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“Extent of host range of fall armyworm, *Spodoptera frugiperda* (J.E. Smith) in Latur district (Maharashtra, India)”

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Abstract

In the present investigation “Extent of host range of fall armyworm, *Spodoptera frugiperda* (J.E. Smith) in Latur District (Maharashtra, India)” was investigated by conducting a survey in Latur district during *kharif* 2019 to find different host plants of *S. frugiperda* covering 25 villages from 5 Talukas of Latur district grown with different host crops during August to November, 2019. Among different host plants observed in five different Talukas in Latur District, the maximum infestation of *S. frugiperda* was revealed in Renapur Taluka followed by, Latur (rural) region infesting Maize crop. While, among different host plants maximum infestation was observed in Maize followed by Bajra, Cotton, Sunflower and occasional infestation on Jhonson grass was reported.

Keywords: Host range, fall armyworm, *S. frugiperda*.

Introduction

Spodoptera frugiperda, popularly best known as the fall armyworm, is an important Lepidopteran pest in the Americas. The pest has invaded Africa with the first detections being reported in central and western Africa in early 2016, and in late 2016 and 2017 in parts of southern, eastern and northern Africa. It became important during the mid-19th Century when it was reported attacking Maize, Sugarcane, Rice and Grasses in the southern USA (Hinds and Dew, 1915) [1]. It normally overwinters successfully in the United States only in southern Florida and southern Texas. The fall armyworm is a strong flier, and disperses long distances annually during the summer months. The maximum migration flight recorded for FAW was 1600 km (Rose *et al.*, 1975) [2]. It is recorded from virtually all states east of the Rocky Mountains. However, as a regular and serious pest, its range tends to be mostly the south eastern states. In 2016 it was reported for first time from African continent in Nigeria, Sao Tome, Benin and Togo (Goergen, 2016) [3]. In India the pest was first reported in Karnataka on Maize crop in 2018 (ICAR-NBAIR, 2018) [4]. In Maharashtra first time reported in Tandulwadi village, Taluka Karmala, District Solapur by Dr. Ankush Chormule in month of September 2018. In Maratwada region, *S. frugiperda* was reported by Dr. Bhede in Itlapur village from Parbhani District on *rabi* sorghum in the month of November 2018. By December 2018, it was reported in Bangladesh, Srilanka and Thailand. It was also found to be spread in Myanmar, China, Indonesia, Malaysia, Vietnam, Egypt, Korea and Japan till June. The pest has spread all over the globe and currently assumed the position of A1 threat. The European Union recognizes the pest as quarantine pest (Anonymous, 2019) [5].

The fall armyworm cause major damage to economically important cultivated grasses such as Rice, Sorghum and Sugarcane as well as Cabbage, Beet, Peanut, Soybean, Alfalfa, Onion, Cotton, Pasture Grasses, Millet, Tomato and Potato. A total 353 *S. frugiperda* larval host plants recorded belonging to 76 plant families, principally Poaceae (106), Asteraceae (31) and Fabaceae (31) (Montezano *et al.*, 2018) [7].

The *S. frugiperda* is a cosmopolitan pest of the Maize crop (Wiseman, 1966) [8]. It feeds on all growth stages of Maize but most frequently in the whorl of young plants up to 45 days old. *S. frugiperda* larvae usually consume large amount of foliage and eventually destroys the growing point of the plant. Ovipositional preference and larval behavior for this species within host plants greatly reduces susceptibility to many insecticides. Adults may deposit clusters of 10-500 eggs throughout the plant canopy, but often prefer to oviposit in the lower two-thirds of Cotton plants or whorls of corn or sorghum. First instars can be observed in an aggregate near the site of the egg mass, while late instars aggressively disperse within and across adjacent plants (Ali *et al.*, 1989) [9]. The adult female lays the eggs in masses, randomly distributed within the crop. During the summer, egg hatch occurs in 3 days.

The newly hatched larvae immediately start feeding on the tissues, usually beginning with the tender portions. First instar larvae usually eat the green tissue from one side of the leaf, leaving the membranous epidermis on the other side intact. Older instars begin to make holes in the leaf and the fourth to sixth instars may completely destroy small plants and strip larger ones (Cruz, 1995)^[10].

S. frugiperda alone is responsible for causing millions of dollar losses to farmers around the world. In India, Maize, Bajra and sorghum are the sustenance crops grown by many marginal farmers while, the earnings from these crops are meager. Yield reductions in Maize due to feeding of *S. frugiperda* have been reported as high as 34.00 per cent (Williams and Davis, 1990)^[11].

However, the present investigation is planned accordingly after going through the literature, where it was noticed that very little work has been done on the host range of *S. frugiperda* on Indian farmscape.

Materials and Methods

The investigation on “Extent of host range of fall armyworm, *Spodoptera frugiperda* (J.E. Smith)” were accompanied by

conducting a survey in Latur district during *kharif* 2019 to find different host plants of *S. frugiperda* covering 25 villages from 5 Talukas of Latur district grown with different host crops during August to November, 2019. The larvae were reared in laboratory condition at room temperature and all the stages *viz.*, egg, larvae, pupae and adult for critical examination to identify distinct morphological characters of the pest. *S. frugiperda* presence was determined by using the indicators like, presence of fresh frass in leaf funnel, presence of larvae on leaves or in leaf funnel identifiable with the inverted ‘Y’- Shape in head and a set of four dots forming a square on upper surface of the last segment of its body, irregular damage (cuts) on leaves and presence of egg masses. In each field, twenty plants at 10 spots were selected randomly and observations on number of plants damaged due to *S. frugiperda* larvae were recorded. The per cent infestation was calculated by using the formula;

$$\text{Per cent infestation} = \frac{\text{Number of infested plants}}{\text{Total number of plants}} \times 100$$



Larvae showing Pin-hole symptoms



Mature larva and faecal pellets in whorl



Early instar larvae scrapping chlorophyll



Windows on leaf lamina caused by mature larva

Plate 1: Damaging symptoms of *S. frugiperda* in Maize



Plate 2: Infestation of *S. frugiperda* in Bajra



Plate 3: Infestation of *S. frugiperda* in Cotton



Plate 4: Infestation of *S. frugiperda* in Jhonson grass



Plate 5: Infestation of *S. frugiperda* in Sunflower

Results and Discussion

During the roving survey, 25 villages from five Talukas of Latur district were studied for the incidence of *S. frugiperda* during *Kharif* 2019. The larvae identified were collected and reared in laboratory and was conformed as *S. frugiperda* by its morphological characters with the previous reports. During the survey it was observed that eggs were laid in groups which are dome shaped creamy white in colour and laid under surface of the leaves sometimes inner side of the whorls and near the stem. Eggs are covered with grey colored scales by the female adults. Young larvae are light green in colour with dark black head and the grown up larva is in dark brown with

reddish brown head marked with inverted 'Y' shape on the head with the elevated distinct dark colored black spots (Pinacula) on the whole body which bears spines (long primary setae). The arrangement of the dorsal pinacula *i.e.*, the four black spots arranged in square on the eight abdominal segment and large spots especially on ninth segment have a typical arrangement in a trapezoidal pattern and also seen from first to seventh abdominal segments.

Pupation occurs in the soil or sometimes in the leaf folds, where reddish brown pupae exhibited a typical cremaster with 2 spines. Male moths of *S. frugiperda* have a shaded grey and brown forewing with triangular white spots at the tip and near the center of the wing. While, the forewings of females are less distinctly marked, ranging from a uniform greyish brown to a fine mottling of grey and brown. The hind wing of both sexes is shining silver-white with a narrow dark border. These observations are conformity with the others report on the incidence.

A total number of five host plants were observed to be damaged by *S. frugiperda* in Latur District. Among the different host plants revealed three host plants belongs to Graminae family while, the other two host plants were from each Malvaceae and Asteraceae families.

Table 1: List of host plants of *Spodoptera frugiperda* larvae observed in Latur district.

Sr. no.	Local Name	Scientific Name	Family
1	Maize	<i>Zea mays</i> L.	Graminae
2	Bajra	<i>Pennisetum glaucum</i> L.	Graminae
3	Cotton	<i>Gossypium hirsutum</i> L.	Malvaceae
4	Jhonson grass	<i>Sorghum halepense</i> L.	Graminae
5	Sunflower	<i>Helianthus annus</i> L.	Asteraceae

The *S. frugiperda* incidence on Maize was first noticed on 19th August, 2019 at Oil Seed Research Station, Latur on 15 days old crop of variety, Narendra (M-909) with an infestation level of 22 per cent. Infestation of *S. frugiperda* on Maize grown in *Kharif* season in Latur district during 2019 ranged from 15 to 75 per cent with maximum incidence recorded in Ramwadi (72%) (Renapur Taluka) followed by Chatgaon (44%) (Chakur Taluka) of Latur district. In Latur Taluka on Maize crop the infestation ranged from 20 to 45 per cent, whereas in Chakur Taluka infestation ranged from 10 to 30 per cent, in Renapur Taluka infestation ranged from 20 to 75 per cent, in AUSA Taluka infestation was ranged from 20 to 25 per cent and in Ahmadpur Taluka the infestation was about 25 to 40 per cent. The lowest infestation on Maize (12%) was recorded in Latur Road of Chakur Taluka.

In Bajra crop the *S. frugiperda* incidence was about 10 to 30 per cent with highest infestation of 28 per cent in Halli of Ahmadpur Taluka followed by Tembhurni (22%) of

Ahmadpur Taluka and lowest incidence of 12 per cent in Hasegaon of Ausa Taluka. The *S. frugiperda* incidence on Cotton crop of variety (NHH-44 Hy. non-Bt) noticed on 29th November, 2019 at Entomology Research Farm, College of Agriculture, Latur on 65 days old crop with infestation of 8 per cent. The occurrence of *S. frugiperda* on Jhonson Grass was recorded at Entomological Research Farm, College of Agriculture, Latur on September 8th, 2019. Analogously, *S. frugiperda* with the infestation of 5 per cent was observed on 35 days old crop of Sunflower as on October 28th at Oilseed research station, Latur.

Nature of damage caused due to *S. frugiperda* on different host Plants.

During the survey the egg masses of *S. frugiperda* were observed on Maize and Bajra crops. Egg laying was observed mostly on the lower side of leaf as mass of 80-90 eggs in early stages of crop growth. Though, occasionally egg masses on upper side of leaf were noticed where insect population was at its peak. The oviposition on upper side of leaf on Maize crop was noticed in Ramwadi village of Renapur Talukas where the highest infestation (72%) was recorded. Eggs are covered with scales, small in size, circular and shiny white in colour.

Young larvae are green in colour, having black head, which alters into an orange colour in second instar state. The matured larva has pronounced facial region with light colour inverted 'Y' shaped marking. Early instar caterpillars was initially observed as feeding on opened leaves by scraping and skeletonizing epidermis as silvery transparent membrane, later enter into the whorl and feed between the leaves resulting in characteristic row of holes like symptoms in the form of pin holes or small window panes. Usually within a whorl, one or two larvae were noticed feeding voraciously and damaging the whorl. The caterpillar was observed feeding on mid portion *i.e.*, leaf whorl of the Maize crop from 4-6 leaves stage. The damage resulted in extension of defoliation and damage to the growing points (leaf whorls). The nature of the damage indicating moist saw dust like frass observed near the funnel and upper leaves in most of the locations during August and September, 2019. The fall armyworm caterpillars feed on various plant parts including leaves, stems, tassel and immature cobs. Older larvae seem to burrow into Maize cobs causing extensive damage.

Analogously, *S. frugiperda* damage on Maize and Bajra crops noticed at vegetative stage *viz.*, 15-45 days age with scrapping, boring whorls, cutting leaf edges symptoms. The egg mass was observed on Bajra crop at Tembhurni village of Ahmadpur Taluka where the infestation was 22 per cent.

The *S. frugiperda* damage on Jhonson grass which was besides the Maize crop was noticed at Entomological Research Farm, College of Agriculture, Latur. *S. frugiperda* was found to infest the whorl and feed on tender leaf tissue of Jhonson Grass. In Jhonson grass the affected plants are seen with fresh frass pallets in the whorl. When leaves unfold, irregular, elongate feeding areas or rows of holes were visible. Earlier, by pronounced morphological characteristics the *S. frugiperda* was reported in Dehradun district of Uttarakhand by Joshi *et al.* (2020) [12] similar results have been reported in present study also. The findings of present investigation were in tune with the reports of Venkateswarlu *et al.* (2018) [13] who elucidated the fall armyworm, *S. frugiperda* (J.E. Smith) on

Bajra and sorghum in the fields of agricultural research station, Ananthapuramu, Andhra Pradesh by morphological characteristics such as typical inverted 'Y' on head capsule and four dark spots on second abdominal segment from posterior end (four black spots arranged in a square on the last but one abdominal segment) and damage symptoms such as the early instar larvae showed pin hole symptoms on the leaves and later instars cause windows on leaves because of voracious feeding and faecal pellets in whorls. Later larval instars caused the foliar damage by cutting down by leaves.

Chormule *et al.* (2019) [14] Surveyed infestation of fall armyworm on Maize, Sorghum, Sweet corn and Sugarcane and observed that the infestation on sugarcane was less than 5 per cent in Sangli, Kolhapur, Pune districts. Swamy *et al.* (2018) [15] conducted a survey and reported the *S. frugiperda* in Maize, Sweet corn and Sorghum. Sharanabassapa *et al.* (2018) [14] surveyed on *S. frugiperda* and reported its occurrence on Maize in state of Karnataka, India for first time.

More or less similar results were illustrated by Shylesha *et al.* (2018) [16] who indicated the *S. frugiperda* from many locations in Karnataka on Maize crop with infestation ranged from 9.0 to 62.5 per cent. The survey results were in tune with that of Montezano *et al.* (2018) [7] who recorded about 353 *S. frugiperda* larval host plants belonging to 76 plant families, principally Poaceae (106) in Brazil. Analogously, Mallapur *et al.* (2018) [17] who reported the fall armyworm on Maize with per cent infestation ranged from 6 to 100 per cent. Earlier Tindo *et al.* (2017) [18] reported the incidence of *S. frugiperda* in Maize. Thus, these findings endorse the results of present investigation

Table 2: Incidence of fall armyworm, *S. frugiperda* in different villages of Latur district.

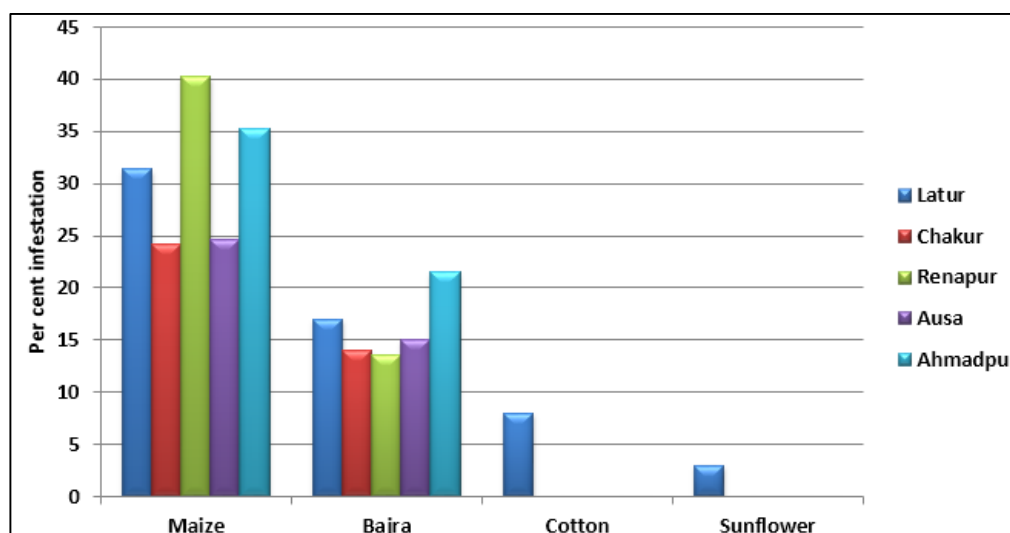
Sr. no.	District	Block	Village	Host plants identified
1	Latur	Latur	Gategaon	Maize
2	Latur	Latur	Mahapur	Maize
3	Latur	Latur	Borwati	Maize and Bajra
4	Latur	Latur	Kolpa	Maize and Bajra
5	Latur	Latur	Latur (Rural)	Maize, Bajra, Cotton, Jhonson grass and Sunflower
6	Latur	Chakur	Kadmuli	Maize
7	Latur	Chakur	Latur Road	Maize
8	Latur	Chakur	Vadmal Nagnath	Maize
9	Latur	Chakur	Janwal	Maize
10	Latur	Chakur	Bothi	Maize
11	Latur	Renapur	Bawchi	Maize
12	Latur	Renapur	Chatgaon	Maize
13	Latur	Renapur	Motegaon	-
14	Latur	Renapur	Bhokramba	Maize
15	Latur	Renapur	Ramwadi	Maize
16	Latur	Ausa	Babhalgaon	Maize
17	Latur	Ausa	Almala	Maize
18	Latur	Ausa	Limbala	Maize
19	Latur	Ausa	Pomadevi jawlga	Bajra
20	Latur	Ausa	Hasegaon	Bajra
21	Latur	Ahmadpur	Kingaon	Maize, Bajra
22	Latur	Ahmadpur	Halli	Maize and Bajra
23	Latur	Ahmadpur	Dhalegaon	Maize
24	Latur	Ahmadpur	Tembhurni	Maize and Bajra
25	Latur	Ahmadpur	Malegaon kh.	Bajra

Table 3: Per cent infestation of *S. frugiperda* on different host plants in different villages of Latur district.

Sr.no.	District	Talukas	Village	Crop	Age of Crop	Per cent infestation
1	Latur	Latur	Gategaon	Maize	28 days	36%
			Mahapur	Maize	26 days	32%
			Borwati	Maize	18 days	41%
				Bajra	29 days	18%
			Kolpa	Maize	32 days	26%
				Bajra	29 days	18%
			Latur (Rural)	Maize	15 days	22%
				Bajra	32 days	15%
				Cotton	65 days	8%
				Sunflower	32 days	5%
			Jhonson grass	-	-	
2	Latur	Chakur	Kadmuli	Maize	33 days	26%
			Latur Road	Maize	41 days	12%
				Bajra	32 days	14%
			Vadwal Nagnath	Maize	33 days	18%
			Janwal	Maize	26 days	32%
			Bothi	Maize	19 days	33%
3	Latur	Renapur	Bawchi	Maize	44 days	26%
			Chatgaon	Maize	38 days	44%
				Bajra	22 days	13%
			Bhokramba	Maize	29 days	19%
			Ramwadi	Maize	36 days	72%
				Bajra	29days	14%
4	Latur	Ausa	Babhalgaon	Maize	44 days	28%
			Almala	Maize	32 days	24%
			Limbala	Maize	29 days	22%
			Pomadevi Jawalga	Bajra	54 days	18%
			Hasegaon	Bajra	62 days	12%
5	Latur	Ahmadpur	Kingaon	Maize	55 days	25%
				Bajra	46 days	18%
			Halli	Maize	59 days	36%
				Bajra	51 days	28%
			Dhalegaon	Maize	62 days	39%
			Tembhurni	Maize	54 days	41%
				Bajra	47 days	22%
Malegaon Kh.	Bajra	36 days	18%			

Table 4: Taluka wise average per cent infestation of *S. frugiperda* on different host plants.

Taluka	Average infestation on Maize	Average infestation on Bajra	Average infestation on Cotton	Average infestation on Sunflower
Latur	31.4 %	17 %	8 %	3 %
Chakur	24.2 %	14 %	0 %	0 %
Renapur	40.25 %	13.5 %	0 %	0 %
Ausa	24.67 %	15 %	0 %	0 %
Ahmadpur	35.25 %	21.5 %	0 %	0 %

**Fig 1:** Taluka wise average per cent infestation of *S. frugiperda* on different host plants.

Conclusion

From the survey conducted to estimate the infestation of *S. frugiperda* among different host plants observed in five different Talukas in Latur District, it can be concluded that the maximum infestation of *S. frugiperda* was revealed in Renapur Taluka followed by, Latur (rural) region infesting Maize crop. While, among the different hosts maximum infestation was reported on Maize crop followed by, Bajra crop.

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