

Studies on mating and oviposition behaviour of *Campoletis chlorideae* Uchida on *Spodoptera frugiperda* (J. E. Smith)

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Abstract

Campoletis chlorideae Uchida (Hymenoptera: Ichneumonidae) is one of the solitary larval parasitoid *Helicoverpa armigera* (Hubner) and other lepidopterans. It is also reported on *Spodoptera frugiperda* (J. E. Smith) which is a recent serious pest of maize in India. The field experiment was conducted in maize fields located at Karveer taluka of Kolhapur district, Maharashtra during rabi 2020-21 to collect samples of *C. chlorideae* and *Spodoptera frugiperda*, whereas the laboratory experiment was carried out in the Research laboratory, Department of Zoology, Shivaji University, Kolhapur, Maharashtra to study the mating and oviposition behaviour of the larval parasitoid *C. chlorideae* on *S. frugiperda*. Prior to copulation, the adult male *C. chlorideae* wings vibrate rapidly and antennae moved up and down until it made contact with the female using his antennae. The adult male mounts the adult female, stops vibrating his wings, and steps backward slightly bending his abdomen to achieve genital contact. For few minutes, the adult male maintains the typical copulatory posture, with his abdomen bent at a ninety-degree angle. The mated adult females are restless and in search of host for oviposition. The adult female *C. chlorideae* extends her antennae over and around the *S. frugiperda* larva and parasitizes quickly. Multiple stabbing was also observed on a single host larva.

Keywords: *Campoletis chlorideae*, *Spodoptera frugiperda*, maize, parasitoid, oviposition, mating

Introduction

The larval parasitoid, *Campoletis chlorideae* Uchida (Hymenoptera: Ichneumonidae) is well known to parasitize *Helicoverpa armigera* (Hubner) and other lepidopterans (Dhillon and Sharma, 2011) [2]. It is also recorded on *Spodoptera frugiperda* (J. E. Smith) which is a serious pest of maize in India (Shylesha *et al.*, 2018 [6]; Sharanabasappa *et al.*, 2019) [6, 5] as well as other neighbouring countries. The biology of *C. chlorideae* was also reported on the host, *S. frugiperda* (Kamble and Jadhav, 2023) [3]. The duration of egg, larval and pupal period were 1.4 ± 0.11 , 6.9 ± 0.20 days and 6.2 ± 0.14 days, respectively. The sex ratio was 1:3.2 (M:F), while the adult male and female longevity were 6.27 ± 0.42 and 7.07 ± 0.38 days, respectively (Kamble and Jadhav, 2023) [3]. Keeping in view its biological attributions, the present study was conducted to understand the mating behaviour of adults *C. chlorideae* as well as the oviposition behaviour of *C. chlorideae* on the larvae of *S. frugiperda*.

Material and Methods

The field collections of *Spodoptera frugiperda* (host) and *Campoletis chlorideae* (parasitoid) were carried out from the maize fields located at Karveer taluka of Kolhapur district, Maharashtra during rabi 2020-21 and brought into the Research laboratory, Department of Zoology, Shivaji University, Kolhapur, Maharashtra to study the mating and oviposition behaviour of the larval parasitoid *C. chlorideae* on *S. frugiperda*. The *S. frugiperda* egg masses collected from the field and reared in the laboratory to obtain the *S. frugiperda* larval culture. The young maize leaves were provided for feeding the larvae of *S. frugiperda*. The host larval culture was maintained at the research laboratory under controlled conditions (27 ± 2 °C and 65-85% RH). The cocoons of *C. chlorideae* were also collected from the maize fields and brought into the laboratory. The cocoons were individually placed in separate plastic vials (10 ml

capacity). The adult male and female parasitoid after emergence were released in the 2l plastic cages for mating and 10% honey solution was provided for feeding. The second instar larvae of *S. frugiperda* were provided for the oviposition purpose. The *C. chlorideae* parasitoid culture was maintained at 27 ± 2 °C, 70 ± 10 % RH. A single mated *C. chlorideae* and a single second instar larva of *S. frugiperda* were placed in the glass tube (15ml) for the purpose of oviposition. A total of 20 sets were utilized to study the mating and oviposition behaviour.

Results and Discussion

After emergence, adult male and females show different flying movement. The adult female exhibits normal movement, while the adult male began to move continuously in many directions. The adult males elevated the anterior portion of their bodies. Before copulation, the wings began to vibrate more and the antennae moved up and down. The adult male repeatedly vibrated his wings until it made contact with the female using his antennae. When female pheromone is present, all aspects of courtship behaviour and attempted copulation take place, and the male uses wing vibration to help him locate this odour source (Vinson, 1972; Dhillon and Sharma, 2009) [7, 1]. The adult male mounts the adult female, stops vibrating his wings, and steps backward slightly bending his abdomen to achieve genital contact. For about 120 seconds, the adult male maintains the typical copulatory posture, with his abdomen bent at a ninety-degree angle. When an adult female decides to stop mating, she advances and pulls the adult male with her in the copulatory posture. However, unless the male chooses to stop mating, this kind of activity by the female is insufficient to stop it. The adult male copulatory posture holds up a locking mechanism in the adult male genitalia (Dhillon and Sharma, 2009) [1].

A few hours after mating, the mated adult *C. chlorideae* female became restless and started searching for the appropriate host. When a single second instar larva of *S. frugiperda* is offered, the adult *C. chlorideae* female locates the *S. frugiperda* larva easily this might be due to the host odour. Similarly, Sathe and Santhakumar (1990) studied the saliva of host larva, intact host larvae, larval faeces and extracts of host larvae indicating the host finding is only olfactory by *C. chlorideae*. Similarly, Dhillon and Sharma (2009) [1] reported the female *C. chlorideae* travels more quickly till it reaches the host larvae after detecting the host odour. After locating the *S. frugiperda* larva, the adult female *C. chlorideae* extends her antennae over and around the *S. frugiperda* larva. It parasitizes quickly and moves away from the host *S. frugiperda* larva. The *C. chlorideae* decides the stabbing region before parasitization. After stabbing, the host *S. frugiperda* larva tries to move away faster. Sometimes, the *S. frugiperda* injures the *C. chlorideae* by biting at the time of repelling during the *C. chlorideae* contacts the host by antennae. The adult female parasitoid returns and parasitizes the same larval host once more if there isn't a new larval host nearby and three to seven stabbings were noticed on the same larva after a short interval from the first oviposition. Even though multiple stabbings were observed, only one parasitoid cocoon recovered from the host larva. Similar findings were

observed by Dhillon and Sharma (2009) [1] who reported during a single host and parasitoid interaction, a pause of 20 to 60 seconds and up to 7 stabbings were seen on the same larva of *H. armigera*.

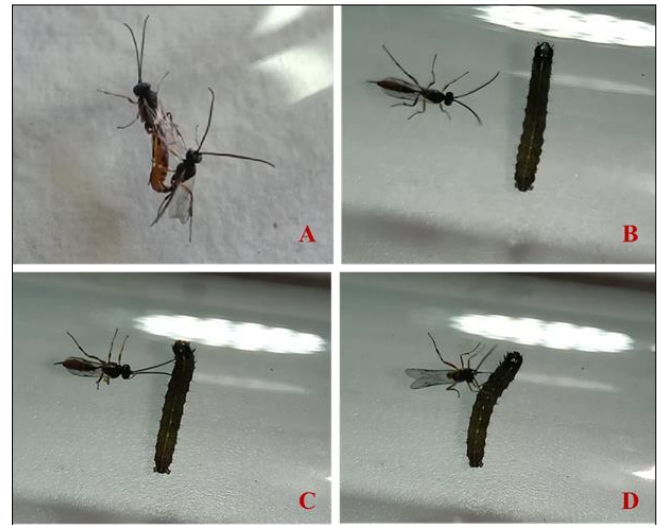


Fig 1: *Campoletis chlorideae*: Mating (A) and Interaction with *Spodoptera frugiperda* early instar larva during the oviposition (B, C & D).

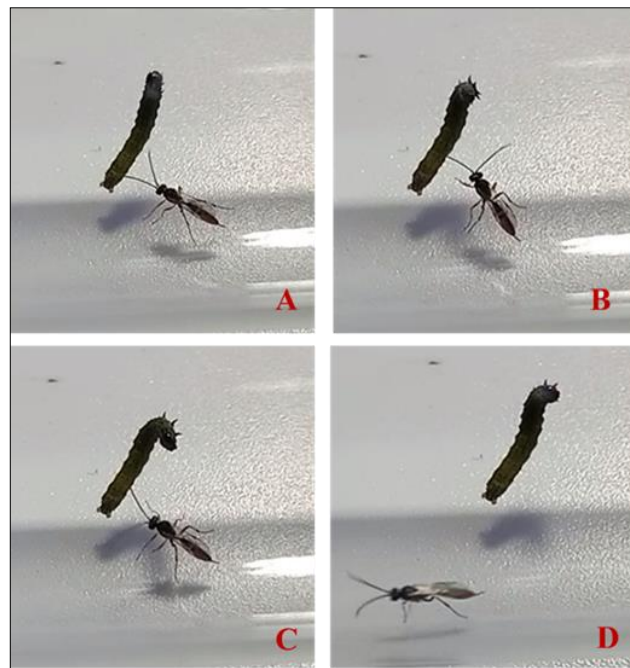


Fig 2: Behaviour of *Spodoptera frugiperda* larva to repel the parasitoid *Campoletis chlorideae* during the parasitization (A to D).

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Conflict of Interest

All authors declare no conflict of interest

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