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# BIOLOGY OF *CAMPOLETIS CHLORIDEAE* UCHIDA (HYMENOPTERA: ICHNEUMONIDAE) ON *SPODOPTERA FRUGIPERDA* (J E SMITH)

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**ABSTRACT**

**The field and laboratory studies were carried out to understood the biology of *Campoletis chlorideae* Uchida (Hymenoptera: Ichneumonidae) on *Spodoptera frugiperda* (J E Smith) (Lepidoptera: Noctuidae) on maize crop. Field collection of *C. chlorideae* cocoons and *S. frugiperda* larvae were carried out from nearby maize fields of Karveer taluka, Kolhapur district. The culture of *S. frugiperda* and *C. chlorideae* were maintained in laboratory at 27± 2ºC and 65-85% RH, respectively. The egg and larval period of *C. chlorideae* observed was 1.4± 0.11 and 6.9± 0.20 days; and pupal period was 6.2± 0.14 days, while longevity of male and female was 6.27± 0.42 and 7.07± 0.38 days, respectively.**

**Key words:** *Spodoptera frugiperda*, *Campoletis chlorideae*, maize, parasitoid, biocontrol, host, instars, lifecycle, egg, larva, cocoon, longevity

The fall armyworm *Spodoptera frugiperda* (J E Smith) is an invasive pest, economically destructive and native of tropical and subtropical regions of the Americas (Kumar et al., 2020). Being highly migratory in nature this pest had invaded into the African continent in 2016 and dispersed to >44 countries of the continent (Goergen et al., 2016; Cock et al., 2017; Rwomushana et al., 2018). This pest had also invaded the Indian subcontinent and was detected for the first time during mid 2018 in Karnataka found infesting maize (Shylesha et al., 2018; Sharanabasappa et al., 2018; Ganiger et al., 2018). It is a polyphagus pest and feeds on >350 plants including maize, and crops such as rice, sorghum, millet, sugarcane, vegetables and cotton (Abraham et al., 2017; Ganiger et al., 2018). *Campoletis chlorideae* Uchida (Hymenoptera: Ichneumonidae) is the most prominent biocontrol agent of the *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae) and other lepidopterans (Dhillon and Sharma, 2011). It has also been recorded on *S. frugiperda* (Shylesha et al., 2018; Sharanabasappa et al., 2019) and it prefers early instars for oviposition and pupates exterior of the host in the form of a cocoon (Pandey and Kumar, 2006). The present study focuses on biology of *C. chlorideae* on its host, the fall armyworm.

## MATERIALS AND METHODS

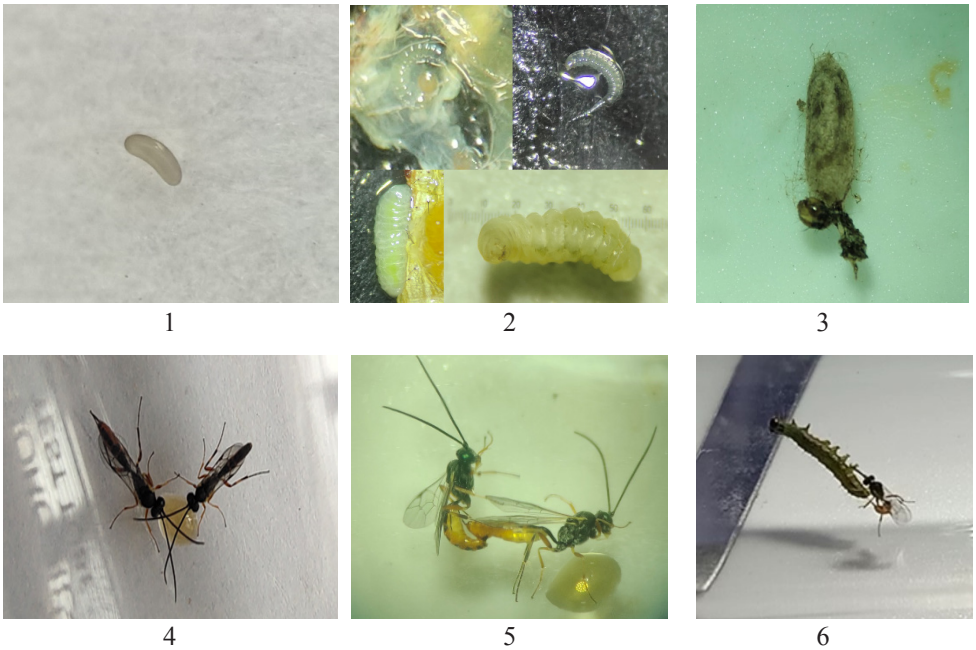
The field collections were carried out from nearby maize fields located at Karveer taluka of Kolhapur district of Maharashtra during rabi 2018-19, along with laboratory experiments in Department of Zoology, Shivaji University, Kolhapur, Maharashtra. The egg masses of *S. frugiperda* were collected and reared in the laboratory till pupation. After emergence, the moths were released in wooden cages (30 x 30 x 30 cm) and provided with 10% sucrose for feeding. Fresh and tender maize leaves were placed in the cage so that mated female moth will lay eggs on the surface of leaves. Egg masses laid by mated moths were collected and used for continuous mass rearing. The *S. frugiperda* culture was maintained at the laboratory under controlled conditions. The cages were kept at 27± 2ºC and 65-85%RH.

The *C. chlorideae* cocoons were also collected by visiting the maize fields and brought to the laboratory. The cocoons were individually kept in separate glass vials (15 ml capacity) to get the emergence of adult. After emergence, the male and female were released in the 2l plastic cages for mating, with 10% honey solution provided for adult feeding. These were transferred to the glass vials (15 ml capacity) for the purpose of oviposition. From the laboratory- maintained host culture, single second instar larva of *S. frugiperda* was provided to a single mated female parasitoid for the oviposition. The parasitized *S. frugiperda* larva was removed and placed in separate container and reared by providing fresh tender maize leaves. Thus, one by one second instar larvae of *S. frugiperda* were provided till the mated female stops oviposition. The culture was maintained at 27± 2°C, 70 ± 10% RH. At every

24 hr interval, larva was dissected under stereozoom trinocular microscope of magnification (8-50x) to study the developmental stages of *C. chlorideae*. In order to record the duration of egg, larval, and pupal stage, a set of 20 parasitized larvae were used for each stage. The longevity of adults was examined by keeping 15 individuals of each sex in separate glass vials (15 ml) provided with 10% honey solution until the death of parasitoid. The sex ratio was also recorded by estimating the ratio of male and female after emerging from the cocoons. The observations of biological attributes such as egg period, larval period, pupal period, longevity, sex ratio were statistically analysed further by using Microsoft Excel.

## RESULTS AND DISCUSSION

The growth and development of *Campoletis chlorideae* on early instars of *S. frugiperda* was analysed (Fig. 1-6). After dissecting the 24 hr parasitized larvae revealed the presence of parasitic eggs within the host body. The freshly deposited egg was pale brownish, elongated, broadly rounded at both ends, somewhat curved in the middle (Fig. 1). The egg period was 1.4± 0.11 days (n=20), and measured 0.4 mm long and 0.1 mm wide by using stage micrometer. The larva was found floating in the haemolymph within the body of *S. frugiperda* larva. In the larval stage, four instars were found (Fig. 2); newly hatched larva was creamy white, elongate and with a long tail, and 1.2x 0.3 mm in size. The second instar larva was caudate type, white, with shorter tail, and measured 2x 0.5 mm, while third instar was elongate, flattened, creamy white and hymenopteriform type in appearance, and measured 4 x 0.8 mm. The fourth instar larva was whitish, hymenopteriform, measuring 6x 1.2 mm. The total duration of the larval period was 6.9± 0.20 days (n=20). On the completion of larval stage, the larva come out of the host and pupate within the cocoon (Fig. 3); pupae are exarate cocoons, initially whitish then turned dirty white with black dots; pupal period was 6.2± 0.14 days, and pupa measured 5x 0.2 mm (n=20) The adult longevity ranged from 5-8 days, with male survival being less, ranging from 6.27± 0.42 and 7.07± 0.38 days, respectively, and with sex ratio of 1:3.2 (M: F) (n=15) These observations corroborate with those of Sharma and Dhillon, (2005) and Gupta et al., (2004). From the results, it can conclude that *C. chlorideae* can be used as biocontrol agent for effective control of fall armyworm in various crops. The data also provides details of the development's stages of *C. chlorideae*, their duration, morphology etc. The present study will also be beneficial for adopting further IPM (Integrated Pest Management) strategy to save maize and other crops and to enhance IPM applications for the benefits of farming community. It will be helpful to increase the crop protection and net returns to farmers.




Figs. 1-6. *C. chlorideae*, 1. Egg; 2. Larva; 3. Cocoon with host remnant; 4. Adults; 5. Mating; 6. Parasitization of host (*S. frugiperda*)

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**AUTHOR CONTRIBUTION STATEMENT**

The aforementioned experiment was carried out by VVK under the guidance of ADJ. The manuscript was written by VVK with the assistance of ADJ. In this study, ADJ and VVK both contributed equally.

**CONFLICT OF INTEREST**

All authors declare no conflict of interest.

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