



# Effect of Date of Sowing on Incidence of Fall Armyworm, *Spodoptera frugiperda* in Maize

Darshan R <sup>a\*</sup>, Prasanna P M <sup>b</sup>  
and Jayalaxmi Narayan Hegde <sup>c</sup>

<sup>a</sup> Department of Agricultural Entomology, College of Agriculture, Dharwad, India.

<sup>b</sup> Department of Agricultural Entomology, College of Agriculture, Hanumanamatti, India.

<sup>c</sup> Department of Entomology, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga, India.

## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## ABSTRACT

Fall armyworm (*Spodoptera frugiperda*) is a member of the Noctuidae family which has economic importance as a polyphagous and extreme pest of many important crops, including maize in India and elsewhere. In this context, an experiment regarding the influence of different dates of sowing on the incidence of fall armyworm was conducted in MARS, Dharwad. The results revealed that the least mean larval load of fall armyworm was recorded in crop sown during the July 2nd fortnight (0.75 larvae per plant) and the highest was recorded in crop sown during the August 2nd fortnight (1.53 larvae per plant). Whereas, the lowest mean leaf damage score of 2.95 was observed in crop sown during 2nd fortnight of July and the highest was recorded in the crop sown during 2nd fortnight of August (4.82).

\*Corresponding author: E-mail: darshanr703@gmail.com;

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## 1. INTRODUCTION

Maize (*Zea mays*) is one of the most significant cereal crops in the global agriculture economy equally as food for man and fodder for animals and is referred as the “Queen of cereals” because of its 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 a human diet. Maize seeds are consumed as human food, as feedstuff for poultry birds and cattle and also used in the production of starch, glucose and edible oil from industry. The annual global production of this crop is 1016 million tons from an area of 184 million hectares with productivity of 5,520 kg per hectare. About 35 percent of maize produce in India is utilized for consumption by humans, 48 percent is used for poultry as well as cattle feed whereas 15-17 percent 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 hectares and productivity is 2,830 kg per hectare. The major maize-growing areas in India are Karnataka, Uttar Pradesh, Andhra Pradesh, Rajasthan, Tamil Nadu, and Maharashtra which contribute to the area and production of 60 and 70 percent, respectively. Maize is grown in an area of 1.36 million hectares in Karnataka, and the production is 4.09 million tons whereas the productivity is 3020 kg per hectare [1]. At present, the average yields of cereal grains are lower in India due to variety of factors, among which, 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 crops from sowing to harvesting [2]. Among these, stem borer (*Chilo partellus*), cob borer (*Stenachroia elongella*) and shoot fly (*Atherigona soccata*) were found to be as major pests. Stem borers are the major insect pests followed by defoliators but now, the fall armyworm, *Spodoptera frugiperda* (J. E. Smith) (Noctuidae: Lepidoptera) is a polyphagous and extreme pest of many important crops, including maize in India and elsewhere. The different recommendations on dates appropriate for sowing exist across all agroecological zones where maize is cultivated. Maize cropping is between March/April (early) and August/September (late) in the Southern agro-

ecological zone of the country (rain forest) where the crop covers a larger area. The proper sowing time is recommended considering various problems including pests and diseases. This was intended to recognize sowing dates that would result in lower infestations that are sufficient to prevent economic crop loss so that insecticide application can be minimized.

## 2. METHODOLOGY

The experiment on this particular objective was conducted at MARS, Dharwad in *kharif* 2019 by growing the maize hybrid, R-3033. The plot size was 7 × 4 m with spacing of 60 cm × 20 cm was followed. The crop was not implicated with any kind of plant protection measures except regular agronomic practices *viz.*, tilling, fertilization, intercultivation and hand weeding operations as per the recommendation to maintain a good crop stand. The treatments consisted of 3 different dates of sowing at 15 day intervals *viz.*, 2<sup>nd</sup> fortnight of July (1<sup>st</sup> date of sowing), 1<sup>st</sup> fortnight of August (2<sup>nd</sup> date of sowing), and 2<sup>nd</sup> fortnight of August (3<sup>rd</sup> date of sowing) and were replicated seven times.

### 2.1 Observations Recorded

#### 2.1.1 Incidence of fall armyworm on different dates of sowing

Observations on the incidence of fall armyworm on different dates of sowing were recorded from five randomly selected plants in each replication at weekly intervals. Further, this data was used for calculation of mean larval population per plant by using the following formula.

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

#### 2.1.2 Leaf damage

Leaf damage assessment was made on 5 randomly selected plants by using visual scale ranging from 0 to 9. Davis et al., [3].

- 0 = no visible leaf damage
- 1 = only pin-hole damage to the leaves
- 2 = pin-hole and shot-hole damage to leaves
- 3 = small elongated lesions (5–10mm) on 1–3 leaves
- 4 = midsized lesions (10–30mm) on 4–7 leaves

- 5 = large elongated lesions (>30mm) or small portions eaten on 3–5 leaves
- 6 = elongated lesions (>30mm) and large portions eaten on 3–5 leaves
- 7 = elongated lesions (>30cm) and 50 % of leaf eaten
- 8 = elongated lesions (30cm) and large portions eaten on 70 % of leaves
- 9 = most leaves have long lesions

## 2.2 Statistical Analysis

The data obtained from all the sowing dates during the present study were subjected to one way ANOVA. The observations regarding incidence were subjected to square root transformation. The differences among the treatments were compared by following Duncan's Multiple Range Test (DMRT).

## 3. RESULTS AND DISCUSSION

### 3.1 Larval Load of Fall Armyworm in Maize Crop at Different Dates of Sowing

The infestation of fall armyworm on different dates of sowing showed that, the larval load of fall armyworm in the first sown crop was found to be significantly least with infestation of 0.45 larvae per plant compared to the other two dates of sowing (second (0.71 larvae/plant) and third sown crop (1.02 larvae/plant)). Similarly, the infestation level of fall armyworm was continued up to 85 DAS in maize crop sown in first sowing. However, the peak level of infestation was observed in all the sowing dates with infestation of 3.37, 2.93 and 2.25 larvae per plant in third, second and first sown crops, respectively at 36 DAS.

The study revealed that, the least mean larval load was noticed in first sown crop (0.75 larvae per plant) compared to third sown crop registered 1.53 larvae per plant. This is due to unsuitable environmental factor for pest attack *i.e* heavy rainfall as it was negatively correlated with the incidence of fall armyworm. The results of the present investigation are in line with the findings of Waddill et al. [4] reported that heavy rainfall kill a significant number of early instar of fall armyworm which reduce the adult population. Okweche et al. [5] reported that damage variables and population dynamics of *C. partellus* were significantly lower in early-planted maize as compared to late-planted maize.

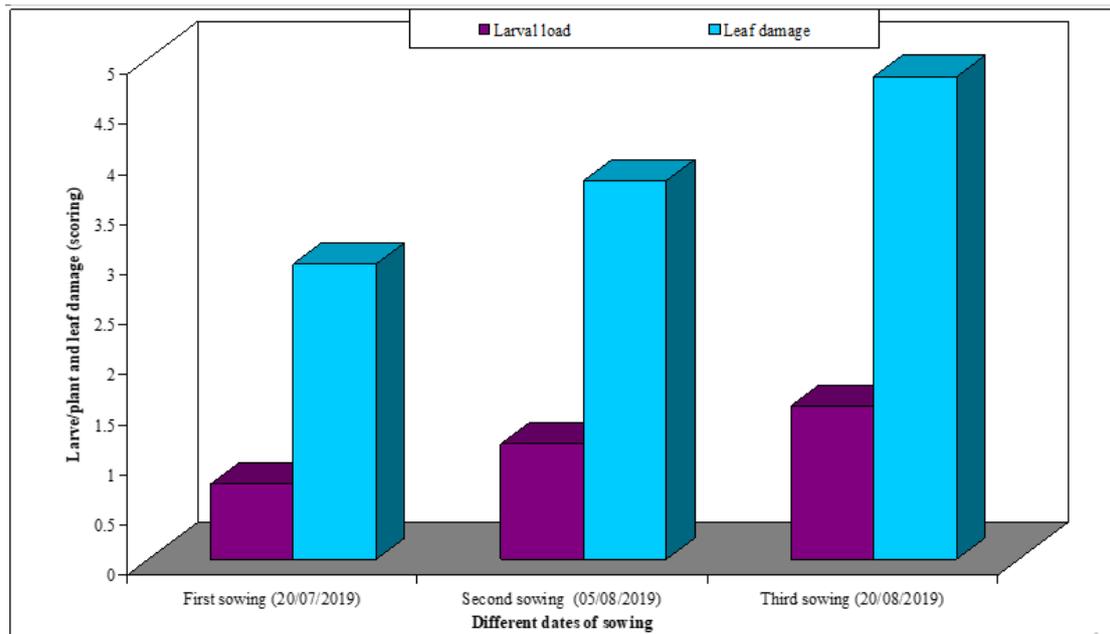
### 3.2 Leaf Damage

The scoring of leaf damage by fall armyworm was significantly least in first sown crop with a leaf damage score of 0.63. The subsequent second and third dates of sown crop registered higher leaf damage score of 1.14 and 1.63, respectively at 15 DAS. Similarly, the leaf damaging score was increased throughout observation upto 85 DAS in all the dates of sowing. The peak leaf damage was noticed at 36 DAS in all the sowing dates with leaf damage score of 6.69, 5.74 and 4.63 in third, second and first sowing, respectively. However, the lowest mean leaf damage score was observed in first sown crop (2.95) followed by second date of sowing (3.78) and the highest mean leaf damage score was noticed in third date of sowing (4.82).

The lowest mean leaf damage score was noticed in first sowing (2.95) whereas, the highest mean leaf damage score was recorded in third sowing (4.82). This might be due to least larval load recorded in first sowing compared to third sowing. Results about the different dates of sowing which affects the incidence of fall armyworm in maize is scanty. However, Nath et al. [6] reported that leaf damage caused by *Spodoptera litura* was highest in late sown groundnut crop (20<sup>th</sup> July) compared to early sown crop (20<sup>th</sup> June and 5<sup>th</sup> July).

The study investigates the impact of different sowing dates on the incidence of fall armyworm infestation and subsequent damage in maize crops. Fall armyworm (*Spodoptera frugiperda*) is a significant member of the Noctuidae family, notorious for its polyphagous nature and its status as a major pest affecting various crops, particularly maize, in regions including India and beyond.

This research holds paramount importance in the context of agro-environmental factors (Bertorelli and Olivares, [7], Hernandez et al. [8], climate dynamics (Campos, [9], Olivares, [10], soil characteristics Olivares, [11] Olivares et al. [12], and agronomic practices [13] prevalent in tropical environments of Latin America, where maize cultivation forms a crucial component of agricultural activities [14], [15]. Understanding the relationship between sowing times and fall armyworm infestation is essential for devising effective pest management strategies [16], optimizing agricultural practices (Hernandez et al. [17], and ensuring food security in these regions Cortez et al. [18], Hernandez et al. [19].



**Fig. 1. Influence of different dates of showing on incidence of fall armyworm**

The findings of this study provide valuable insights into the temporal dynamics of fall armyworm infestation in maize crops Montenegro et al. [20,21] By elucidating the variation in larval load and leaf damage scores across different sowing dates Hernandez and Olivares, [22], the research underscores the significance of timing in mitigating pest pressures [23]. Specifically, the observation of lower mean larval loads and leaf damage scores in crops sown during the July 2nd fortnight compared to those sown in August highlights the potential benefits of timely sowing as a preventive measure against fall armyworm infestation [24, 25, 26].

Moreover, the documented differences in infestation levels based on sowing dates contribute to the existing body of knowledge regarding pest ecology and management strategies in tropical maize agroecosystems [27]. This study adds empirical evidence to the ongoing discourse on the influence of agroclimatic factors (Parra et al. [28], Parra et al. [29] and agronomic practices on pest dynamics, thereby facilitating informed decision-making by farmers, agricultural extension services, and policymakers Parra et al. [30], Olivares et al. [31].

#### 4. CONCLUSION

In conclusion, the investigation into the effect of sowing dates on fall armyworm infestation in

maize offers valuable scientific insights with practical implications for sustainable maize production in tropical environments [32, 33, 34]. By elucidating the temporal dynamics of pest pressure, the study underscores the importance of strategic timing in crop management practices, ultimately contributing to enhanced agricultural resilience and productivity in the face of evolving agro-environmental challenges [35,23,36].

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#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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