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First report of the occurrence of fall armyworm, *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae) on Ginger (*Zingiber officinale*) in Haveri district, Karnataka, India

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Abstract

Fall Armyworm (FAW), *Spodoptera frugiperda*, (J.E. Smith), has been occurring on Maize (*Zea mays*) since 2018 in parts of Karnataka, Andhra Pradesh, Telangana and Maharashtra and likely to spread to other states gradually, where intensive and extensive cultivation of maize is practiced. Subsequently the pest was reported on millets and rice crop from Andhra Pradesh and Karnataka respectively.

Recently in July 2019, we have observed fall armyworm larvae feeding on Ginger (*Zingiber officinale*) foliage in Mudur village of Haveri district in Karnataka. The larvae were grown up and around fifth instar stage.

The presence of late instar larvae on ginger leaves with holes and feeding of leaf margins and fresh faecal matter indicated that the larvae were well established and have been surviving on the new host, Ginger. Considering the feeding potential of this pest, this finding marks the beginning of yet another challenge to the Indian farmers, particularly those in Ginger cultivation and also to the administrators and researchers. This is the first record of the FAW on Ginger in India.

Keywords: Fall armyworm, *Spodoptera frugiperda*, ginger, Karnataka, India, new record

Introduction

Fall Armyworm (FAW), *Spodoptera frugiperda*, (J.E. Smith), the dreaded pest from the Americas for long, has been found on maize for the first time in Africa in 2016^[1]. Since its first report from Africa, it had spread to India within a couple of years. Globally several important plant species such as maize, rice, sorghum, cruciferous crops, cucurbits, cotton, banana, beans, solanaceous vegetable crops, cowpea, groundnut, potato, soybean, besides some wild grasses and sugarcane have been reported as major hosts of FAW^[2].

In India, this pest has been identified to occur on maize (*Zea mays*) in many districts of Karnataka, Andhra Pradesh, Telangana and Maharashtra states since 2018. It was first identified on Maize in Shivamogga district of Karnataka state^[3]. Subsequently it was found feeding on sugarcane in the state of Maharashtra and Tamil Nadu^[4, 5] and on Rice in Karnataka^[6]. FAW was also reported from Anantapuram in Andhra Pradesh on Bajra and Sorghum^[7]. It was reported to have spread from neighbouring districts of Karnataka.

There are two identical strains of *Spodoptera frugiperda*, the R-Strain and C-Strain. They have different characteristics. The R-Strain feeds on rice and the C-Strain feeds on Maize^[8]. However, cross feeding of host plants by these strains have also been well established. In India R-Strain is reportedly present on Maize and also found feeding on Rice^[6]. It appears that while the "R" strain has colonized maize, sweet corn and sorghum, "C" strain has started adapting to sugarcane and maize^[5].

World over FAW alone is responsible for causing millions of dollar losses to farmers. In India maize, bajra and sorghum are crops grown by many marginal farmers for sustenance. The earnings from these crops are meagre. Considering the ravaging nature of FAW the economic damage would be too high to be ignored. Initially the pest created a panic amongst farmers. Now some farmers are able to recognise it and look forward for suitable advisory from the dependable sources.

In Karnataka besides hybrid maize several other crops are grown in the districts of Hassan and Shivamogga. In these districts, particularly in Hassan, Ginger is an important commercial crop. The high fecundity and dispersal ability of this insect may help its expansion of host

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range and geographical range within the country.

In this context our present observation of FAW on this crop will bear a commercial significance.

Materials and Methods

The authors have undertaken a routine field visit in Karnataka for the survey and collection of FAW from maize fields. On maize, the two other species commonly seen from the genus *Spodoptera* are *S. litura* and *S. exigua*. They are seen from the early growth stages of the crop.

On reports of occurrence of lepidopteran pests in one Ginger (*Zingiber officinale*) field around Mudur village in Hangal taluk of Haveri district, the authors went to inspect the field to provide suitable advisory. The field was less than half an acre. Ginger was planted in raised beds of 5m x 2m separated by trenches. A couple of rows of chilli were grown between every two or three beds of ginger. The ginger crop was 2-3 months old and the chilli was in reproductive stage. The field was surrounded by other ginger fields. From the descriptions provided by the farmer we were sure that the pest could be different from *S. litura*. The ginger beds were randomly searched for the damage and presence of FAW larvae.

The chilli plants were also examined for the possible damage and presence of the insect. It was ascertained from the farmers there was no cultivation of maize plants in the vicinity of the field. We have collected the FAW larvae from the ginger field and closely observed the morphological features. The larvae were grown up and probably in fifth instar stage. Though the typical markings on the larva were distinct to the naked eyes, a handheld lens was used for better viewing and confirmation.

Results and Discussions

Our search for FAW on chilli crop did not show up any damage or presence of the pest on chilli.

During our inspection of the ginger field, we came across a few early instars of *S. litura* on ginger. Further search in ginger field resulted in locating the presence of a few FAW larvae which were in the fifth instar stage. The ginger farmer confirmed that was a new pest he was concerned about. The larvae on ginger were active and were found feeding on the foliage. On the same leaves small holes and damage to leaf margins were observed. The fresh faecal pellets were noticed on the leaves along with the larvae, confirming the feeding. As the surrounding ginger fields were treated with *diamide* insecticides we could not locate any lepidopteran pest.

The morphological examination of larvae clearly showed the inverted V shaped mark on the head capsule and the four spots arranged in a square form at the posterior segment to confirm the morphological identity (See the image).

Further, the larvae could not have come accidentally from other hosts, as there was no maize crop or rice in the vicinity. There was no incidence found on the chilli plants grown between the beds of ginger. However, we could not locate any egg masses or other stages of larvae on ginger. The low larval population could have been due to the chemical control measures taken by the farmer about a week back.



Fig 1: Faw on ginger leaf

In our past experience we have come across *S. litura* in several ginger fields in Hassan and Haveri districts in Karnataka. During control failures we have noticed large scale foliar destruction by *S. litura*.

Similarly on maize, till recently, *S. litura* and *S. exigua* were frequently observed, particularly *S. litura* predominantly.

As per the information on CABI- Plantwise Knowledge Bank^[2] [Plantwise.org] ginger is reported as one of the main hosts of FAW, elsewhere.

Our present finding of FAW on ginger in Karnataka would be a concern to many ginger growers, considering the importance of the crop. Ginger (*Zingiber officinale*) is a perennial crop widely grown in India in over 1.5 lakh hectares. India is a leading producer of this crop, the rhizomes of which is being used as a spice. India is producing over 7.45 lakh tonnes of the spice from key states like Karnataka, Assam, Gujarat, Meghalaya, Arunachal Pradesh and Orissa. These states together contribute to 65 per cent of country's total production.

In Karnataka ginger is grown in over 20,000 acres and farmers consider it as a high profit crop. While the crops like paddy and maize give them a return of Rs.25, 000/acre, ginger gives them a lucrative income of over Rs.100, 000 with an average yield range of 80-100 quintals per acre at a modest price of Rs.2000 per quintal. At times ginger prices can go over Rs.8000 per quintal. So, of late the crop has become an attraction to many Karnataka farmers.

However, the ginger cultivation needs chemical interventions for the management of diseases like soft rot of rhizomes and leaf spots. In India, of the known insect pests of ginger, the important Lepidopterans are the Shoot borer (*Conogethes punctiferalis*) and the Tobacco caterpillar (*Spodoptera litura*). In light of our finding of the occurrence of FAW on ginger there is a new challenge to the farmers, more so to the administrators and researchers to find suitable management measures. Till an official management strategy is formulated by the researchers we propose an interim strategy for the management.

- Ginger being a high value crop, it should be segregated from maize and other known hosts of FAW. Farmers are to be advised not to grow them together as intercrops.

- It is important to make all ginger growers to identify the initial damage symptoms caused by FAW and take timely interventions.
- On identifying the strain of FAW, suitable pheromones lures and traps may be distributed and their proper use to be demonstrated by the state governments.
- Suitable bio-pesticides like Bacterial, fungal and virus [NPV] based insecticides are to be evaluated and provided for the use of farmers.
- Till suitable IPM measures are formulated effective chemical interventions may be recommended for faster relief.
- As an interim action subsidies on effective chemicals may be provided to protect the farmers from incurring losses.
- Ginger being a long duration crop chemical interventions alone would not be cost-effective. Hence more research is required at Spices Board, State agricultural universities and ICAR level.
- Surveys across the states to establish the occurrence of FAW on various crops, particularly on high value crops is the urgent need of the hour.

Conclusion

Ginger has been reported as one of the main host crops for FAW elsewhere in the globe. Our report is the first observation on the occurrence of FAW in India on ginger. The typical morphological observations of the larvae confirm the identity as *Spodoptera frugiperda*.

Recent studies have confirmed that the R-strain reported in India can feed on Rice and Maize [6]. Another speculation is that the C-strain besides maize is stabilising on sugarcane [5]. It needs to be ascertained which of these strains is prevalent on ginger what is the level of preference of ginger over maize. This being a recently invaded pest the identity and population structure of FAW infesting different host plants in different parts of India is unknown. These strains can reliably be distinguished using molecular markers. With the speed at which the pest is spreading to new host crops, elucidation of strain level identification of FAW on several crops would help in identifying the right pheromone required to manage the species on different crops.

Also important are further studies to ascertain the damage potential on ginger and which stages are susceptible. If ginger turns out to be one of the preferred hosts it would be a disaster to ginger cultivation. This calls for more research on finding appropriate management strategies, an integrated approach comprising cultural, chemical and biological methods to combat this dreaded pest.

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