



Research Article

## Behavioral aspects of tachinid fly *Carcelia illota* Curran (Diptera: tachinidae) a larval pupal parasitoid of *Helicoverpa armigera* (Hubner.)

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**Abstract:** *Helicoverpa armigera* is a polyphagous pest. Its natural enemy is parasitoid tachinid fly, *Carcelia illota*. Behavioral aspects like mating and oviposition of *Carcelia illota* Curran, a larval pupal parasitoid of *Helicoverpa armigera* (Hubner) were studied. The pre-mating period in female ranged from 4 hours to three days. The mating time recorded was 15- 37 (mean  $22.23 \pm 5.59$ ) minutes. The pre-oviposition period ranged from six - nine (mean  $7.06 \pm 0.8$ ) days. The oviposition period ranged from four - nine (mean  $6.1 \pm 1.79$ ) days. Emergence of adults occurred during morning hours and duration ranged from 7- 36 (mean  $17.9 \pm 9.48$ ) seconds. Generally, the males emerged earlier than females.

**Keywords:** Behavior; mating; oviposition; adult emergence; *Helicoverpa armigera*; *Carcelia illota*

### Introduction

*Helicoverpa armigera* (Hubner) is highly polyphagous pest and is known to attack more than 180 cultivated and wild plants. *Carcelia illota* (Curran) is a larval ex-pupal parasitoid of *H. armigera* (Manjunath *et al.*, 1989). Some fundamental biological characteristics of *Carcelia illota* like mating, oviposition and emergence of adults have been attempted. This study will provide the basic data on behavioral aspects of the parasitoid; which will be useful for mass multiplication.

### Materials and Methods

The continuous rearing of host larvae *H. armigera* and its parasitoid, *C. illota* was maintained in the laboratory conditions with natural photoperiod and temperature on pigeon peapods. Mating and oviposition period in *C. illota* was studied in the laboratory by using more than one to three days old males and more than 4 hours or one-day-old females. They were released in breeding chamber of size (30.5X 30.5 X 30.5cm) (Figure 1), which was made of plywood, the top with wire screen & front side with 10 cm hole having cotton sleeve. The flies were in 10 pairs for observing the mating. The pair was also trapped in two plastic containers of same size (5 X 3cm), one container inverted on other with sugar cubes as food material for about two hours or until mating occurs. In breeding chamber sugar cane pieces, or sugar cubes were provided as food. Sometimes, containers were gently shaken to stimulate the flies for mating. They were also exposed to the morning sun for about two hours or until mating occurs. Mating (Figure 4) was studied by keeping in view the behavior before and after mating, pre-mating period, mating dance and female response. Food preference activities of both the sexes before and after mating were also

noted. Mating arrangement for *C. illota* adults was made as shown in figure 3. As soon as mating ends, female were kept separately in plastic containers or were released into 15X 15 X15cm size wire gauze cage (figure2), in which they were held until completion of gestation, the males being returned to the mating cage. The cages were provided with adequate humidity by placing cloth soaked with water.



Figure 1: *C.illota* mating chamber.

Oviposition was observed in breeding chamber referred above. For oviposition by females the 4th, 5th, or 6th instars larvae of *H. armigera* were placed on brush one by one. In another method used for egg laying, a mated female was placed in the plastic container of size (7.5 X 6.5 cm). It was then inverted over a host larva placed on a piece of blotting paper. Oviposition took place on the body of the host larva. Each parasitized larva was

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removed to an individual in plastic vials of size (5 X 3 cm) with food. Fresh host larva was exposed, the process repeated five times. Records were made on preoviposition period, host selection process, duration of oviposition and feeding after oviposition. Adult emergence was studied by keeping 25 parasitoid puparia in big plastic container of size (26 X 13 cm) on soil in small plastic lids of 6cm diameter. The actual process of emergence of adults and duration for the same was observed.



Figure 2: *C. illota* rearing chamber.

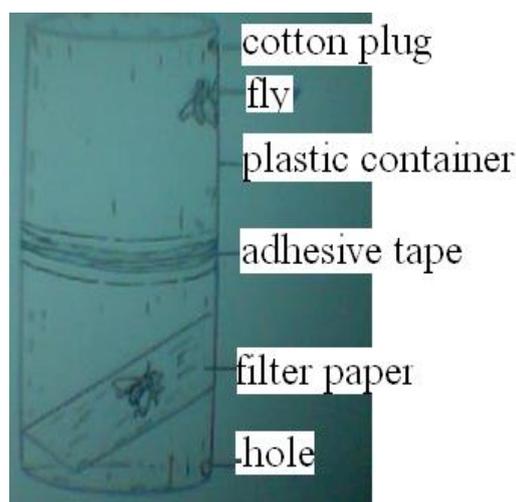


Figure 3: *C. illota* mating arrangement.

## Results

### Mating behavior (Fig.4.):

After completion of four hours to three days of pre-copulation period, female if interested, accepted the approaching male. In pairing, the initiative was taken by the male by jumping and mounting on her back, meanwhile maintaining the periodic vibrating movements of the wings. After about half a minute, the male slips back and turns the tip of his abdomen under that of the female. The latter shows acceptance (if virgin) by extruding her ovipositor, and allows the male to establish successively a closer contact and copulation occurs

rapidly. Mating was observed in the morning sunlight, under laboratory conditions in the afternoon in shade or evening sunlight. Reflected sunlight from mirror if adjusted on mating chamber stimulates pairing. Mating in males occurs once or twice in a day (multinuptial) and in female once (uninuptial).

The precopulation period in female (16 observations) ranged from four hours to three days with an average of 1.26 days, in case of male it was two to three days. The duration of mating (table 1) varied from 15 to 37 (mean  $22.23 \pm 5.59$ ) minutes (16 observations).



Figure 4: Mating in *C. illota*.

### Oviposition behavior (Fig.5):

Female deposits the eggs on dorsal side when the host larva is halfway inverted; it lays the eggs on head region near mouth, when host larva moves forward she quickly deposit the eggs on posterior end of the body. The gravid female remains quiet and calm in dark place particularly below the lower surface of host plant leaves or in corners of cages. The egg laying declines on the fourth day of oviposition in laboratory. During egg deposition, female feed on fluid that oozes out on attack by larva towards parasitoid and on frass. The pre-oviposition period (16 observations) ranged from six - nine (mean  $7.06 \pm 0.8$ ) days (table 1). The oviposition period (16 observations) ranged from four - nine (mean  $6.1 \pm 1.79$ ) days.

### Emergence behavior (Fig.6):

The newly emerged adult was soft and crumpled with a colorless integument and perfectly formed (though not fully pigmented) pubescence and bristles. It swallowed air to expand its body. The ptilinum, an inflatable membranous sac, is withdrawn inside the head within about 45 to 60 minutes. The newly emerged adults had soft and very small wing buds, which stretch and harden into wings. The average time required for spreading the wings (10 observations) ranged from 10 -15

minutes (mean  $12.5 \pm 1.74$  minutes). The genital part retracted inside which was outside at the time of emergence. The time recorded for complete emergence of adults (10 observations) ranged from seven to 36 (mean  $17.9 \pm 9.48$ ) seconds.



**Figure 5:** *C. illota* ovipositing on body of *H. armigera* larva.



**Figure 6:** Emergence of imago of *C. illota* from cocoon.

**Table 1:** Account on the behavioral aspects on mating, oviposition and emergence of adults of *C. illota*.

Behavior	Observations
<b>Mating</b>	
i. Precopulation period	4 hrs to 3 (mean 1.26) days in female, 2 to 3 days in male.
ii. Mating period	15 -37 minutes (mean 22.23 SD $\pm$ 5.59).
iii. Mating attempts	Male mated once or twice in a day (multinuptial), female uninuptial.
iv. Feeding after mating	Attracted towards food after some minutes.
<b>Oviposition</b>	
i. Preoviposition period	6 to 9 days (mean 7.06, SD $\pm$ 0.8)
ii. Oviposition period	4 to 9 days (mean 6.1, SD $\pm$ 1.79)
iii. Feeding after oviposition	Feed intermittently or after oviposition about 1/2 hrs. duration, feed on host fluid or frass.
<b>Adult Emergence</b>	
i. Time required for adult emergence	7 -36 seconds (mean 17.9, SD $\pm$ 9.48)
ii. Place of emergence	Through circular holes, irregular slits at anterior end
iii. Feeding after emergence	After about 1-2 hrs. Emergence duration
iv. Attracted towards	opposite sex After completion of pre oviposition period
v. Wings spread	After 10 to 15 minutes

## Discussion

*C. illota* male can mate with a second female after about 30 minutes of the first mating; male is multinuptial and female uninuptial as observed in *Eucellatoria armigera* (Sankaran and Nagraja, 1979). The mating behavior is similar to other tachinids observed earlier (Patel and Singh, 1972). The duration of mating period (table 1) recorded in *C. illota* is more than *Palexorista imberbis* Wied (10-30 minutes) and less than *Exorista fallax* Meign (four to 20 hours) (Achan *et al.*, 1968). The mating period recorded by them in *S. illota* (20–25 minutes) is not same (15-37 minutes). The average mating period recorded in present findings is more than *Goniophthalmus balli* Mesnil (12.48 minutes) (Patel and Singh, 1972). The pre-mating, mating, preoviposition and oviposition period recorded with this tachinid fly is the only recent attempt. The

data will be useful to identify the species and in mass propagation programme. There is further necessity of review of behaviors and statistical analysis of other tachinid parasitoids of *H. armigera*.

## References

1. Achan PD, Mathur KC, Dharmadhikari PR and Manjunath, TM, 1968. Parasites of *Heliothis* spp. In India, pp.129-149. Commonwealth Institute of Biological Control, Bangalore, India, Technical Bulletin No. 10, 155 pp.
2. Manjunath TM, Bhatnagar VS, Pawar CS and Sithanatham S, 1989. Economic importance of *Heliothis* spp. in India and an assessment of their natural enemies and host

- plants, pp.197-228. In *Proceedings of the Workshop on Biological control of Heliothis: Increasing the effectiveness of Natural Enemies*, E. G. King and R.D. Jackson (Eds.). 11-15 November, 1985. New Delhi, India. Far Eastern Regional Research Office, U.S. Department of Agriculture, New Delhi, India.
3. Patel RC and Singh R, 1972. Biology and breeding method of *Goniophthalmus halli* Mesnil (Diptera: Tachinidae) a larval parasite of *Heliothis armigera* (Hubn.). *Indian Journal of Agricultural Sciences*, 42 (8): 739-43.
  4. Sankaran T and Nagraja H, 1979. A note on *Eucelatoria* sp. near *armigera* (Coq.) (Diptera: Tachinidae). Imported from the U.S.A. for trial against *H. armigera* (Hubn.) (Lepidoptera: Noctuidae) in India. *Entomon*, 4 (4): 379- 381.

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