



Occurrence, Damage Pattern and Developmental Parameters of *Spodoptera Frugiperda* on Corn in Pakistan

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Abstract: Fall armyworm, *Spodoptera frugiperda* belonging to family Noctuidae of order Lepidoptera, native to Americas. Recently, it has been reported from Pakistan as an invasive alien species and causing severe economic losses. An experimental study was conducted to check the occurrence, damage pattern and developmental parameters of this invasive alien species on maize. The biological studies showed that incubation period, total larval and pupal period were recorded 2, 10 and 7 days, respectively. Total life period from egg to adult was recorded 33-34 days (2 + 10 + 7 d) the range not given? on maize while a single female can lay about 289-300 eggs in her whole life duration. The larval weight and survival % were 0.545 g and 80 % on maize, respectively while pupal weight and survival % were recorded 0.123 and 76%, range respectively. The infestation of FAW was observed on maize in all study area. The percentage infestation was recorded 15-50% on maize. The results concluded that pest is very destructive for horticultural and agricultural crops in the study area. The current parameters can prove fruitful in the management of this emerging insect pest in the country (Pakistan).

Keywords: Invasive alien species, *Spodoptera frugiperda*, Life history, Biological parameters, Host plants.

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INTRODUCTION

Fall armyworm (FAW), *Spodoptera frugiperda* is a destructive pest which causes up to 34% yield losses, native to the tropical and subtropical areas of the globe (Prowell *et al.* 2004; Figueiredo *et al.*, 2005; Clark *et al.*, 2007; Lima *et al.*, 2010). Many host plants have been reported that attacked by this noxious pest in the globe (Montezano *et al.*, 2018) such as corn, rice, soybean, sorghum, cotton and many grasses. These host

plants are frequently infested by *Spodoptera frugiperda* larvae all over the world and consider its major host plants (CABI 2018; Montezano *et al.*, 2018; Casmuz Augusto *et al.*, 2010; Goergen *et al.*, 2016).

This polyphagous pest has been spread in many countries of the world and becoming major threat to food security and starvation. Two strains of this pest have been reported that differ from each

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other on the basis of food source such as corn and rice strains. Rice strain only attack on the rice and grasses while corn strain on corn, cotton and sorghum (Dumas *et al.*, 2015). In Pakistan 2019, corn strain has been recorded on corn crop (Naeem-Ullah *et al.*, 2019). Now, it has been distributed in all Province of Pakistan which highly infested the maize crop.

In Pakistan, *S. frugiperda* could possibly move to other agricultural crops such as wheat and mustard. By keeping the current scenario of pest on corn, pest can attack on all other coming crops and considered serious threat to food security and crop production (Wu, 2020) resulting the reduction in gross domestic product (GDP). Not a single study about biology, ecology, damage pattern of *S. frugiperda* and effect of host plants has been carried out in Pakistan till to date.

The basic knowledge about ecology, biology, habitats and damage pattern of *S. frugiperda* is very important to develop effective management strategies against this destructive pest in the country. The current study was conducted to check the occurrence and damage pattern in and lab while biological parameters under controlled conditions.

MATERIAL AND METHODS

Field survey and Collection of larvae

A field survey was conducted in all tehsils of Multan to check the infestation of FAW in maize. From each tehsil, three different maize fields of 1 acre were selected and ten plants were thoroughly examined from each selected acre to check the percentage damage. The damage of FAW was counted on the symptoms basis as described by early researchers; presence of faecal pellets in the whorls, skeletonizing the upper epidermis and windows on leaves. The percentage damage was calculated by using formula;

Percentage damage= [Number of damage plants/Total number of observed plants] X 100

Rearing and developmental parameters

Larvae were collected from damaged plants and reared in Rearing Laboratory at Institute of Plant Protection, Muhammad Nawaz Shareef University of Agriculture Multan during September 2020-December 2020 for further studies. Second generations of FAW adults were used in the experiment. Twenty, first instar larvae were randomly collected from reared culture and shifted separately into each petri dish containing maize leaves. Each petri dish was considered replicate. There were total twenty replications. Fresh leaves of maize were supplied to larvae till pupation on daily basis. The emerged adults were released into adult

rearing cage and provided cotton pads soaked with 10% honey solution as food. Tissue papers were hanged into cage for oviposition. The laid eggs were collected on daily basis and placed into separate petri dishes for hatching and further study purposes. The developmental parameters such as larval survival, larval weight, pupal survival, and pupal weight, duration of life cycle, developmental period and fecundity were recorded by using procedure of Maruthadurai and Ramesh (2019). The rearing of FAW was conducted at $26\pm 2^{\circ}\text{C}$.

RESULTS

Occurrence and damage pattern

All stages either mature or immature were found in all study areas (Shujabad, Jalalpur and Multan). The maximum pest population was recorded on vegetative stages of fodder maize as compared to reproductive stages. The damage pattern of *S. frugiperda* was observed in field and laboratory conditions. In field conditions, it was observed that early instar (1st instars) consume fresh plant tissue on one side while later instars (3rd-6th) made large holes and consume whole plant leaf except epidermic layer. The vegetative growth was highly infested by larvae as compared to reproductive growth. The early growth of plant was found most sensitive to larvae than later growth.

It was observed that older instar larvae burrowed into plant buds or whorls and cut the upper portion of plant, resulting maximum defoliation even death of plant occurred. The ear, silk tissue and kernels of plants were found infested by larvae. The settlement of larvae on ear, silk and kernels is due to insufficient food for larvae. Later instars were found together in least number as compared to early instars. The reduction in later instars population was due to cannibalistic behaviour that occurred in 3rd instars larvae to onward. The maximum population of larva was recorded on fresh corn leaves than mature leaves.

The fresh and newly emerged leaves were found most suitable food for larvae as compared to mature and older leaves. It was observed that silk was not suitable for larval growth and development. The presence of faecal material in whorls was the main symptom of FAW attack. The damage infestation was recorded 15-50% on maize. The damage pattern was also observed in the laboratory conditions.

Morphological identification

The colour of FAW eggs was creamy white which covered with scales. Full grown larvae were brownish black in colour having black spots on the body while a white inverted "Y" line on the head. The main difference from other *Spodoptera* species is the

presence of four black spots on the 8th and 9th abdominal segment which present in a square pattern and a trapezoidal pattern, respectively. Pupae were reddish brown in colour while moths with greyish brown forewings.

Developmental parameters

The developmental parameters of FAW such as adult, pupa, larva and egg periods, total life cycle from egg to adult, fecundity, larval and pupal weight

were recorded on maize. The egg period was 2.10 ± 0.10 days. Majority of eggs were hatched after 2 days. The larval and pupal period was recorded 14.76 ± 0.27 days and 9.98 ± 0.39 days, respectively. The total life period from egg to adult was 33.54 ± 0.40 days (Table 1). A single female was laid 289-300 eggs in her total life period. The majority of eggs were laid by a female in her early age (days). In her later age, reduction in the number of eggs was recorded.

Table-1: Developmental parameters; Egg, larval, pupal period, life cycle from egg to adult and fecundity/ female of larvae fed on corn

Host	Developmental parameters				
	Egg period (days) n=18	Larval period (days) n=12	Pupal period(days) n=12	Life cycle egg-adult n=12	Fecundity/female n=6
	Mean \pm SE	Mean \pm SE	Mean \pm SE	Mean \pm SE	Mean \pm SE
Co	2.10 ± 0.10	14.76 ± 0.27	9.98 ± 0.39	33.54 ± 0.40	289.48 ± 72.06

The larval and pupal weight of FAW larvae fed on corn was recorded. The larval and pupal weight was 0.545 and 0.123 g, respectively. The

larval and pupal survival was recorded 80 and 76%, respectively (Table 2).

Table-2: Larval weight, larval survival, pupal weight and pupal survival (mean \pm SE) of larvae fed on corn

Host	Developmental parameters			
	Larval weight (g) n=11	Larval survival (%) n=11	Pupal weight (g) n=11	Pupal survival (%) n=11
	Mean \pm SE	Mean \pm SE	Mean \pm SE	Mean \pm SE
Corn	0.545 ± 0.01	80 ± 9.546	0.123 ± 0.026	76 ± 10.11

DISCUSSION

FAW is a very dangerous pest of various horticultural as well as agricultural crops especially graminaceae family crops all over the world including Pakistan. More than 350 host plants of this emerging pest have been recorded worldwide. The most suitable host plant is maize followed by sorghum, cabbage, sugarcane, millet, rice, wheat and many grasses (Nagoshi *et al.*, 2007; Boregas *et al.*, 2013). The preference of host plant can vary according to geographical distribution and presence of host plants (Montezano *et al.*, 2018). In Pakistan, authentic report of FAW larvae on maize was published in 2019 which collected from different areas of province Sindh (Naeem-Ullah *et al.*, 2019) while reported from Africa in 2016 (Georgen *et al.*, 2016). Due to high reproduction and migrating power, pest was spread in all provinces of country. In the end of 2018, it was reported on maize from India (Sharanabasappa *et al.*, 2018; Sisodiya *et al.*, 2018; Mahadevaswamy *et al.*, 2018; Sarfaraz *et al.*, 2018). In very short period of time, it was widely distributed in Myanmar, Sri Lanka, Thailand, China and Bangladesh (FAO, 2019 a).

This is first study on the occurrence, damage pattern and developmental parameters of FAW on corn in Pakistan. In the current study 15-50 percentage damage was recorded on maize while had recorded 16-52% age damage. Some researchers from India had reported about 9-16% damage on maize crop (Sharanabasappa *et al.*, 2018; Shylesha *et al.*, 2018; Mallapur *et al.*, 2018) which is not in line with our study findings.

Total developmental duration from egg to adult was found 22 days on maize which is almost similar to Murúa and Virla (2004). Maximum fecundity was recorded on maize as compared to other tested host plants (Murúa *et al.*, 2008). The developmental parameters which described in the current study are similar to findings of previous study researchers. The variation in developmental period is due to phenology of host plants and geographical variation. The most important and suitable host is maize for larval feeding, insect growth and development. The developmental period of *S. frugiperda* was found short on maize as compared to other host plants that tested by early researchers (Dias *et al.*, 2016; Shylesha *et al.*, 2018).

CONCLUSION

The current study provides basic knowledge about occurrence, damage pattern and developmental parameters of *S. frugiperda* on maize crop under laboratory conditions. The basic knowledge can prove best strategy to adopt good decision against these emerging insect pests in the country. The pest can attack on non-preferable host plants in the absence of suitable host like maize. It will be necessary to manage this pest at early stage to minimize the crop losses and protect the country from issues that will come in future due to FAW.

CONFLICT OF INTEREST

Author declares no conflict of interest.

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