

## Biology of Fall Armyworm, *Spodoptera frugiperda* (Lepidoptera: Noctuidae) A New Alien Invasive Pest in Pakistan

Muhammad Ramzan<sup>1\*</sup>, Dilawar Abbas<sup>2</sup>, Firdaus Kauser Bukhari<sup>3</sup>, Shahid Mehmood<sup>2</sup>, Arslan Javed<sup>2</sup>, Zohair Abbas<sup>4</sup>, Muhammad Adeel Ghafar<sup>2</sup>, Muhammad Zaheer<sup>5</sup>

<sup>1</sup>State Key Laboratory for Biology of Plant Diseases and Insect Pests, Institute of Plant Protection, Chinese Academy of Agricultural Sciences Beijing 100193, China

<sup>2</sup>Department of Entomology, University of Agriculture, Faisalabad

<sup>3</sup>Institute of Pure and Applied Biology, Bahauddin Zakariya University, Mutan

<sup>4</sup>Department of Entomology, ARID Agriculture University Rawalpindi

<sup>5</sup>Department of Agronomy, Faculty of Agriculture, Faisalabad, Pakistan

\*Corresponding Author E-mail: [ramzan.mnsua@gmail.com](mailto:ramzan.mnsua@gmail.com)

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### ABSTRACT

Fall armyworm, *Spodoptera frugiperda* is most destructive pest of agricultural crops especially maize all over the world. The pest has got primary pest status due to high feeding, migration and reproduction potential. The present study was conducted to check the biology of *S. frugiperda* under laboratory conditions. The flattened and pale green eggs were laid by female which turn golden yellow and then black prior to hatching. The mean number of eggs laid by female were  $981.76 \pm 99.67$ . The incubation period of pest was 2-3 days. There were six larval instars which lasted for about 14-18 days. The duration periods of first, second, third, fourth, fifth and sixth larval instars were  $2.23 \pm 0.56$ ,  $2.29 \pm 0.59$ ,  $1.50 \pm 0.58$ ,  $1.53 \pm 0.69$ ,  $2.35 \pm 0.65$  and  $3.60 \pm 0.97$  days, respectively. Pupa was obtect. The female longevity was greater than male while male body length was small as compared to female. The average wingspan of female and male was 3.10 and 3.14 cm, respectively. Fall armyworm, *Spodoptera frugiperda* is serious pest of maize crop and attain status of primary pest.

**Keywords:** *Spodoptera frugiperda*; Noctuid moth; Invasive pest; Life cycle; *Zea mays*; fodder crops.

### INTRODUCTION

Fall Armyworm (FAW), *Spodoptera frugiperda* (Lepidoptera: Noctuidae) is a polyphagous pest of various host plants like agricultural crops including maize, cotton,

rice, soyabean, sorghum, millet, sugarcane and many different kinds of grasses (Nabity et al., 2011). The larvae of pest attack on all plant parts and cause maximum damage (Pogue, 2002; Nagoshi, 2007; & Bueno et al., 2010).

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It is native to tropical and subtropical areas of the globe (Prowell et al., 2004; & Clark et al., 2007).

First time the current *Spodoptera* species has been identified and reported from Africa in 2016 and spread in many countries in a very short period of time. The infestation of the pest has been reported from various countries, including Africa, India, China, Korea, Thailand, Japan, Australia, Indonesia, Egypt and Philippines (Goergen et al., 2016; Sharanabasappa et al., 2018 & Igyuve, 2018; & Gamil, 2020). The current pest has caused significant economic crop losses in African countries and many more in the world. It can cause the main reason of hunger in coming days in various countries especially African.

In Pakistan 2019, the pest has been collected from maize fields and identified to species level and named *Spodoptera frugiperda* (Naeem-Ullah et al., 2019). It has been considered a primary pest of maize crop, but now becoming serious threat to others agricultural and horticultural crops in the world especially country (Pakistan). The adaptation of proper management strategies to control this pest is very important in the country. The proper management strategies could be possible with the knowledge of its all mature and immature stages. So, the biological study of *S. frugiperda* was carried out under controlled conditions for planning IPM strategies against it.

## MATERIALS AND METHODS

### Collection and rearing

The larvae were collected from the maize fields located near Muhammad Nawaz Shareef University of Agriculture, Multan and brought to the laboratory with maize leaves for rearing purposes. The collected larvae were kept in plastic containers with maize leaves and food changed after three days of interval until larvae reach to pupation. The pupae were separated from culture and kept into separate containers for adult emergence. Pupae were checked on a daily basis until adults emerged. Two pairs of adults were kept in adult rearing cage for obtaining eggs culture. The obtained culture was further tested in the study.

### Study design

The research work was performed under controlled conditions ( $26 \pm 1^\circ\text{C}$ ). Each stage of the pest was observed and noted during the study. At 12 hours of egg laying intervals, eggs were collected and transferred to petri dishes. There were three replications and each replication consists of 100 eggs, which observed on a daily basis to check the embryonic period, hatching time and percentage (%age). After eggs hatch, equal size or age new emerged 100 larvae were randomly selected from culture and shifted into petri dishes containing maize leaves for food with the help of a camel hair brush. There were five replications and each replicate containing 20 larvae. The larvae were observed and time duration recorded on a daily basis until reaching to pupation. The fleshy pupate larvae were collected within the same day of pupation and placed in separate petri dishes and one pupa/petri dish. There were four replications and each consists of 20 pupae. The developmental parameters such as pupal period, weight and adult emergence (%age) were recorded. Five pairs of adults were shifted into the adult rearing cage. There were five replicates (two moths (1 male: 1 female) / replicate). The adult survival, number of eggs laid by single female and adult longevity were recorded. The ovipositional periods were also observed and recorded.

### Data analysis

The standard errors of collected data were analysed by using equations given by Campbell et al. (1974).

## RESULTS AND DISCUSSION

Fall armyworm (FAW), *Spodoptera frugiperda* is belongs to order lepidoptera, native to tropical and subtropical countries including Pakistan and America. Now the pest has been widely distributed including Pakistan (Ramzan et al., 2021). It has been reported that more than 80 plant species including grasses, agricultural and horticulture crops attacked by early as well as later instars of FAW. Other researcher (Montezano et al., 2018) had reported more than 350 plant species

belonging to different botanical families the most preferable hosts of pest. The most infested crops are cotton, maize, soyabean, millet, sorghum, sugarcane and rice (Casmuz et al., 2010; Silva et al., 2017; & CABI, 2018).

Among mentioned crops, maize/corn is the most preferable host plant of FAW (Maruthadurai & Ramesh, 2020) in all maize growing areas of the world including Pakistan. It has caused significant maize losses in various countries such as Africa (Georgen et al., 2016; & Sisay et al., 2018). The vegetative as well as reproductive stages of maize crop are attack by each larval instars. The complete defoliation or death of crop occurred during high population of larvae. The similar findings had been discussed by early scientists (Georgen et al., 2016; & Sisay et al., 2018).

The damage percentage or reduction of maize crops due to attack of FAW varies according to geographical distribution. In India, 12% to 74% corn losses had been reported (Maruthadurai & Ramesh, 2020) while 9% and 62% in Goa and even 6% to 100% reported in Karnataka (Mallapur et al., 2018; Sharanabasappa et al., 2018; & Shylesha et al., 2018). The sorghum was highly infested by larvae of pest because the characteristics of sorghum is similar to the characters of maize crops.

Eggs are given in batches on upper as well as lower side of leaves as laid by other *Spodoptera* species. The flattened and pale green eggs were laid by female which turn golden yellow and then black prior to hatching. The incubation period of pest was 2-3 days and variations in embryonic period may

be due to climatic conditions or geographical distribution. The total life period from egg to adult formation was 32-45 days which is similar to the findings of Ramzan et al. (2021). Sharanabasappa et al. (2018) had reported the similar results about embryonic period and colour of eggs. The mean number of eggs laid by female were  $981.76 \pm 99.67$ .

There were six larval instars had been reported and some researchers reported 5 larval instars. During the study,  $2.23 \pm 0.56$ ,  $2.29 \pm 0.59$ ,  $1.50 \pm 0.58$ ,  $1.53 \pm 0.69$ ,  $2.35 \pm 0.65$  and  $3.60 \pm 0.97$  days, respectively were the average mean of first, second, third, fourth, fifth and sixth larval instars. The total larval period (1<sup>st</sup>-6<sup>th</sup>) was 14-18 days. The larval length and width could be varying according to food quality and climatic condition. Cunha et al. (2008) had reported the similar findings. The current pest is considered most destructive and primary pest of various crops due to high reproductive potential and migration. Our findings are in line with the agreement of early studies (Nagoshi and Meagher 2008). The female was long lived as compared to male. The longevity of female may be due to various factors such as more consumption of food at larval stage or may be consumption of her eggs which become the source of energy that help her in longevity. The length of male was small as compared to female while female wingspan was short than male. The average wingspan of female and male was 3.10 and 3.14 cm, respectively. Biology of FAW, *Spodoptera frugiperda* reared on maize leaves under laboratory conditions is given (Table 1).

**Table 1: Biology of FAW, *Spodoptera frugiperda* reared on maize leaves under laboratory conditions**

Stages	Maize	
	Mean±SD	Range
Embryonic period	2.99 ± 0.11	2-3 days
Larval period	13.66 ± 0.35	14-18 days
1 <sup>st</sup> instar	2.23±0.56	2-3 days
2 <sup>nd</sup> instar	2.29±0.59	2-3 days
3 <sup>rd</sup> instar	1.50±0.58	2 days
4 <sup>th</sup> instar	1.53±0.69	2 days
5 <sup>th</sup> instar	2.35±0.65	2-3 days
6 <sup>th</sup> instar	3.60±0.97	4-5 days
Pupal period	9.00 ± 0.42	9-11 days
Fecundity	981.76±99.67	900-1100
Total life cycle	30.43±0.39	32-45 days

It has been observed that each larva fed maize leaves vigorously and proved most destructive pest. The moths (male and female) are nocturnal and active at night time while hide under the leaves or leaf litter at day time (Kalleshwaraswamy et al., 2018). There is need to monitor the pest by using different traps in infested crops because monitoring is an integral part of integrated pest management (IPM) strategies (Murtaza et al., 2019). Among these strategies, the best strategy should be adopted to control this noxious pest. The different management strategies are tested to control various *Spodoptera* species especially *Spodoptera litura* and many other lepidopteran pests (Ramzan et al., 2019).

#### Conflict of interest

Authors have no conflict of interest.

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#### CONCLUSION

The pest has high migrating and reproductive potential which attack more than 353 plant species especially maize crops. The early as well as later instars are highly damaging stage. The reproductive and vegetative stage of maize crop could be infested by larvae which cause maximum crop damage.

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