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Exploring the Role of various Abiotic Factors on Occurrence and Population Density of FAW *Spodoptera frugiperda* (J. E. Smith) infesting *rabi* Maize

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ABSTRACT: Maize (*Zea mays* L.) also called as the queen of cereals which belongs to the family Graminae is one of the important grain crop mainly utilized as feed, food and raw material for diverse industrial applications globally. Some reports states that 250 pests attack the maize but only few of pests area reason of concern and require control measures. Among them *Spodoptera frugiperda* is of great concern since it attacks maize in both vegetative as well as reproductive stage and can cause 100% yield loss. Keeping this in mind the field experiment was conducted to study the seasonal occurrence of FAW, *Spodoptera frugiperda* on maize during *rabi* season 2021 and the observations were taken at twice per week. The first incidence of *S. frugiperda* on *rabi* maize was recorded in 48th standard meteorological week (9.00 larvae per quadrat) with its peak population level (25.00 larvae per quadrat) in 51st standard meteorological week. The correlation studies revealed that the relative humidity before the noon and relative humidity in afternoon had positive influence on the larval population of *S. frugiperda,* while maximum temperature and wind speed had negative relationship with larval density of *S. frugiperda* during *rabi* season.

Keywords: Fall armyworm, maize, temperature, population density, incidence and rainfall.

INTRODUCTION

Maize (*Zea mays* L.) is one of the important cereal food crop belonging to family Poaceae, globally known as "Queen of cereals" due to its high genetic yield potential and variability. Among cereals maize ranks third in cereals after rice and wheat and is a staple food for a large segment of the world's population (Malhotra, 2017). The importance of maize to the nutrition of millions of people around the world is widely recognized. Maize or corn is a healthy food due to the presence of numerous nutrients and phytochemicals (USDA, 2019). Phytochemical compounds play an important role in preventing the chronic diseases. It contains various important phytochemicals like carotenoids, phenolics and phytosterols (Shah *et al*., 2016). As a C4 plant, maize has a higher potential output than other cereals (Scott and Emery 2016). However, insect pest attacks at distinct phases of crop growth, from seeding to maturity, severely restrict the crop's ability to reach its full potential yield during different seasons. A number of pests have been reported to be attacking maize, however only a small number of these pests are considered significant enough for their management. The fall armyworm *S. frugiperda* is a polyphagous insect pest resident of tropical and subtropical America (Luginbill, 1928; Sparks, 1979) which rapidly expanding in most of the maize growing areas and thus becoming A1 threat to the globe. In Maharashtra it has emerged as serious menace to the maize growing farmers since it is able to cause a 100 per cent yield loss due to its surprising occurrence right from the seedling to the harvesting stage in maize. An increase in the average temperature, a shift in the pattern of precipitation, and extreme weather occurrences are the indicators of global climate change. The vegetation, fauna, and population dynamics of insect pests would all be impacted by these long-term and seasonal fluctuations. It is well recognised that the climatic conditions directly affect the population dynamics of insect pests and the natural enemies that prey on them by influencing the rates of development, survival, fecundity, voltinism, and dispersion. In light of this, the current study's goal was to determine how meteorological conditions affected the seasonal occurrence of FAW on rabi maize.

MATERIALS AND METHODS

The studies entitled, Population dynamics of *Spodoptera frugiperda* (J.E. Smith) infesting rabi maize were conducted at the Department of Entomology, College of Agriculture (Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani), Campus Latur Dist: Latur (MS)-India during *rabi* season, 2021-22. The non-replicated outdoor experiment was set up with 48 quadrats, each measuring 2.70 by 3 square metres. In 48 quadrats, the well-known local maize variety GOLD-1166 was seeded on November 6, 2021, for the rabi season, with a 45 × 30 cm spacing. The field experiment was carried out without the use of any pesticides. *S. frugiperda's* succession on rabi maize was determined by documenting their observations on the entire plant. Twice throughout each meteorological

week, five randomly chosen plants were taken from each of the three quadrats. Using WASP 2.0 software created by ICAR Research Complex, Goa, the statistical analysis of the data *S. frugiperda* population on rabi maize and meteorological factors was done using simple correlation and multiple regression.

RESULTS AND DISCUSSION

During the course of studies, the weather parameters in *rabi* season *viz*., minimum temperature, maximum temperature, before noon relative humidity, afternoon relative humidity, rainfall and wind speed were ranged from 11.99 to 23.04ºC, 29.4 to 37.00 ºC, 42.31 to 91.2 per cent, 22.3 to 64.5 per cent, 0.00 to 6.25 mm and 18.4 to 27.9 km/h, respectively. The data pertaining to the population of *S. frugiperda* on *rabi* maize during *rabi* season 2021-22 are presented in Table 1.

The first incidence of *S. frugiperda* on *rabi*maize was recorded in 48th standard meteorological week (9.00 larvae/quadrat) with its peak population level (25.00 larvae/quadrat) in 51st standard meteorological week. During the peak population of *S. frugiperda*, the prevailing weather factors *viz*., rainfall, maximum temperature, minimum temperature, before noon relative humidity, afternoon relative humidity and wind speed were 0.00 mm, 29.5ºC, 12.2ºC, 74.4 per cent, 42.4 per cent and 20 km/ h, respectively.

The results of the current investigation are in accordance with the results of Hajare (2020) where he illustrated that the first occurrence of *S. frugiperda* on *rabi* maize was recorded in 44th SMW (12.00 larvae/quadrat) with its maximum population level (21.33 larvae/quadrat) in 47th SMW. Vijayaakshaya Kumar *et al.* (2020) documented that *S. frugiperda* was observed on maize was at the lowest point during second fortnight of October, 2019 (10 per cent) and highest in first fortnight of November, 2019 (72 per cent). Anandhi *et al.* (2020) stated that the larval population of *S. frugiperda* was maximum on maize during *kharif* (0.99 to 3.66 larvae per plant) compared to *rabi* (0.66 to 2.60 larvae/plant) in Cauvery Delta Zone. During *rabi*, population was maximum during 45th SMW (2.10 to 2.60 larvae/plant) and reached the minimum during 3rd SMW (1.00 to1.19 larvae/plant) in various locations. Paul and Deole (2020) exhibited that *S. frugiperda* appeared first on maize during 37th SMW (0.12 larva per plant) with its highest population during 39thSMW (0.56 larva/plant).

Table 1: Succession of *S. frugiperda* on *rabi* maize in relation to weather parameters.

Month	Standard Metrological Week	Rainfall (mm)	Temperature (ºC)		Relative Humidity (%)		Wind speed (km /h)	Average No. of larvae/quadrat
			Min.	Max.	Before noon	After noon		*S. frugiperda*
November 2020	48	-	17.5	29.4	79.4	64.5	22.3	9.00
December 2020	49	-	13.1	31.3	67.4	39.5	21.6	10.66
	50	-	15.6	31.2	67.7	45.2	21.4	24.33
	51	-	12.2	29.5	74.4	42.4	20	25.00
	52	-	12.8	30.5	75.4	43.6	18.4	14.66
January 2021	1	-	16.5	30.4	91.2	53.4	18.7	16.33
	2	1	16.86	31.9	82.53	51.5	19.9	15.33
	3	-	16.2	31.9	81.47	48.1	19.7	12.33
	4	-	16.7	32.8	75.83	43.5	20.0	5.66
	5	1.25	15.39	31.6	76.99	37.7	23.1	5.66
February 2021	6	0.5	11.99	30.9	60.24	32.5	21.7	5.33
	7	-	15.44	32.9	65.86	36.3	24	4.33
	8	6.25	14.6	30.8	72.9	39.6	25.7	3.00
	9	-	18.49	36	48.81	24.8	26.1	1.00
March 2021	10	-	23.4	37	42.48	25.8	26.1	0.66
	11	-	19.1	36.7	42.31	22.3	27.8	0.66

Correlation of *Spodoptera frugiperda* (J.E. Smith) on *rabi* maize with weather parameters. The results of simple correlations between larval population of *S. frugiperda* infesting *rabi* maize and weather parameters during 2021-22 are shown in Table 2.

The data revealed that relative humidity before the noon (r= 0.578*) and relative humidity during afternoon (r= 0.582*) revealed positively significant correlation with larval population of *S. frugiperda*. While maximum temperature (r= -0.653*) and wind speed (r= -0.730*) exhibited negative-significant correlation with larval population of *S. frugiperda*. However, rainfall (r= -0.232) and minimum temperature (r= -0.480) showed negative non- significant correlation with larval population of *S. frugiperda*.

Table 2: Simple correlation of various weather parameters with *S. frugiperda* infesting *rabi* maize.

Weather parameter	Correlation coefficient ('r' values)
	S. frugiperda
Rainfall (mm)	-0.232
Maximum temperature (ºC)	-0.653*
Minimum temperature (ºC)	-0.480
Before noon relative humidity (%)	0.578*
Afternoon relative humidity (%)	0.582*
Wind speed (km per h)	-0.730*

N= 16; *Significant at 5%

Regression studies. Weather based multiple linear regression model was developed in respect of incidence of *S. frugiperda* (Y) as a dependent variable and weather parameters (B1 to B6) as independent variables and presented in Table 3.

Table 3: Multiple regressions of weather parameters with *S. frugiperda* on rabi maize.

Weather parameter	Regression coefficients (b)	SE (b)	T test	T table (0.05)
Rainfall (mm) (B1)	-1.102	1.353	-0.815	2.262
Maximum temperature (ºC) (B2)	-2.931	3.017	-0.971	2.262
Minimum temperature (ºC) (B3)	0.999	1.742	0.573	2.262
Morning RH (%) (B4)	-0.171	0.353	-0.485	2.262
Evening RH (%) (B5)	-0.159	0.569	-0.280	2.262
Wind speed (km per h) (B6)	-1.861	1.410	-1.319	2.262
Intercept (a) = 148.176 **Coefficient of determination (R) Square) = 0.631** Multiple Correlation Coefficient (R) = 0.794 Standard Error =6.146				

The regression equation worked out is as follow.

Y=148.176+ (-1.102) × B1 + (-2.931) × B2 + (0.999) × B3 + (-0.171) × B4 + (-0.159) x B5 + (-1.861) × B6 + 6.146

The equation of regression revealed that the different weather parameters had intense influence on occurrence of *S. frugiperda* on *rabi* maize. The coefficient of determination (R^2= 0.631) which indicated that various weather parameters contributed 63.1 per cent variability in larval population of *S. frugiperda*.

The present results observed are in concurrence with the findings of Paul and Deole (2020) who evidenced that total rainfall indicated a non-significant negative correlation with larval density of *S. frugiperda* on maize. Anandhi *et al.* (2020) stated that larval population of FAW infesting maize varied due to temperatures and rainfall among the locations. Fonseca-Medrano *et al.* (2019) exhibited that relative humidity had positive correlation with *S. frugiperda* population, while precipitation did not affect *S. frugiperda* population significantly. Garcia *et al.* (2019) exhibited that an increase in 1°C of weekly mean temperatures could increase the populations of *S. frugiperda* twice. Murua *et al.* (2006) revealed that temperature and rainfall were the climatologic factors that significantly affected density of *S. frugiperda* on corn.

CONCLUSIONS

The population of *S. frugiperda* was seen minimum during the First fortnight of March, 2022 and the maximum population was found at the second fortnight of December, 2021. Population of the *S. frugiperda* decreases with increase in the rainfall whereas the population increases with increase in relative humidity.

FUTURE SCOPE

Keeping in mind the effect of change in climatic conditions on seasonal incidence and its distribution of FWA should be studied.

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Conflict of Interest. None.

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