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Research Article

Preferable Host Plants of Fall Armyworm, *Spodoptera frugiperda* (Lepidoptera: Noctuidae) Larvae in Southern Punjab Pakistan under Laboratory Conditions

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ABSTRACT

Fall armyworm, Spodoptera frugiperda is considered an important noctuid moth pest of agricultural crops all over the world and recently become an invasive pest in Pakistan. The crops belonging to Asteraceae, Fabaceae and Poaceae families are highly affected with this pest. The description of host plants is very important in understanding the biology, ecology and application of most effective techniques against the pest. By keeping in view, the importance of this pest, the current study was conducted to evaluate the most preferable host plant such as maize, potato, cabbage, cotton and lehli for this pest in the study area. The results showed that cabbage and maize were the most suitable hosts for larval feeding. The incubation period was recorded 2.00 and 2.12 days on cabbage and maize, respectively. The developmental period of larvae was found longer on cabbage as compared to maize. Potato, cotton and lehli were not found suitable for pest rearing. The study concluded that maize and cabbage are the most suitable hosts for S. frugiperda larvae under natural and controlled conditions.

Keywords: *Fall armyworm, Invasive alien species, Hosts, Pakistan.*

INTRODUCTION

Fall armyworm, *Spodoptera frugiperda* is destructive pest of maize crops all over the world. Two strains, maize and rice firstly have been reported from African areas in 2016 (Goergen et al., 2016) and spread to Pakistan by adopting different migrating ways.

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First time, it has been reported in 2019 from Pakistan and invade the maize crops of country in very short period of time. More than 80 plant species are infested with the current pest all over the world especially crops belonging to family poaceae (Abrahams et al., 2017).

As maize is staple food crop, majority of people consume it as food and also use as domestic purposes. Female can lay eggs in cluster on the lower side of plant, neonate larvae spread quickly on the whole plant (Ali et al., 1990) and feed vigorously on the new leaves while later instars (3rd- 6th) chew up cobs. The infestation of larvae on maize crops has been observed by many researchers (Kalleshwaraswamy et al., 2018) and reported the huge crop losses (Montezano et al., 2018). Larvae are phototactic and feed on whole plant parts such as vegetative and reproductive parts.

The excessive feeding of FAW larvae caused losses of 8.3-20.6 m tons of maize per annum, resulting about 20% reduction in the total production without any adopting management strategies as estimated by experts. No diapause phase of FAW has reported till now by any expert throughout the world. It can only overwinter in areas of United States (US). Adult is considered good flier that cover long distance during summer months. Total life period from egg to adult is 30 days in summer and 60 days in spring while prolong during winter months. The number of generations varies with geographical distribution and environmental conditions.

Pakistan is affected with the attack of this invasive alien species for last two years. Due to high reproductive and migrating potential, pest has attained primary status which is serious threat to food security (Midega et al., 2018; & Montezano et al., 2018).

Many other host plants such as cotton, sorghum, sugarcane, millet, rice and groundnut of current pest have been reported from other countries by many researchers except Pakistan. There is need to check the preferable host plants of pest in Pakistan, control strategies should be adopted against the pest after proper host verification. For this purposes, current study was conducted to evaluate the available host plants of *S. frugiperda* in Southern Punjab Pakistan.

MATERIALS AND METHODS

Collection, identification and stock culture

Larvae of *S. frugiperda* were collected from different fields of Multan with the help of fine camel hair brush. The collected larvae were placed into plastic containers and brought to Ecology Laboratory for identification and rearing purpose.

Preferable host plants, host range, artificial diet, damage and field infestation

Some reported host plants were evaluated to check their potential larval hosts and pest infestation like two species of cotton (*Gossypium arboretum*, *Gossypium hirsutum*), two species of cabbage (*Brassica oleracea; Brassica juncea*), maize (*Zea mays*) and potato under laboratory environment. The artificial diet was also evaluated as food for larvae (Nair et al., 2019). Nature of pest damage in field was observed and described. The fresh and new leaves of mentioned host plants were collected from non-sprayed fields and washed with water. After air dried, leaves cut at about the size of the bottom cover of a plastic plate (inside diameter of 9cm). One piece of each host leaf and small pieces of prepared artificial diet were placed per petri dish and five 2^{nd}-6^{th} instar larvae allowed to feed for 24 hours. Feeding of larvae was compared with maize leaves by using the following qualitative parameters: +++ = extensive, ++ = moderate, + = slight and - = zero feeding. The current experiment (trial) was repeated four times to check the possible host plants for larval infestation and rearing under laboratory conditions. The biological parameters of *S. frugiperda* on preferable hosts was determined.

RESULTS AND DISCUSSION

Agriculture is the backbone of Pakistan and play key role in the economy of country. The most important crops are maize, cotton,

soyabean, sorghum and rice that grown in large area of country to fulfil the basic requirements of country. Fall armyworm (FAW), *S. frugiperda* is polyphagous pest (Clark et al., 2007; Casmuz et al., 2010; & Murúa et al., 2015) that cause economic losses of crop such as soyabean, rice, maize and many others. Two strains (maize and rice) of *S. frugiperda* (Nagoshi & Meagher, 2004) have been found in tropical and subtropical areas of the world (Cruz et al., 1999). This is new pest and currently reported in Pakistan but spread in all maize growing areas of Pakistan. The alternation of host plant is helpful in the management of this notorious pest because each host grown in different seasons and has different phenologies. The different growing season and phenologies of host plants can prove helpful in pest migration or movement from one host to another or from one country to others. The presence of single preferable host of pest can maintain the insect population that become difficult to control that pest (Barros et al., 2010). The basic knowledge of host plants and biological of pest is very important to develop integrated pest management strategies against *S. frugiperda* in the study area.

The fertility, fecundity, growth and development of pest are significantly affected by host plants. The different types of terrestrial insect pests are found with different developmental times, some have shorter life cycle and some with longer. The longer life period and shorter developmental period represent the host suitability (Saeed et al., 2010; & Awmack & Leather, 2002). More than 350 plants species have been recorded the hosts of *S. frugiperda* in the globe but all species not examined still (Montezano et al., 2018).

Different host plants of different families were tested to check the preferable host of *S. frugiperda* under laboratory conditions. Cabbage and maize were found the most suitable host for *S. frugiperda* growth and development among tested hosts. The remaining host plants (cotton, potato, lehli and artificial diets) were not suitable for pest rearing and 90% larvae died within one days. In the current study, two species of cotton were tested as host plant of larvae. The study resulted that cotton is not suitable host for pest rearing while Bueno et al. (2011) and Hardke et al. (2015) had reported the cotton and soyabean as suitable hosts. The developmental time of pest prolonged on cotton plant as discussed by early scientists. The suitability of host plants and feeding damage of *S. frugiperda* larvae has given in Table 1.

Table 1: Host plants tested as potential larval hosts and feeding damage of 2nd-6th instar larvae after 24h feeding

Host Plants		Extent of damage*			
Common Name	Scientific Name	Trial 1	Trial 2	Trial 3	Trial 4
Family: Brassicaceae					
Cabbage	*Brassica oleracea*	++	++	+++	+++
Cauliflower		-	-	-	-
Mustard	*Brassica juncea*	-	-	-	**-Family: Solanaceae**
Potato	*Solanum tuberosum*	-	-	+	+
Family: Malvaceae					
Cotton	*Gossypium arboretum*	-	-	-	-
Cotton	*Gossypium hirsutum*	-	-	++	++
Family: Poaceae					
Maize	*Zea mays*	+++	+++	+++	+++
Family: Convolvulaceae					
Lehli	*Convolvulus arvensis*	-	-	-	-
Artificial diet	(Nair et al., 2019)	-	-	-	-

Note*: +++ = extensive feeding, ++ = moderate feeding, + = slight feeding, - = zero feeding

The developmental period of each stage such as egg, larva and pupa was prolonged on cabbage than maize. The developmental period of first, second, third, fourth, fifth and six instars was 4.45, 2.88, 3.55, 3.11, 3.14 and 3.12 days respectively on cabbage while 2.03, 1.89, 1.38, 1.66, 2.13 and 3.00 days, respectively on maize (Table 2).

Table 2: Developmental times (M ± SE) of different developmental stages of *Spodoptera frugiperda* on cabbage and maize under laboratory condition

Stages (days)	Host plants	
	Cabbage	**Maize**
Eggs		
Egg	2.0±0.01b	2.12±0.04b
Larvae		
1st instar	4.45±0.13a	2.03±0.01e
2nd instar	2.88±0.16a	1.89±0.01e
3rd instar	3.55±0.15a	1.38±0.06e
4th instar	3.11±0.15a	1.66±0.03d
5th instar	3.14±0.20b	2.13±0.05d
6th instar	3.12±0.10b	3.00±0.11d
Pupae		
Pupa	11.42±0.35a	9.89±0.12b
Adults		
Adult longevity		
Male	3.67±0.01a	5.05±1.70a
Female	19.01±0.02b	15.19±0.13a

The consumption rate of larvae was observed more on maize as compared to cabbage. The number of larval instars can be increased on cabbage. The adult longevity on maize was longer while shorter on cabbage. It was observed that male short lived as compared to female. The longevity of male and female was 3 and 19 days, respectively on cabbage while 5 and 15 days, respectively on maize.

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