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RESEARCH PAPER

Status of fall armyworm, *Spodoptera frugiperda* (J. E. Smith) (*Lepidoptera* : Noctuidae) and its natural enemies at major maize growing areas of Haveri district

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Abstract: Fall armyworm (*Spodoptera frugiperda*) belongs to the family Noctuidae which has got economic importance as polyphagous and extreme pest of many important crops, including maize in India and elsewhere.In this context, roving survey was conducted on two cropping seasons at fortnightly interval during *kharif* and *rabi* of 2019-20 to know the status of fall armyworm in all the seven talukas of Haveri district *viz*., Hirekerur, Ranebennur, Byadagi, Haveri, Shiggaon, Savanur and Hangal. The results revealed that the mean larval population and per cent infestation of fall armyworm was ranged from 0.30 to 0.44 larvae per plant and 23.10 to 33.77 per cent, respectively in different talukas surveyed. In overall view Haveri district registered the mean larval population and per cent infestation of 0.37 larvae per plant and 28.99 per cent, respectively, in *kharif* and *rabi*. During the study period, it was observed for two different species of parasitoids *viz., Campoletis chlorideae* (Hymenoptera: Ichneumonidae) and *Exorist axanthaspis* (Diptera:Tachinidae) were parasitizing FAW larvae. Along with parasitoids, one entomopathogenic fungi, *Metarhizium rileyi* was known to infect the larvae which was collected during the survey period.

Key words: Fall armyworm, Haveri district, Maize, Natural enemies

Introduction

Maize (*Zea mays*) is one of the utmost significant cereal crops in the global agriculture economy equally as food for man and fodder for animals and referred as "Queen of cereals" because of greater yield potential. It is being cultivated both in the tropical and subtropical climatic conditions of the world. Maize produced in the country is mainly used as human diet. Maize seeds are consumed as human food, as feed stuff for poultry birds and for cattle and also used in production of starch, glucose and edible oil from industry. An annual global production of this crop is 1016 million tons from an area of 184 million hectare with productivity of 5,520 kg per hectare. About 35 per cent of maize produced in India is utilized for consumption by humans, 48 per cent is used for poultry as well as cattle feed where as 15-17 per cent is used for preparation of corn flakes, corn oil, popcorn, corn syrup, dextrose and starch in food processing industries. India is the fourth largest producer with a production of 27.15 million tons in an area of 9.60 million hectare and productivity is 2,830 kg per hectare. The major maize growing statesin India are Karnataka, Uttar Pradesh, Andhra Pradesh, Rajasthan, Tamil Nadu and Maharashtra which contribute to the area and production of 60 and 70 per cent, respectively. Maize is grown in an area of 1.36 million hectare in Karnataka, and the production of 4.09 million tons where as the productivity is 3020 kg per hectare (Anon., 2018). At present, the average yields of cereal grains are lower in India due to various factors, among which, the insect pests have been considered as one of the most important constraints. It is estimated that as many as 141 insect pests cause different degrees of damage to maize crop from sowing to harvesting (Reddy and Trivedi, 2008).Among these, stem borer (*Chilopartellus*), cob borer (*Stenachroia elongella*) and shoot fly (*Atherigona soccata*) were reported as major pests. Stem borers are the major insect pests followed by defoliators, at present the fall armyworm, *Spodoptera frugiperda* (J. E. Smith) (Noctuidae: Lepidoptera) is a polyphagous and important pest of maize in India and elsewhere. The pest was recently reported on maize from Karnataka for the first time in India (Sharanabasappa *et al*., 2018). There is a every chance that this pest may migrate to neighboring states in India as well as other Asian countries. The main explanation for its rapid spread may be its efficient ability to travel and migrate long distances in short time. Despite strict quarantine standards, the invasion of FAW may contribute to easy global trade and transport and human activities. In this context, an attempt was made to document the status of fall armywormat major maize growing area of Haveri district in which maize is being cultivated under rain fed condition.

Material and methods

During roving survey, four villages were randomly selected from each taluka. From each village five randomly selected fields were observed at fortnightly interval to record the following observations.

Incidence and percent infestation of fall armyworm, *Spodoptera frugiperda*

In each field, twenty plants were randomly selected and observations on the number of plants damaged, number of larvae per plant were recorded. Further, the data was used for calculation of mean larval population per plant as well as percent pest infestation by using the following formulae.

$$\text{Incidence of larvae per plant (Nos.)} = \frac{\text{Number of larvae}}{\text{Number of plants observed}}$$

$$\text{Percent infestation} = \frac{\text{Number of plants damaged}}{\text{Total number of plants observed}} \times 100$$

Incidence of natural enemies of fall armyworm, *Spodoptera frugiperda*

Parasitoids

Twenty fall armyworm larvae were collected randomly from each field and the collected larvae were reared under laboratory and observed for the emergence of any parasitoids. Further, the parasitoids were preserved in 70 per cent ethyl alcohol and sent for identification. The data obtained were used for calculation of per cent parasitization.

$$\text{Per cent parasitization (\%)} = \frac{\text{No. of parasitoids observed}}{\text{Total No. of larvae collected}} \times 100$$

Incidence of entomopathogens of fall armyworm, *Spodoptera frugiperda*

During the survey, the cadaver of fall armyworm larvae were collected in butter paper covers separately and preserved under cold storage. Further, these larval cadavers were diluted in distilled water and smeared over suitable growth media for pathological studies of fungi. Later, the fungus involved in infection was identified by seeking the help from an expert.

Results and discussion

The variation in the fall armyworm incidence across major maize growing talukas of Haveri district which was documented through roving surveys is depicted in Table 1.

The survey was conducted on two cropping seasons at fortnightly interval in seven talukas of Haveri district during *kharif* and *rabi* of 2019-20. The incidence and per cent infestation of fall armyworm and its natural enemies were recorded during the roving survey on maize. During the course of survey, the larval load and per cent infestation in different talukas ranged between 0.30 to 0.44 larvae per plant and 23.10 to 33.77 per cent, respectively. Whereas, the highest mean larval load and percent infestation was noticed in Savanur taluka with 0.44 larvae per plant and 33.77 per cent infestation, respectively, followed by Ranebennur taluka (0.41 larvae per plant and 32.00 per cent infestation). Mean while, the lowest mean larval load and per cent infestation was noticed in Hirekerur taluka (0.30 and 23.10, respectively). In overall view Haveri district registered the mean larval population and per cent infestation of 0.37 larvae per plant and 28.99 per cent, respectively, in *kharif* and *rabi*.

The variations in the level of fall army worm incidence might be due to differences in sowing date of maize in all the seven talukas surveyed, disparity among cultivars used, cultural practices, distribution of weather elements (temperature, rainfall and relative humidity) coupled with geographical variation and edaphic factors which may have the direct impact on the level of fall armyworm infestation. The effect of climatic factors on fall armyworm incidence was documented by Waddill *et al*. (1981) reported that heavy rainfall was found lethal to the pest, as rain drops accumulates in whorls which creates suffocation to larvae. Rainfall was having a significant negative correlation with the incidence of fall armyworm during *kharif* season in Perambalur district (Kumar *et al*. 2020). Irrespective of the talukas surveyed, the late sown maize crop (last week of July) suffered more as compared to the early sown (last week of May) and timely sown crop (first week of June) who stated that The infestation of fall armyworm in Northern Karnataka was ranged between 6.00 to 100 per cent (Mallapur *et al.*, 2018 and Painkra *et al*., 2019).

Two species of parasitoids *viz.,Campoletis chlorideae* and *Exorist axanthaspis* were recorded on the fall armyworm during the study period. The highest mean per cent parasitization of both *C. chlorideae* and *E. xanthaspis* were observed in Savanur taluka (1.21 and 0.29 per cent, respectively), followed by Ranebennur taluka (1.05and 0.28 per cent, respectively). Whereas, the lowest mean parasitization of both parasitoids were noticed in Hirekerur taluka (0.83 and 0.22 per cent, respectively). However, the peak per cent parasitization of both the species of parasitoids werecoincided with peak FAW infestation. This might be due to availability of more number of larvae to parasitise,this well fits into the predator-prey relationship *i.e.,*increased density of pest led to increased parasitization of these parasitoids. Shylesha *et al.* (2018) observed *Telenomus*sp. (Hymenoptera:Platygastridae), *Trichogramma* sp. (Hymenoptera: Trichogrammatidae) egg parasitoids and solitary larval parasitoid, *C. chlorideae* (Hymenoptera: Ichneumonidae) were known to parasitize the FAW effectively. Five species of larval parasitoids *viz*., *Coccygidiummelleum, C.chlorideae, Eriborus* sp., *E.sorbillans*

Table 1. Status of fall armyworm, *Spodoptera frugiperda* and its natural enemies in Haveri district during *kharif* and *rabi* 2019-20.

Talukas	Mean number of larvae/plant	Mean of per cent infested plants	Mean number of natural enemies Per cent Parasitisation		Per cent infestation *of*
			Campoletischlorideae	Exoristaxanthaspis	Metarhiziumrileyi
Hirekerur	0.30	23.10	0.83	0.22	3.56
Ranebennur	0.41	32.00	1.05	0.28	2.60
Byadagi	0.40	31.22	1.02	0.27	3.08
Haveri	0.37	29.78	0.99	0.26	2.92
Shiggaon	0.35	27.03	0.93	0.25	2.81
Savanur	0.44	33.77	1.21	0.29	2.41
Hangal	0.33	26.08	0.92	0.24	3.34
Range	0.30 – 0.44	23.10 – 33.77	0.83 – 1.21	0.22 – 0.29	2.41 – 3.56
Mean ± SD	0.37± 0.04	28.99±3.75	1.00 ± 0.12	0.26 ± 0.02	2.96± 0.40

and *Odontepyris*sp were reported by Sharanabasappa *et al*. (2019). *E. xanthaspis* a parasitoid of FAW in India was reported for the first time by Navik *et al.* (2020).

Along with parasitoids, one entomopathogenic fungi, *Metarhizium rileyi* was known to infect the FAW which was collected during the survey period. *M.rileyi* was observed on the fall armyworm throughout the *kharif* season. However, the fungus was not observed in *rabi* season, due to prevalence of lower relative humidity,which was not favourable for the pathogen to survive. *M. rileyi* was recorded its highest incidence in Hirekerur taluka (3.56 per cent), followed by Hangal taluka (3.34%) whereas,the lowest incidence was observed at Savanur taluka (2.41%). Mallapur *et al*. (2018) and Sharanabasappa *et al*. (2019) reported the infection of *M.rileyi* on *S.frugiperda* ranging from 1.87 to 18.30 per cent and 10 to 15 per cent, respectively in Northern Karnataka in August month.

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