



ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2021; 10(2): 643-646
© 2021 TPI
www.thepharmajournal.com
Received: 16-12-2020
Accepted: 22-01-2021

Sneha Tiwari
Department of Entomology,
College of Agriculture, Indira
Gandhi Krishi Viswavidyalaya,
Raipur, Chhattisgarh, India

Sonali Deole
Department of Entomology,
College of Agriculture, Indira
Gandhi Krishi Viswavidyalaya,
Raipur, Chhattisgarh, India

Studies on life cycle of fall armyworm, *Spodoptera frugiperda* (J.E. Smith) on maize at Raipur, Chhattisgarh

Sneha Tiwari and Sonali Deole

Abstract

The life cycle of fall armyworm, *Spodoptera frugiperda* (J. E. Smith) (Lepidoptera: Noctuidae) was studied by rearing *S. frugiperda* during *kharif*, 2019 under *in vitro* condition at the Bio-control Laboratory, Department of Entomology, College of Agriculture, IGKV, Raipur (C.G.). According to investigation the average life cycle of *Spodoptera frugiperda* took 34.5 ± 0.72 days in laboratory condition, when the host was sweet corn. There were six larval instars and the duration of larval stage was noted as 16.65 ± 0.16 days. The pupation period was noted 6.30 ± 0.14 days. Adult female longevity was observed as 9.05 ± 0.19 days, while the longevity of adult male was noted 6.15 ± 0.13 days.

Keywords: Biology, fecundity, instar, life cycle, *Spodoptera frugiperda*

Introduction

Maize (*Zea mays* L.) belongs to family Poaceae and is the world's third most important crop after rice and wheat. Due to high yield potential, wider adaptability and utility as food, feed and forage crop, maize signifies its importance.

The production of maize crop is affected by many factors and insects are one of the major factors that lower the production of the crop. The losses caused by insect pests in maize crop ranges from 5% to 15% (Kumar *et al.* 2018)^[8]. The major insects that affect the production of maize crop are; maize stem borer (*Chilo partellus*), termite (*Odontotermes obesus*), shoot fly (*Atherigona orientalis*), pink stem borer (*Sesamia inferens*), corn earworm (*Helicoverpa armigera*). Besides, there are nearly one dozen more pests which occur sporadically and cause considerable crop loss at times (Kumar *et al.* 2018)^[8]. But a more recent invasive species, *Spodoptera frugiperda*, commonly named fall armyworm (FAW), is now the major insect causing substantial yield losses in maize (Assefa and Ayalew, 2019)^[2].

Fall armyworm, *S. frugiperda* is an invasive pest with a high potential to spread rapidly due to its natural distribution capacity and represents a real threat to food security and livelihoods of millions of small- holder farmers. FAW is a polyphagous lepidopteran pest (Cruz *et al.* 2012)^[4]. It is known to cause serious damage to maize crops under warm and humid conditions (Clark *et al.* 2007, Luginbill 1928)^[3, 9]. Pannuti *et al.* (2015)^[15] reported that although young (vegetative stage) leaf tissue is suitable for growth and survival of FAW. Study of life history will give the needed informative background of the pest, so there is a need to study the life cycle of FAW to manage it efficiently. This study was proposed with the objective of obtaining information of the life cycle of FAW in sweet corn.

Materials and methods

The larvae of FAW were collected from the various fields of maize crop and the nucleus culture was maintained in laboratory conditions. For the maintenance of the nuclear culture, leaves of sweet corn (Sugar-75) were used and the egg masses were collected. The study was carried out in completely randomized block design and replicated 20 times. Each replication was performed by using individual larvae (*i.e.* 20 larvae per treatment = total of 60 larvae) under controlled conditions at an average temperature of 25 ± 1 °C. For investigation of life cycle of *S. frugiperda* on sweet corn, fresh leaves of sweet corn were collected from the fields and brought into the Bio-control Laboratory of the Department of Entomology, IGKV, Raipur (C.G.). The experiment was conducted by using Petri dishes. Each replication was performed intensively. Data were carefully observed for the study of life cycle of *S. frugiperda*.

Corresponding Author:
Sonali Deole
Department of Entomology,
College of Agriculture, Indira
Gandhi Krishi Viswavidyalaya,
Raipur, Chhattisgarh, India

The larvae were reared until they become adult. After adult emergence the male and female moths were separated and placed for mating in transparent jars, covered with a fine muslin cloth secured with a rubber band. The inner surface of the jars were lined with a black paper, which helped to provided clear visibility of eggs on the surface of jars, where the adults were regularly observed (oviposition). Eggs masses were collected and data were carefully observed for pre-oviposition, oviposition, post-oviposition and fecundity rate.

The eggs were allowed to hatch, then the neonates were carefully collected using a soft camel hair brush and were individually transferred in 20 Petri-dishes (In each Petri-dish, newly emerged leaves of sweet corn were supplied every morning to each larva as food and the leaves were renewed at 12 h intervals and wet cotton was used to keep the leaves turgid and fresh). Observations regarding the larval stage, *i.e.* larval period, number of instars was recorded. The larvae were fed till all they pupated and were collected from each jar. The duration was recorded. After adult emergence, male and female adult longevity was recorded.

The petridishes used in the experiment were thoroughly washed in detergent, treated with 2% formalin and then dried to check microbial contamination in the insect culture. The observations were taken at proper interval and the data were analyzed for calculating mean and standard deviation, subjected without transformation and statistically analysed with CRD using OPSTAT.

Results and discussion

Results pertaining to life cycle of *S. frugiperda* on sweet corn revealed that total life cycle period lasted for about 28 to 45 days with an average of 34.5 ± 0.72 days.

Description of different stages of *S. frugiperda*

Egg

The eggs were laid in cluster and covered by whitish scales. The incubation period was reported 2 days in all replications with an average of 2.00 ± 0.00 days, where the selected host was sweet corn. The incubation period of *S. frugiperda* was observed with an average of 2.63 ± 0.03 days on corn crop (Murua *et al.* 2008)^[1]. More or less similar incubation period were noted by Sharanabasappa *et al.* (2018), in maize crop ranged from 2 to 3 with an average of 2.50 ± 0.50 days.

Larva

It was observed that during the larval period of *S. frugiperda*, the caterpillar moulted for five times thus passed through six larval instars.

The duration of first instar larvae was noted 2 days in all the replications, with an average of 2.00 ± 0.00 days. Sharanabasappa *et al.* (2018) noted the duration of first instar larvae as 2 to 3 days with an average of 2.60 ± 0.49 days on maize crop. The duration of second instar larvae was varied from 2 to 4 days with an average of 3.00 ± 0.07 days. According to Igyuve *et al.* (2018)^[6] the mean duration of second instar larvae was 1.7 days on maize crop. Sharanabasappa *et al.* (2018) noted the duration of second instar larvae as 2 to 3 days with an average of 2.60 ± 0.49 days on maize crop.

The duration of third instar larvae was varied from 2 to 3 days with an average of 2.10 ± 0.06 days. According to Igyuve *et al.* (2018)^[6] the mean duration of third instar larvae was 1.5 days on maize crop. Sharanabasappa *et al.* (2018) noted the duration of third instar larvae as 2 days with an average of 2.00 ± 0.00 days on maize crop.

The duration of fourth instar larvae was varied from 2 to 3 days with an average of 2.10 ± 0.06 days. According to Igyuve *et al.* (2018)^[6] the mean duration of fourth instar larvae was 1.5 days on maize crop. Sharanabasappa *et al.* (2018) noted the duration of fourth instar larvae as 2 days with an average of 2.00 ± 0.00 days on maize crop.

The duration of fifth instar larvae was varied from 3 to 4 days with an average of 3.05 ± 0.05 days. Sharanabasappa *et al.* (2018) noted the duration of fifth instar larvae as 2 to 3 days with an average of 2.40 ± 0.49 days on maize crop.

The duration of sixth instar larvae was varied from 3 to 5 days with an average of 4.30 ± 0.12 days. According to Igyuve *et al.* (2018)^[6] the mean duration of sixth instar larvae was 3.7 days on maize crop. Sharanabasappa *et al.* (2018) noted the duration of sixth instar larvae as 4 to 6 days with an average of 4.50 ± 0.50 days on maize crop.

The total larval period varied from 16 to 18 days with an average of 16.65 ± 0.16 days, when the insects were reared in sweet corn. The larval period tends to be about 14 – 30 days has been reported (Pitre and Hogg, 1983), 14 to 19 days (Sharanabasappa *et al.*, 2018) in maize crop, which may fluctuated by weather condition.

Pre-pupa

The colour of body changed to light green, during the pre-pupal stage. The pre-pupal stage duration was varied from 2 to 3 days with an average of 2.10 ± 0.06 days.

Pupa

The newly developed pupa of *S. frugiperda* was soft and greenish in colour. The duration of pupal stage was varied from 5 to 8 days with an average of 6.30 ± 0.14 days. Pupal period was ranged from 9.0 to 12.0 days with an average of 10.50 ± 1.28 days (Sharanabasappa *et al.* 2018).

Adult

The size of female moth was slightly bigger than the male once. The forewings of female were less conspicuous, ranging from uniform grayish brown to delicate gray and brown spots. The male forewings were shaded with brown and gray scales, with a white triangular patch in the apical region and a circular spot in the middle of the wing. The hind wing was silver-white in both male and female, with a narrow dark margin.

Pre-oviposition period

The pre-oviposition period of female moths of *S. frugiperda* varied from 3 to 4 days with an average of 3.05 ± 0.05 days. Igyuve *et al.* (2018)^[6] and Prasanna *et al.* (2018) observed the pre-oviposition period of *S. frugiperda* as 3 to 4 days on maize crop.

Oviposition period

The oviposition period of female moths of *S. frugiperda* was reported 1 to 2 days with an average of 1.85 ± 0.08 days. The oviposition period was noted 2 to 3 days with an average of 2.8 ± 0.40 days on maize crop (Sharanabasappa *et al.* 2018).

Post oviposition period

After completion of egg laying, the female moths of *S. frugiperda* lived for 3 to 5 days with an average post-oviposition period 4.00 ± 0.07 days. Similarly the post-oviposition period was observed 4 to 5 days with an average of 4.30 ± 0.46 days on maize crop (Sharanabasappa *et al.* 2018).

Longevity of adults

The longevity of male moths ranged from 5 to 7 days with an average of 6.1 ± 0.8 days, while the longevity of female moths was ranged from 7 to 11 days with an average of 9.2 ± 0.9 days. The female adult survived for 10.80 days with a range of 9 - 12 days compared to male with a range of 7- 9 days with an average of 8.20 days (Sharanabasappa *et al.* 2018).

Fecundity

The egg laying capacity of female varied from 536 to 579 eggs with an average of 557.2 ± 2.81 eggs. Sharanabasappa *et*

al. (2018) noted that each female laid 835 to 1169 eggs with an average of 1064.80 eggs.

Total life span

The total life cycle of *S. frugiperda* occupied on an average of 33.1 ± 0.69 days ranging from 28 to 41 days in case of male, while 36.0 ± 0.75 days ranging from 30 to 45 days in case of female, when *S. frugiperda* was reared in fodder corn. The life span of male moth of *S. frugiperda* ranged from 32 to 43 days with an average of 37.50 ± 5.00 days, while in case of female moth this period ranged from 34 to 46 days with an average of 40.50 ± 4.88 days (Sharanabasappa *et al.* 2018).

Table 1: Biology of fall armyworm, *Spodoptera frugiperda* reared on three different genotypes of maize crop

Stages	Total life span		
	Sweet corn (Sugar 75)		
	Min	Max	Mean \pm SD
Incubation period	2	2	2.00 ± 0.00
Larval period			
1 st instar	2	2	2.00 ± 0.00
2 nd instar	2	4	3.00 ± 0.07
3 rd instar	2	3	2.10 ± 0.06
4 th instar	2	3	2.10 ± 0.06
5 th instar	3	4	3.05 ± 0.05
6 th instar	3	5	4.30 ± 0.12
Pre-pupation period	2	3	2.10 ± 0.06
Pupation period	5	8	6.30 ± 0.14
Male longevity	5	7	6.15 ± 0.13
Female longevity	7	11	9.05 ± 0.19
Total life cycle (Egg to adult)			
Male	28	41	33.1 ± 0.69
Female	30	45	36.0 ± 0.75



Fig 1: Egg



Fig 2: Larva



Fig 3: Pre-pupa



Fig 4: Pupa



Fig 5: Adult male



Fig 6: Adult female

Conclusion

The average life cycle of *Spodoptera frugiperda* took 34.5 ± 0.72 days in sweet corn in laboratory condition. There were six larval instars and the duration of larval stage was noted as

16.65 ± 0.16 days. The duration of pupation period was observed 6.30 ± 0.14 days. Longevity of adult female was observed as 9.05 ± 0.19 days, while the longevity of adult male was noted 6.15 ± 0.13 days.

Acknowledgement

The authors are thankful to the in-charge of Bio-control Laboratory for providing the necessary facilities for carrying out this study and constant encouragements. Thanks are also due to the Department of Entomology, IGKV, Raipur (C.G.) for financial support.

References

1. Abraham S, Head GP, Juarcz ML, Murua MG, Prieto S, Vera MT *et al.* Fitness and mating compatibility of *Spodoptera frugiperda* (Lepidoptera: Noctuidae) populations from different host plant species and regions in Argentina. *Annals of the Entomological Society of America* 2008;101(3):639-649.
2. Assefa F, Ayalew D. Status and control measures of fall armyworm (*Spodoptera frugiperda*) infestation in maize fields in Ethiopia: A review. *Cogent Food & Agriculture* 2019;5:1-16.
3. Clark PL, Molina-Ochoa J, Martinelli S, Skoda SR, Isenhour DJ, Lee DJ, *et al.* Population variation of the fall armyworm, *Spodoptera frugiperda*, in the western hemisphere. *Journal Of Insect Science* 2007;7(5):5.
4. Cruz I, Figueiredo MDLC, Silva RBD, Silva IFD, Paula CD, Foster JE. Using sex pheromone traps in the decision-making process for pesticide application against fall armyworm, *Spodoptera frugiperda* [Smith] (Lepidoptera: Noctuidae) larvae in maize. *International Journal of Pest Management* 2012;58(1):83-90.
5. Hogg DB, Mulrooney JE, Pitre HN. Fall armyworm (Lepidoptera: Noctuidae) oviposition: crop preferences and distribution on plants. *Journal of Economic Entomology*, 1983, 463-466.
6. Igyuve T, Ochigbo AE, Ojo GOS, Ugbaa MS. Fall armyworm (*Spodoptera frugiperda*); its biology, impact and control on maize production in Nigeria. *Nigerian Journal of Crop Science* 2018;5(1):70-71.
7. Kalleshwaraswamy CM, Maruthi MS, Pavithra HB, Deshmukh S. Biology of invasive fall army worm, *Spodoptera frugiperda* (J. E. Smith) (Lepidoptera : Noctuidae) on maize. *Indian Journal of Entomology* 2018;80(3):540-543.
8. Kaur J, Kumar P, Lakshmi SP, Sekhar JC, Suby SB. Pests of maize and their management 2018, 51-79.
9. Luginbill P. Fall Armyworm. United States Department of Agriculture, Washington, DC, U.S.A 1928.
10. Pannuti L, Baldin E, Hunt TE, Paula Moraes S. On plant larval movement and feeding behaviour of fall armyworm (Lepidoptera: Noctuidae) on reproductive corn stages. *Environmental Entomology* 2015;45(1):192-200.
11. Prasanna B, Huesing J, Eddy R, Virginia R. Fall armyworm in Africa: A guide for integrated pest management. USAID and CIMMYT, Mexico 2019;5:15-20.