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Population dynamics of Fall armyworm, *Spodoptera frugiperda* (J.E Smith) on maize

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Abstract
The present research was conducted during *Kharif* 2023 at B.R.D. P.G. college research farm. The incidence of fall armyworm was initiated during 4th week of July (30th SMW) and become its peak during 35th SMW. It is evident from data presented in table 1 that the population of fall Armyworm larvae was positively correlated with maximum temperature and minimum temperature having r-value 0.3349 and 0.3869, respectively. The incidence of fall armyworm was negatively correlated with morning relative humidity (r= -0.4134), evening relative humidity (r= -0.7156) and rainfall (r= -0.0173).

Keywords: Population dynamics, correlation, fall armyworm, *Spodoptera Frugiperda*, larvae

Introduction

The cereal crop maize (*Zea mays L.)* is the most important crop having wider adoptability under various agroclimatic condition. It belongs to the family poaceae (Gramineae). Globally, maize is also known as "Queen of Cereals" due to its highest genetic yield potential among the cereals (Jeyaraman, 2017) [7]. Various abiotic and biotic factors are responsible to reduction in maize yield, among them insect pests play vital role from the time of planting to harvest, as many as 141 insect pests harm maize to varied degrees (Reddy *et al*,2008) [12]. The primary insect pests of maize are Spotted stem borer (*Chilo partellus* S.), Army worm (*Mythimna separata* W.), Cut worm, (*Agrotis ipsilon* R.), Grass hopper (*Hieroglyphus nigrorepletus*), Sugarcane leaf hopper (*Pyrilla perpusilla* W.), Corn earworm (*Helicoverpa armigera* H.), Shoot fly (*Atherigona soccata*) and Fall armyworm (*Spodoptera frugiperda*) (Kumar *et al*., 2020) [9]. Among these the fall armyworm (FAW), *Spodoptera frugiperda* is the most devastating insect pest of maize (FAO, 2017). It belongs to family- noctuidae, Order- Lepidoptera. Being first detected in the African continent in 2016, the pest is affected at least 28 sub-Saharan African countries by the end of 2017. In May 2018 noticed the first occurrence of the invasive pest *Spodoptera frugiperda* in India, in maize fields at the College of Agriculture in Shivamogga, Karnataka. (Ganiger *et al*., 2018) [4]. According to early studies, this pest has caused crop losses of 33–36% in India (Aruna *et al.*, 2019) [1].

The fact that FAW appears early in the crop life cycle, shows voracious feeding habit, extensive aggressive behaviour, high reproduction, rapid migration, a wide host range, and permanent crop damage make it a significant pest on maize. Females of fall armyworm lay eggs in clusters (160-200 eggs) at the underside of the leaves which is white in colour and spherical in shape. After 3-5 days the eggs turn blackish and hatched. The black headed tiny larvae with greenish black spots are emerges. The late instars larvae show the inverted "Y" on head capsule and four black dots in square pattern at the eighth abdominal segment (Hardke *et al*., 2015) [6]. Full grown larvae get a size up to 3.5 cm. It stops feeding at its full maturity (14-16 days). After that the resting stage pupa arises and long lasting about 6-10 days. Cannibalism is common in larvae of FAW (Paul and Deole, 2020) [11]. Forewing of male is grey brown with white triangular patch at the apical region and circular spot at the centre of the wing, whereas female has uniformly greyish brown forewings mottled with dark brown spots. The hindwings of both male and female are silvery white with a dark border (Ganiger *et al*. 2018) [4].

Materials and methods

Field experiments were conducted during *Kharif* season 2023-24 at Agricultural Research Farm, Baba Raghav Das Post Graduate College, Deoria. The selected experiment site was uniform, cultivable with typical sandy loam soil having good drainage. The Experimental materials for present investigation comprised of maize was sown by dibbling method at the rate of recommendation (*i.e*. 20 Kg/ ha). The meteorological parameters like Temperature, Relative humidity and Rainfall were recorded daily and then converted into weekly basis again in standard meteorological weeks with corresponding weekly population of insect pests.

Identification of FAW larvae

The fall armyworm has a brighter stripe on top of a darker one in this region. Dark brown larvae having inverted 'Y' shape elevated mark present on the head with remarkable four dark or black coloured spots arranged in square form on the 8th abdominal segment whereas trapezoidal ('C' shaped) pattern black dots seen on 9th abdominal segment (Babu *et al*. ,2019) [2]. Neonates, or immature larvae, feed on the leaf, leaving what are known as "windows" that are partially translucent. Larvae prefer to eat the leaf whorl in young plants, while they prefer the leaves around the cob silks and tassels in older plants.

Observations method

The populations of fall armyworm were recorded by visual inspection of plant whorl, leaf and cob. The young larvae were directly observed near the whorls but the availability of excreta nearby whorls indicates the presence of maturing larva into the central whorl and forming dead heart. The plant having dead heart symptom was opened by scraping top leaf sheath and larval counts were taken on randomly five selected plants.

Fig 1: FAW larva with identification mark

Fig 2: Damaged whorl identification

Fig 3: Damaged cob with larva of FAW

Result and discussion

The data represented in Table 2 indicated that the incidence of fall armyworm (FAW) was initiated during 4th week of July (30th SMW) with a population of 1.07 larvae/plant. During this period the maximum and minimum temperature were 33.57 °C and 28 °C respectively whereas maximum RH (morning), minimum RH (evening) and rainfall were recorded as 85.42 %, 65.71% and 6.21 mm respectively. The population increases during 1st week of August (31th SMW) (1.27 larvae/plant) but it gets declined further in next week of August (32th SMW) (0.47 larvae/plant). Thereafter, an increasing trend of the larval population was recorded from 3nd week of August (33th SMW) till 1st week of September (35th SMW), then again population decline from 2nd week of September (36th SMW) (0.67 larvae/plant) until the period of harvesting of the crop. The population of FAW reached to its peak during 1st week of September (35th SMW) with a population level of 1.53 larvae/plant just before harvesting. The weather parameter *viz.*, maximum temperature, minimum temperature, maximum RH, minimum RH and rainfall recorded during the peak period of FAW infestation were 34.57°C, 28.57°C, 80.85%, 62.57% and 7.44 mm, respectively.

Minimum population of FAW were observed during 2nd week of August (32th SMW) with a population of 0.47 larvae/plant.

It is evident from data presented in Table 1 that the population of Fall Armyworm larvae was positively correlated with maximum temperature and minimum temperature having r-value 0.3349 and 0.3869, respectively. The incidence of Fall Armyworm was negatively correlated with morning relative humidity (r= -0.4134), evening relative humidity (r= -0.7156) and rainfall (r= -0.0173).

The present findings on seasonal incidence are in agreement with the results of Kumara *et al*. (2022) [10] who investigated that "the incidence of fall armyworm started in the 1st week of August at 30 days old crop with initial per cent infestation 9.71and reached to peak of 35.43 per cent infestation in the third week of August at 45 days old crop during *Kharif*, 2019". Kalyan *et al.* (2019) [8] noticed that fall armyworm larvae began infesting the crop from the 29th SMW and their numerical abundance peaked during the 33rd SMW with a mean population of 26.50 larvae/10 plants.

The finding of Paul and Deole (2020) [11] supports our findings, who stated that the incidence of larvae was negatively correlated with relative humidity and rainfall while it showed a positive correlation to the minimum and maximum temperature. Similarly, Kumar *et al.* (2020) [9] observed a significant negative correlation of rainfall with the incidence of FAW**.** Nivetha *et al.* (2022) noticed that the correlation study on larval incidence showed the maximum temperature, minimum temperature and rainfall exhibits positive correlation while it was negatively correlated to that of morning and evening RH.

Table 1: Correlation coefficient (r) for larval population of FAW

Weather Parameters	Correlation coefficient
Temp. (°C) (maximum)	0.3349
Temp. (°C) (minimium)	0.3869
Relative Humidity (%) (morning)	-0.4134
Relative Humidity (%) (evening)	-0.7156
Rainfall (mm)	-0.0173

Table 2: Incidence pattern of Fall armyworm larvae

SMW	Period	Larva per plant	Temperature (ºc)		Relative Humidity (%)		Rainfall (mm)
			Max.	Min.	morning	evening	
30	24 July to 30 July	1.07	33.57	28	85.42	65.71	6.21
31	31 July to 06 Aug	1.27	33.71	29	84.28	69.28	1.57
32	07 Aug to 13 Aug	0.47	29.71	27.85	86.28	82.14	0.07
33	14 Aug to 20 Aug	1.00	32.85	27.14	89.14	71.42	0
34	21 Aug to 27 Aug	1.27	29.85	26.85	89	78.42	7.42
35	28 Aug to 03 Sep	1.53	34.57	28.57	80.85	62.57	7.44
36	04 Sep to 10 Sep	0.67	34.57	27.14	86.14	75.42	16.42

Conclusion

On the basis of results obtained in the present studies following conclusion may draw:

1. Fall armyworm (FAW) appeared as most abundant and destructive pest in Maize.
2. Highest population of FAW seen during 35th SMW.
3. Weather parameters together highly influenced the population of FAW.

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