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## Status of alien pest fall armyworm, *Spodoptera frugiperda* (J E Smith) on maize in Northern Karnataka

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#### Abstract

In recent days, the production of maize is threatened by the notorious alien pest, *Spodoptera frugiperda*. Early incidence of fall armyworm was noticed in Dharwad and was confirmed by molecular studies with GenBank accession number MH822830. Its infestation in Northern Karnataka ranged from 6.00 to 100 percent. Among different locations surveyed, cent percent incidence was observed in Hullur and Guttala while, the lowest pest infestation was observed in Sirsi (6.00%) and Mudgod (10.00%). District wise infestation ranged between 13.50 and 66.50 percent. Highest infestation (66.50%) was in Dharwad district succeeded by Belagavi (59.55%), Bagalkot (54.96%), Gadag (50.30%), Haveri (50.07%) and Vijayapura (28.83%) while the least was in Uttar Kannada district (13.50%). The larval population varied from 8.00 to 140.00 in different maize growing areas of Northern Karnataka. Due to its wide host range, the pest has a potential to spread to other important crops in near future.

**Keywords:** Fall armyworm, *Spodoptera frugiperda*, percent infestation

#### 1. Introduction

Maize is commonly called as “Queen of cereals”. In India maize is cultivated to serve various purposes like human consumption, cattle and poultry feed, food processing and in the extraction of starch, dextrose, corn syrup, corn oil *etc* by various industries. In India, maize is cultivated in an area of 96.33 million hectares with a production of 258.99 million tonnes and productivity of 2.69 tonnes per hectare. In Karnataka, maize is cultivated over an area of 13.70 million hectares with a production and productivity of 33.14 million tonnes and 2.42 tonnes per hectare, respectively [2].

As many as 141 insect pests cause varying degree of damage to maize crop right from sowing till harvest [16]. Apart from these, the recently introduced pest, fall armyworm (*Spodoptera frugiperda*) is of serious concern due to its notorious and polyphagous behaviour. In the recent past numerous alien insect pests and diseases have been introduced into India which has caused havoc and are of potential threat to Indian agriculture. The main reason for its fast spread might be its strong capacity to fly and disperse long distances annually during the summer months. The invasion of this pest might be due to advances in agriculture, easy of global trade and transport and human activities despite strict quarantine norms.

The pest, which is indigenous in the Americas, is highly polyphagous, causing economic damage in various crops such as maize, sorghum, beans and cotton (Abrahams *et al.*, 2017; Day *et al.*, 2017). This invasive pest was first reported in West Africa in late 2016 (Goergen, Kumar, Sankung, Togola, & Tamo, 2016); by early 2017, the pest invaded Sub-Saharan Africa. Recent reports con-firmed the occurrence of fall armyworm in 28 countries in Africa (Cock, Beseh, Buddie, Cafa, & Crozier, 2017; Day *et al.*, 2017) indicat-ing the rapid spread of the pest in the African continent, threatening the food security of millions of people.

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In India, it is reported for the first time on maize from Shivamogga district (Karnataka) during May-June, 2018 [17]. According to the recent studies, fall armyworm can cause maize yield losses ranging from 8.3 m to 20.6 million tonnes per year in absence of management practices [8].

In this context, the present study was undertaken to generate preliminary information on incidence, distribution and extent of damage caused by fall armyworm in major maize cultivating districts of North Karnataka.

## 2. Materials and Methods

Initially the larval samples were collected from maize field in Dharwad district and were sent to National Bureau of Agricultural Insect Resources (NBAIR) for molecular identification and confirmation of the species.

A roving survey was carried out in maize growing areas of different taluks in Northern Karnataka covering Dharwad, Haveri, Belagavi, Bagalkot, Gadag, Uttar Kannada and Vijayapur districts during August – September 2018. In each taluk, a minimum of three villages and in each village two farmer's fields were observed for the incidence of fall armyworm. In each field, twenty plants at 10 randomly selected spots were selected and observations on the number of plants damaged due to fall armyworm out of 200 plants as well as number of larvae per plant were recorded. The percent pest infestation was calculated by using the following formula [11].

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

## 3. Results and Discussion

### 3.1 Morphological and molecular identification of *Spodoptera frugiperda*

The larval sample collected from Dharwad district was identified and confirmed as *Spodoptera frugiperda* (J E Smith) [Noctuidae: Lepidoptera] by NBAIR, Bengaluru base on molecular studies with a GenBank accession number of MH822830.

### 3.2 Incidence of fall armyworm, *Spodoptera frugiperda* in different major maize growing villages of Northern Karnataka

During the roving survey, 80 villages from seven districts of Northern Karnataka were studied for the incidence of fall armyworm *S. frugiperda* (Table 1). Among various villages surveyed, the infestation of fall armyworm ranged from 6.00 to 100 percent. Among these, cent percent incidence was observed in Hullur (Bagalkot district) and Guttala (Haveri district), followed by 94.5 percent in Basaspur (Haveri district), 89.5 percent in Mallur (Haveri district), 88.00 percent in Katherahalli (Haveri district), 83.5 percent in Biligi and Kudala Sangam (Vijayapur district) and 82.5 percent in UAS Dharwad. However, lowest percent infestation was observed in Tavaragi (10.60%) (Haveri district) and Sirsi (6.00%) (Uttar Kannada district).

Within each district, the infestation varied among different taluks (Table 2). In Belagavi district, fall armyworm infestation ranged from 47.50 to 70.75 percent. Highest percent incidence was observed in Gokak (70.75%), followed by Kittur (68.00%), Hukkeri (67.50%), Chikkodi (64.75%), Belagavi (60.50%), Ramdurga (57.00%), Mudalagi (55.25%), Savadatti (49.50%) while the lowest was observed in Nippani (47.75%) taluks.

In Bagalkot district, highest incidence was recorded in Bagalkot (91.75%) and lowest in Badami (45.50%) taluks. In the remaining taluks, infestation was to the tune of 51.25, 45.50, 50.00, 53.00 percent in Mudhol, Biligi, Hunagundand and Jamakhandi, respectively. Similarly, in Vijayapur district, highest incidence was recorded in Muddebihal taluk (37.00%) followed by Nidagundi (29.50%) and Basavan Bagewadi (20.00%).

As high as 74.17 percent infestation was observed in Dharwad taluk while, the lowest incidence was observed in Kalghatagi (50.50%) taluk in Dharwad district. Hubballi, Kundagol and Navalgund taluks evidenced 71.00, 72.50 and 60.50 percent incidence, respectively. Among four taluks of Uttar Kannada district, maximum incidence was noticed in Haliyal taluk (19.00%), followed by Dandeli (14.50%), Mundagol (18.00%) and the least was observed in Sirsi (6.00%).

In Haveri district, the pest incidence ranged from 11.75 to 75.5 percent with the highest incidence recorded in Haveri taluk and the lowest in Hirekerur taluk. The pest infestation was revealed at 41.00, 14.50 and 63.00 percent in Hanagal, Ranebennur and Byadagi taluks, respectively. In case of Gadag district, highest incidence was recorded in Ron taluk (57.00%) followed by Naragund (51.75%), Shirahatti (51.00%), Mundaragi (46.75%) and Gadag (45.00%).

Across the seven districts surveyed, the fall armyworm infestation ranged from 13.50 and 66.50 percent. The maximum average infestation (66.50%) was observed in Dharwad district which was succeeded by Belagavi (60.11%), Bagalkot (54.96%), Haveri (50.07%), Gadag (50.30) and Vijayapur (28.83%) whereas, Uttar Kannada district experienced the minimum infestation by the pest (13.50%) (Table 2).

After the first report of fall armyworm *S. frugiperda* from Shivamogga [17], the present study depicts the incidence and spread of fall armyworm on maize in Northern Karnataka. The fall armyworm incidence on maize was observed in all the districts studied with varying degrees of infestation. It was also observed that the pest preferred young plants rather than old and matured ones. During the survey, it was also noticed that the pest not only feed on leaves and central whorls but also on young, immature cobs and grains.

Very high incidence of fall armyworm was observed in northern transitional belt of Karnataka except for Hirekerur and Ranebennur taluks wherein, the crop was sown early. Environmental conditions particularly temperature and rainfall of the northern transitional belt (Haveri, Dharwad and Belagavi districts) aid the plants to grow succulently and produce new leaf whorls faster than the plants grown under stress. Extensive cultivation of maize, staggered sowing and prevailing congenial environmental conditions favoured higher incidence of fall armyworm in northern transitional belt. However, the highest incidence of fall armyworm noticed in Bagalkot and Gadag districts can be attributed to late and staggered sowing of maize due to lack of timely rainfall.

Lower incidence of fall armyworm in Vijayapur district may be probably due to harsh environmental conditions and the delay in migration of the pest and its further build up. In contrast to these, least percent incidence was observed in Uttar Kannada district, where the crop was sown very early (during second fortnight of May) due to which it might have escaped the early incidence before the pest could attain its maximum density.

The present study corroborated the observations of [12] who

reported that early planting paved way for corn plants to escape from heavy densities of fall armyworm. This study strengthens the recommendation of avoiding delayed planting in Integrated Pest Management practices (IPM) of fall armyworm *S. frugiperda* given by [3, 9]. The larval population in major maize growing areas of Northern Karnataka

averaged between 58.83 and 105.65 larvae/ 200 plants. A similar percent infestation was observed by [13] wherein they recorded a range of 0.1% to 71.30% infestation by fall armyworm on maize from two agrological regions for over a period of four years.

**Table 1:** Incidence of fall armyworm, *Spodoptera frugiperda* in different major maize growing villages of Northern Karnataka

District	Taluk	Village	Number of larvae/200 plants	Number of plants damaged /200 plants	Average infestation (%)
Belagavi	Savadatti	Yaragatti	57.00	103.00	51.50
		Yaragatti	66.00	93.00	46.50
		Munavalli	72.00	101.00	50.50
	Gokak	Gokak	73.00	136.00	68.00
		Kalloli	57.00	147.00	73.50
	Mudalagi	Mudalagi	60.00	105.00	52.50
		Hirenandi	96.00	116.00	58.00
	Hukkeri	Rakshi	67.00	140.00	70.00
		Hukkeri	54.00	130.00	65.00
	Chikkodi	Karoshi	64.00	111.00	55.50
		Majalatti	64.00	148.00	74.00
	Nippani	Nippani	57.00	112.00	56.00
		Tavandi	56.00	79.00	39.50
	Belagavi	Yamakanmaradi	62.00	115.00	57.50
		Hatragi	57.00	127.00	63.50
Ramdurg	Mullur	73.00	97.00	48.50	
	Halgatti	101.00	131.00	65.50	
Kittur	Kittur	73.50	147.00	73.50	
	Mallapur	62.50	125.00	62.50	
District average			66.95	108.74	59.55
Bagalkot	Mudhol	Mudhol	58.00	96.00	48.00
		Belagali	66.00	109.00	54.50
	Jamkhandi	Shirol	55.00	103.00	51.50
		Algur	80.00	109.00	54.50
	Biligi	Amalzari	31.00	61.00	30.50
		Biligi	41.00	92.00	46.00
	Bagalkot	KudalaSangama	87.00	167.00	83.50
		Hallur	140.00	200.00	100.00
	Hungund	Sangamad	78.00	113.00	56.50
		Ganjal	49.00	87.00	43.50
Badami	Guledgudda	58.00	93.00	46.50	
	Kamatagi	63.00	89.00	44.50	
District average			67.17	109.92	54.96
Vijaypur	Nidagundi	Nidagundi	44.00	55.00	27.50
		Alamatti	45.00	63.00	31.50
	Muddebihal	Hullur	67.00	75.00	37.50
		Jattagi cross	60.00	73.00	36.50
	Basavana Bagewadi	Dhavalagi	36.00	37.00	18.50
		Sankanal	41.00	43.00	21.50
District average			48.83	57.67	28.83
Dharwad	Dharwad	Garag	92.00	155.00	77.50
		UAS	93.00	165.00	82.50
		UppinBetageri	16.00	125.00	62.50
	Kalghatagi	Pala Cross	68.00	118.00	59.00
		Kalghatagi	46.00	84.00	42.00
	Hubli	Chabbi	39.00	136.00	68.00
		Kadapatti	29.00	148.00	74.00
	Kundgol	Shaunshi	47.00	167.00	83.50
		Hosalli	42.00	123.00	61.50
	Navalgung	Nagnoor	58.00	111.00	55.50
Gudisagar		67.00	131.00	65.50	
District average			54.27	133.00	66.50
Uttar Kannada	Mundgod	Naganoor	10.00	24.00	12.00
		Hire halli	13.00	23.00	11.50
		Salgaon	8.00	12.00	7.00
	Haliyal	Haliyal	12.00	38.00	19.00
		Dandeli	18.00	29.00	14.50
	Sirsi	Banavasi	8.00	12.00	6.00
District average			12.83	27.00	13.50
Haveri	Hanagal	Kusnur	69.00	81.00	40.50
		Akkialur	47.00	83.00	41.50

	Byadagi	Byagavadi	36.00	95.00	47.50
		Mallur	100.00	179.00	89.50
		Arabagonda	72.00	104.00	52.00
	Haveri	Katenahalli	92.00	176.00	88.00
		Basapur	86.00	189.00	94.50
		Guttala	138.00	200.00	100.00
		Hosaritti	64.00	116.00	58.00
		Agadi	49.00	74.00	37.00
	Hirekerur	Tavaragi	16.00	21.00	10.50
		Channalli	14.00	26.00	13.00
	Ranebennur	Kusaguru	10.00	30.00	15.00
	Kamadoda	18.00	28.00	14.00	
District average			57.93	100.14	50.07
Gadag	Gadag	Hulkoti	62.00	80.00	40.00
		Gadag	94.00	100.00	50.00
	Rona	Kannur	76.00	110.00	55.00
		Belavanki	59.00	118.00	59.00
	Shirahattui	Magadi	73.00	110.00	55.00
		Mulgund	48.00	94.00	47.00
	Naragund	Belavatiagi	59.00	120.00	60.00
		Chick Naragund	110.00	87.00	43.50
	Mundaragi	Dambala	79.00	94.00	47.00
	Doni	81.00	93.00	46.50	
District average			74.10	128.60	50.30
Overall average of Northern Karnataka			58.83	101.76	50.89

**Table 2:** District and taluka wise average incidence of fall armyworm, *Spodoptera frugiperda* on maize in Northern Karnataka

District	Average infestation (%)	Taluk	Average infestation (%)
Belagavi	59.55	Savadatti	49.50
		Gokak	70.75
		Mudalagi	55.25
		Hukkeri	67.50
		Chikkodi	64.75
		Nippani	47.75
		Belagavi	60.50
		Ramdurg	57.00
Uttar Kannada	13.50	Kittur	68.00
		Mundgod	10.17
		Haliyal	19.00
		Dandeli	14.50
Bagalkot	54.96	Sirsi	6.00
		Mudhol	51.25
		Jamkhandi	53.00
		Biligi	38.25
		Bagalkot	91.75
		Hungund	50.00
Vijayapur	28.83	Badami	45.50
		Nidagundi	29.50
		Muddebihal	37.00
Dharwad	66.50	BasavanaBagewadi	20.00
		Dharwad	74.17
		Kalghatagi	50.50
		Hubballi	71.00
		Kundgol	72.50
Haveri	50.07	Navalgung	60.50
		Hanagal	41.00
		Byadagi	63.00
		Haveri	75.50
Gadag	50.30	Hirekerur	11.75
		Ranebennur	14.50
		Gadag	45.00
		Rona	57.00
		Shirahatti	51.00
		Naragund	51.75
		Mundaragi	46.75

## 5. Conclusion

Based on the present studies, it can be concluded that the fall armyworm has spread all over the Northern Karnataka and is

able to cause potential damage to the maize crop. India is a tropical country where a wide range of crops are cultivated. In near future, the pest may stretch to other important crops of

the region like wheat, sugarcane, sorghum, cotton, pigeon pea and vegetables which are grown all throughout the year at one or the other locations. Further studies should be directed towards mitigating this notorious pest and its dispersal.

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