

Original Research Article

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**Biology of Fall Army Worm, *Spodoptera frugiperda* (J. E. Smith)
(Lepidoptera: Noctuidae) on Maize Crop at Raipur (Chhattisgarh)**

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The field experiment were conducted at Research Cum Instructional Farm at IGKV, Raipur (C.G.) during kharif 2018, to know the biology of fall army worm, *Spodoptera frugiperda* on maize crop. The biology of fall army worm, *Spodoptera frugiperda* studied on genotype KSCH-972. Observation was made twice a day to record incubation, larval and pupal period separately. Gravid female was observed laying eggs with the fecundity 160-200 eggs in batches. Incubation, total larval and pupal period were observed to be from 2-4, 14-16 and 8- 10 days, respectively. The total life cycle of male and female was observed to be 29-35, respectively. Under laboratory conditions, the larvae fed on maize crop.

Introduction

Maize or corn (*Zea mays* L.) is a crop of global importance, which holds a unique position in world agriculture. Maize belongs to the family of Poaceae, originated from South America, from where it was taken to all parts of the world.

Its importance lies in the fact that it is not only used as human food and animal feed but at the same time it is also widely used in corn starch industry, corn oil production, and as

baby corn in different recipes. The leafy stalk produces ears which contain the grain, which are seeds called kernels. Maize kernels are often used in cooking as a starch. The six major type of maize are dent, flint, pod, popcorn, flour and sweet corn.

Even though 139 insect pests cause different degree of damage to maize crop, only about a dozen of these are entirely serious and require control measures like the moth group (which includes cutworms, armyworms, earworms, borers and grain moths) is the most damaging

to corn worldwide. The fall army worm is a lepidopteran pest that feeds in large numbers on leaves and stems of more than 80 plant species, causing major damage to economically cultivated grasses such as maize, rice, sorghum, sugarcane but also other vegetable crops and cotton. The literature on this pest is extensive (Ashley *et al.*, 1989). On maize, if 5% of seedlings are cut or 20% of whorls of small plants (during the 1st 30 days) are infested, it is recommended that an insecticide be applied (King and Saunders, 1984); on sorghum the pest threshold level is regarded as one (or two) larvae per leaf whorl and two per head (Pitre, 1985).

Studies on biology studies to help the finding pertaining to standardisation of natural diet for *S. inferens*, feasibility of delaying the egg hatching and standardisation of damage rating are also enumerated. The life cycle of important in managing insects because the habitat, habits and appearance of an insect may change dramatically through the course of a life cycle, depending on the form of life cycle.

Materials and Methods

The study was carried out in the laboratory at Department of Entomology IGKV, Raipur (C.G.) during 2018.

Insect culture

The insect larvae were collected from the infested maize plants from the experimental field and kept in transparent glass jars covered with a fine muslin cloth secured with rubber band. The larvae were transferred to another clean jar containing fresh food for every day till all the larvae pupated.

The pupae thus collected from each jar were kept separately in jars for the emergence of moth. The moths after emergence were kept

in ovipositional glass jars. The inner surface of jars was lined with a dark coloured paper sheet, which provided clear visibility of eggs on the surface. 10% honey solution on a cotton swab was placed in each jar for moth feeding.

Eggs laid on the bottom were collected for further multiplication and study. These eggs were used as nucleus culture for mass rearing of *Spodoptera frugiperda*. The egg diameter was measured by means of an ocular micrometer after calibration.

Biology of *Spodoptera frugiperda*

The biology of fall army worm, *Spodoptera frugiperda* was studied under $26^{\circ}\text{C} \pm 2^{\circ}\text{C}$ temperature and 70 ± 5 per cent RH. Two hundred eggs were collected from stock and kept in petri dishes for hatching. The newly emerged larvae were fed on newly emerged leaves of maize and later on food was changed daily. Observations regarding the moulting, duration, size and number of each larval instar, pupal period, adult longevity and fecundity were recorded.

Results and Discussion

The following biological parameters were recorded

Eggs

The eggs were found sticking to the underside of the leaves, in groups of about 160-200. The eggs were small, spherical and white in colour. The mass of eggs appeared fuzzy due to the scales of the female's body. The incubation period of the eggs under laboratory conditions ranged between 2 to 4 days with an average of 2.9 days. When the eggs are about to hatch the egg turns blackish which is the developing head of the larvae. They were hatched in two-three days (Fig. 1 and 2).

Table.1 Duration of different life stages of fall armyworm *Spodoptera frugiperda* on maize under laboratory conditions

Biological stages	Range (days)	Mean
Fecundity	160-200	179.8
Incubation period	2-4	2.9
Larval period	14-16	14.48
Pupal period	8-10	8.96
Male pupa	7-10	8.5
Female pupa	6-9	7.5
Total life cycle(Egg to Adult emergence)	29-35	31.83
Adult longevity		
Female	5-7	5.86
Male	4-6	4.9

Fig.1 Study of the biology of fall army worm, *Spodoptera frugiperda* in laboratory condition



Fig.2 Different life stages of fall army worm, *Spodoptera frugiperda*



Egg mass



1st instar larvae



2nd instar larvae



3rd instar larvae



4th instar larvae



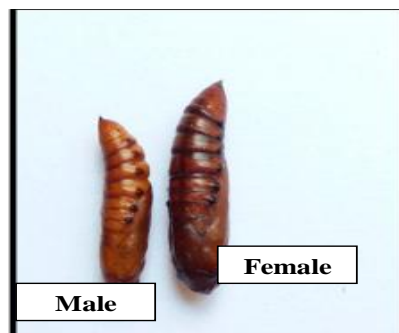
5th instar larvae



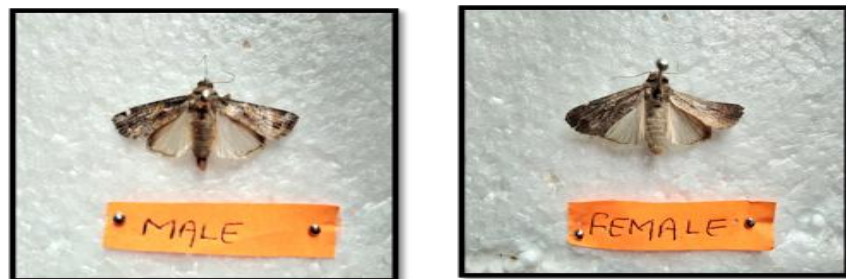
6th instar larvae



Pre- pupal stage



Pupa



Adults of *Spodoptera frugiperda*.

Larva

The Newly hatched larvae were tiny, black-headed with greenish-black spots with longitudinal stripes of a green to dark brown colour. Full grown larvae were recorded 3.2 - 3.5 cm long which secretes green colored fluid when disturbed. The larvae have eight prolegs and a pair of prolegs on the last abdominal segments and the black dorsal and spiracular lines. *S. frugiperda* late instar showing inverted “Y” on head capsule and four black dots in a square pattern on eighth abdominal segment was also recorded by Hardke *et al.*, 2015. Cannibalistic behaviour was also seen when ten larvae were kept in one plastic box. Jason & James 2001 also observed cannibalism in *S. frugiperda* larvae commonly even when food was not limiting, but occurred more frequently at low food quantities and/or high rearing densities. The sex of the larvae had no effect on the incidence of cannibalistic behaviour, however the probability of cannibalism occurring was affected by larval stage. The frequency of cannibalism was significantly higher among fifth and sixth- instar larvae than among earlier instars. The duration of the larvae was recorded for 14-16 days (Table 1).

Pre-pupal stage

Full grown larvae stop feeding and go through the pre-pupal stage which was around for 1-2 days. The pre-pupa position size is 1.9 cm.

Pupae

The newly constructed pupae was green in colour in this situation the movement present in the pupae. After 12-14 hours the pupae were changed to dark reddish brown in colour. Last abdominal segment terminates in two hooks. The sex of the caterpillar can easily be distinguished during this stage. The genital opening in female pupa was present on the 7th abdominal segment, near the septum of 7th and 8th segment while it was present on the 9th segment in case of male pupa. The male pupae measures about 1.3 cm and the female pupae measures about 1.5 cm. The duration of the pupal was recorded for 6-8 days. The total pupal duration ranged between 8-10 days with an average of 8.96 days in the laboratory. The duration of male pupa varied from 7 to 10 days, with an average of 8.5 days, whereas the duration of female pupa varied from 6 to 9 days with an average of 7.5 days. The duration of male pupa was slightly longer (8.5 days) than that of female (7.5 days).

Adult

In the adult the forewing is light brown, gray, and straw coloured in male and dark brown, gray in female with light and dark markings. The tip of each front wing had a distinct white spot. The mark on the male is more gray than the female and was more pronounced than a light diagonal marking on the observe, the

female was more brownish. The back wings were white. Adults live for 5 to 7 days.

The present findings are in agreement with the results of Sharanabasappa *et al*, (2018) who studied that on an average female moth laid 200-900 eggs in her life span. The Adult male and female survived for a period of 5-7 days with an average of 5.86 ± 4.9 days. The female is dark brown while the male is light brown than female. Sharanabasappa *et al*, (2018) who reported that the *Spodoptera* eggs were pale green for one day turned to golden yellowish and ultimately turned to black before hatching. The female covered a layer of scales on the egg mass and this gave moldy appearance. Incubation period ranged from 2-4 days with a mean of 2.90 days. The total larval period completed in twelve to sixteen days with an average of 14.48 days. The adult female period was 5-7 days and male period was 4 to 6 days, respectively with an average of 5.86 and 4.9. The present findings are also in agreement with the results of Sharanabasappa *et al*, (2018) who reported that at $20 \pm 2^{\circ}\text{C}$ fall army worm took longer time to developed. These findings are also in agreement with the findings of Naik *et al*, (2017) who studied that the, egg, larva, and pupal period lasted for 3.13, 16.34 and 8.48 days respectively, on soybean. Hardke *et al*, (2015) also observed cannibalistic behavior in larvae of *Spodoptera frugiperda* even when food was not limited, but was frequent at low fooding volumes and high rearing densitie as observed by Jason *et al*, (2001).

The frequency of cannibalism was significantly higher between fifth and sixth- instar larvae than among earlier instars (Hardke *et al.*, 2015). Cannibalistic behaviour was also observed in larvae of *Spodoptera frugiperda* even when food was not limited, but was frequent at low food volumes and high rearing densities observed by Jason *et al*, (2001). The frequency of cannibalism was

significantly higher between fifth and sixth- instar larvae than among earlier instars

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