

Biology of fall armyworm, *Spodoptera frugiperda* (J.E.Smith) (Lepidoptera : Noctuidae) on sorghum

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In India, occurrence fall armyworm (FAW), *Spodoptera frugiperda*, invasive pest was reported for the first time on maize from Karnataka by Sharanabasappa *et al.* (2018) during the month of May, 2018. Presence of FAW was observed during regular surveillance in maize fields at the College of Agriculture, Shivamogga and neighboring districts. Its occurrence was further confirmed in Karnataka and other states like Tamil Nadu and Telangana. Molecular diversity of fall armyworm, *S. frugiperda* was studied from different states of India and indicated prevalence of R-strain. India being a subtropical, cultivates most of graminaceous food crops such as maize, wheat, rice, sorghum, sugarcane and many minor millets in all parts of the country. The invasive pest though prefers maize but being polyphagous could turn out to be a potential threat to food security of the country. Further, biology of FAW as occurring in India is important for identifying the life stages and also for planning IPM strategies. Hence, this first study on the biology of FAW on sorghum under laboratory conditions was undertaken.

The present investigation was carried out at College of Agriculture, Rajendranagar during *Kharif*, 2019 under laboratory conditions. During the experimental period the average room temperature was maintained at $25 \pm 2^\circ\text{C}$ and relative humidity at $70 \pm 5\%$. The culture of FAW was initiated with larvae collected from maize fields at college farm. The collected larvae were reared on chick pea flour based artificial diet under ambient conditions. For larval feeding test, freshly hatched, neonate larvae, (0-12 hrs old) of *S. frugiperda* were used.

Neonate larvae of *S. frugiperda* were released individually in petri plates containing fresh leaves of sorghum. The larvae were reared on sorghum leaves till pupation. Fresh leaves of sorghum were brought to the laboratory in polythene covers and were cleaned in distilled water, shade dried and later sandwiched

between the two layers of blotting paper for removing the water. Then, the leaves were cut into small discs of around 7-8 cm diameter and placed in small petri plates of 9 cm diameter containing circularly cut moist filter paper, to avoid drying of leaf discs. Proper care was taken to prevent the escape of larvae by covering petri plates with tissue para film paper and the lid was tightly secured with the help of rubber band. Leftover food material along with excreta was removed daily. Fresh leaves of host plants were provided to larvae at every 24 hrs. interval. This process was continued until the larvae entered into final instar. The final instar larvae were collected and transferred into another jar containing sand for pupation. Pupae thus formed were collected and placed in small plastic jars and covered with muslin cloth for adult emergence. Each petri plate was examined daily for recording observations on larval period, pre pupal and pupal period.

To study the impact of sorghum on fecundity and adult longevity, a pair of freshly emerged healthy male and female adults that on sorghum leaves were released into plastic jars which were lined with yellow paper as substratum for egg laying and covered with white muslin cloth. The adults were fed with 10% honey solution soaked in cotton swab placed in plastic cup inside the jar which was replaced daily. The eggs laid on the yellow paper and white muslin cloth were collected daily till the female stopped laying eggs and placed in a separate jar for hatching. The eggs were counted daily using hand lens. Average number of eggs laid per female and per cent viability of the eggs were calculated. Observations were recorded at every 24 hrs. interval on pre oviposition period, oviposition period, post oviposition period, adult longevity of male and female, sex ratio, fecundity, incubation period etc. Data were analyzed statistically for calculating mean and standard deviation.

Table 1: Biology of fall armyworm, *Spodoptera frugiperda* on sorghum

S.No.	Stage of the insect	Mean±SD	Range
1.	Incubation period	2.47±0.051	2.00-3.00
2.	Larval period		
a.	I instar	2.40±0.063	2.00-3.00
b.	II instar	2.37±0.051	2.00-3.00
c.	III instar	2.23±0.051	2.00- 3.00
d.	IV instar	2.25±0.054	2.00- 3.00
e.	V instar	3.23±0.051	3.00-4.00
f.	VI instar	2.80±0.075	2.00-3.00
	Total larval period	15.30±0.167	13.00-17.00
3.	Pre pupal period	2.45±0.054	2.00-3.00
4.	Pupal period	7.88±0.075	7.00-8.00
5.	Adult longevity		
	Female	7.53±0.081	7.00-8.00
	Male	11.27±0.398	10.00-12.00
6.	Total life cycle		
	a. Male	34.35±0.543	32.00-38.00
	b. Female	39.00±0.591	37.00-42.00
7.	Pre oviposition period	3.34±0.116	3.00-4.00
8.	Oviposition period	3.42±0.147	3.00-4.00
9.	Post oviposition period	4.43±0.136	4.00-5.00
9.	Fecundity(no.)	686.68±9.252	606.00-764.00
10.	Sex ratio (M: F)	1:1.14	—

SD: Standard deviation

Results revealed that the incubation period of eggs was found to be 2 to 3 days with a mean of 2.47 ± 0.051 days (Table 1). Hatching of the eggs was observed in the early morning hours. These results were in accordance with the results of Barcelos *et al.* (2019). The larvae moulted five times and passed through six distinct instars till they pupated when reared on sorghum leaves under laboratory conditions. The duration of first instar larvae ranged from 2 to 3 days with a mean of 2.40 ± 0.063 days, second instar larvae ranged from 2 to 3 days with a mean of 2.37 ± 0.051 days, third instar larvae from 2 to 3 days with a mean of 2.23 ± 0.051 days. The larval period of fourth, fifth and sixth instars ranged from 2 to 3, 3 to 4 and 2 to 3 days with a mean of 2.25 ± 0.054 , 3.23 ± 0.051 and 2.80 ± 0.075 days, respectively. The total larval period of *S. frugiperda* varied from 13 to 17 days with a mean of 15.30 ± 0.167 days (Table 1). The present findings on total larval duration slightly deviated from the study of Barcelos *et al.* (2019). After completion of larval development, final instar larva stopped feeding and remained sluggish at one place and stretched its body, gradually forming a shield like structure which was considered as prepupal stage. The duration of prepupa ranged from 2 to 3 days with an

average of 2.45 ± 0.054 days. Barcelos *et al.* (2019) reported similar results. The pupal stage was resting stage, in which development of moth took place and the duration of pupa varied from 7 to 8 days with a mean of 7.88 ± 0.075 days. However, present findings on duration of pupae were in contrast with the results of Barcelos *et al.* (2019) who reported average pupal period as BRS 506 (12.00 ± 1.89 days) followed by BRS 509 (11.7 ± 0.71 days) and BRS 511 (11.6 ± 0.09 days) when *S. frugiperda* larvae were fed on varieties of sorghum. The female and male adult longevity recorded was 10 to 12 days and 7 to 8 days with a mean of 11.27 ± 0.398 days and 7.53 ± 0.081 days, respectively when the larvae were fed on sorghum leaves. Barcelos *et al.* (2019).

The total life cycle of female and male from egg to death of adult varied from 37 to 42 and 32 to 38 days with a mean of 39.00 ± 0.591 and 34.35 ± 0.543 days, respectively. Preoviposition, oviposition and postoviposition period ranged between 3 and 4, 3 and 4 and 4 and 5 days with a mean of 3.34 ± 0.116 , 3.42 ± 0.147 , 4.43 ± 0.136 days, respectively. Yashpalet *et al.* (2005) and Ashwiniet *et al.* (2016) reported similar results. Gravid female oviposition occurred during night-time under laboratory

conditions and the total number of eggs laid by a single female throughout its oviposition period was ranged between 606 to 764 eggs with a mean of 686.68 ± 9.252 eggs when reared on sorghum. The present study indicated very slight dominance of female population with a sex ratio of male to female as 1: 1.14 when fed on sorghum. Present findings are in close proximity with the results of Sharanabasappa *et al.* (2018) who reported the similar results on maize.

The findings of this study provide basic information about the biology of this recently invaded pest. Currently, the pest is spread to entire maize growing area of south India, including Maharashtra. Further spreading may occur as the pest is migratory. In the absence of maize, pest may shift to other hosts and survive and maintain the population in India throughout the year. Knowledge of the biology of fall armyworm on sorghum helps in the management of this insect.

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