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POPULATION DYNAMICS OF FALL ARMY WORM, *SPODOPTERA FRUGIPERDA* (J E SMITH) INFESTING MAIZE

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ABSTRACT

Fall army worm (FAW) *Spodoptera frugiperda* (J E Smith) was found as major pest of maize in Rajasthan. Its peak larval incidence was observed in the first week of August (2.08 larvae/ plant) and second week of August (2.47 larvae/ plant) during 2019 and 2020, respectively. Its damage increased with crop growth and reached up to 48.33 and 58.33% during last week of September (39th SMW) during 2019 and 2020, respectively. The cob damage started in first week of September and peak damage was (36.67 and 42.22%) in the last week of September. Larval incidence exhibited positively significant correlation with mean temperature, and negative significance with rainfall.

Key words: *Spodoptera frugiperda*, population dynamics, maize, incidence, correlation, coefficient, damage, temprature, rainfall, seasonal variations, cob damage

Maize *Zea mays* L. is an important cereal crop next to rice and wheat grown over a wide area (Anonymous, 2013). It is being grown in >166 countries in about 163 million ha area with production of 883 mt (Anonymous, 2012). The yield in developed countries is >8 t/ ha, while in the developing countries it is around 3 t/ ha (Zaidi and Singh, 2005).This is due to poor adoption of hybrids, unbalanced fertilizer application, less irrigation and high level infestation of insect pests and diseases. Among various biotic factors responsible for low production the damage caused by insect pests is important. As many as 141 insect pests cause damage from sowing till harvest (Reddy and Trivedi, 2008). Among the various insect pests, the recent invasive pest, *Spodoptera frugiperda* (J E Smith) is of serious concern due to its rapid spread and polyphagous behaviour. The pest, which is indigenous to America, is highly polyphagous, causing economic damage to various crops such as maize, sorghum, beans and cotton (Day et al., 2017). This invasive pest was first reported in West Africa in late 2016 (Goergen et al., 2016) and by early 2017. This invaded sub Saharan Africa. Recent reports confirm its occurrence in 28 countries of Africa (Cock et al., 2017; Day et al., 2017). Its fast spread is attributed to strong capacity to fly and disperse over long distances. According to recent studies, it can cause yield losses ranging from 8.3 m to 20.6 mt/ year in the absence of management practices (Day et al., 2017). In India, it was reported for the first time on maize from Shivamogga district (Karnataka) during May-June 2018 (Sharanabasappa et al., 2018). The cost of crop protection using pesticides in maize is US$ 71.23, US$ 64.48 and US$ 56.01/ hectare in 2018, 2019 and 2020, respectively (Deshmukh et al., 2021). The knowledge of incidence pattern of *S. frugiperda* of maize plays a great role in its management. The study is on population dynamics of *S. frugiperda* infesting maize.

MATERIALS AND METHODS

The field experiment was conducted during kharif 2019 and 2020 at the Instructional Farm, Department of Entomology, Rajasthan College of Agriculture, MPUAT, Udaipur. The experiment was laid out in plots of size 4.8 x 4.0 m replicated four times. Maize variety Pratap Makka-3 was sown in the prepared field on the 5th July, 2019 and 2nd July, 2020 with row to row and plant to plant spacing of 60 × 25 cm, respectively. The incidence of *S. frugiperda* was recorded on 15 randomly selected plants in terms of number of damaged plants and larval counts. Observations were recorded just after germination. The cob damage at cob formation stage to till harvest was also recorded. Cob damage was recorded on 15 tagged plant % cob damage computed. The abiotic factors viz. mean temperature, relative humidity and total rainfall were recorded during the crop season and their simple correlation with incidence of *S. frugiperda* was calculated by the Karl Pearson formula of correlation coefficient (Fowler et al., 1998). The calculated t-value obtained was compared with tabulated t-value (p=0.05).

RESULTS AND DISCUSSION

The infestation of *S. frugiperda* started in the third week of July (29th SMW) (Table 1). Infestation increased and touched its peak in the first week of August (2.08 larvae/ plant) and second week of August (2.47 larvae/ plant) during 2019 and 2020, respectively The damage increased and reached up to 48.33 and 58.33% in last week of September during 2019 and 2020, respectively. The cob damage started in first week of September and peak (36.67 and 42.22 %) was at last week of September. Larval incidence exhibited positively significant correlation with mean temperature (r= 0.54 and r= 0.64), with a negatively non-significant one with mean relative humidity (r= -0.23). It was negative and significant with rainfall (r = -0.62 and -0.51) during 2019 and 2020, respectively. The multiple linear regression analysis indicated that mean temperature, relative humidity and total rainfall to had a joint influence of 44.2 and 65.2% during 2019 and 2020, respectively. In multiple linear regression equation, the regression coefficient b_1= 0.149 means that holding X_2 (mean relative humidity) and X_3 (total rainfall) constant, with one degree increase in X_1 (mean temperature) led on the average to about 0.149% increase in larva; likewise, b_2= 0.014 means that holding X_1 and X_3, constant, 1% increase in X_2 (mean relative humidity) led on the average to about 0.014 % increase in likewise, b_3=-0.004 means that holding X_1 and X_2 constant, 1 mm increase in X_3 (rainfall) led on the average to about 0.004 % decrease.

The present results agree with those of Ahir et al. (2017), Brahman et al. (2018) and Parmar (2020), on *S. litura* which showed negative and significant correlation with rainfall. The larval counts and % leaf damage of *S. frugiperda* were positively correlation with maximum temperature (Sunitha et al., 2021; Alam et al., 2022). In temperate states of North America, *S. frugiperda* arrives seasonally and then dies out in cold winter. But in much of Africa, continuous generations throughout the year had been reported due to tropical and subtropical climate (Prasanna et al., 2018). As much of India falls under tropical climate, the occurrence of *S. frugiperda*

Table 1. Population dynamics of *S. frugiperda* infesting maize

SMW	Plant damage (%)		No. of larvae/ plant		Cob damage (%)	
	2019	2020	2019	2020	2019	2020
29	13.33	16.67	1.07	1.35	0.00	0.00
30	25.00	28.33	1.97	2.22	0.00	0.00
31	33.33	38.33	2.08	2.42	0.00	0.00
32	35.00	41.67	0.77	2.47	0.00	0.00
33	36.67	43.33	0.83	1.28	0.00	0.00
34	38.33	43.33	1.70	0.50	0.00	0.00
35	40.00	45.00	0.85	1.30	12.22	13.33
36	43.33	46.67	1.35	0.57	16.67	17.78
37	45.00	50.00	1.48	1.42	21.11	23.33
38	46.67	53.33	1.27	1.48	28.89	35.56
39	48.33	58.33	0.80	0.97	36.67	42.22

Larval incidence vs weather parameters

Weather parameter		2019	2020
Temperature (^{0}C)	Maximum	0.47	0.37
	Minimum	0.43	0.72*
	Mean	0.54*	0.64*
Relative humidity (%)	Morning	-0.37	-0.41
	Evening	-0.14	-0.10
	Mean	-0.23	-0.23
Total rainfall (mm)		-0.62*	-0.51*
Regression equation		Y = -3.539+(0.149) X_1+(0.014)X_2+(-0.004)X_3	Y = -16.274+(0.477) X_1+(0.070)X_2+(-0.006)X_3
R^2 value		0.442	0.652

*Significant at 5% level; X_1 - Temperature; X_2 -Relative humidity; X_3 - Rainfall; SMW - Standard Meteorological Week

throughout the year is expected (Sharanabasappa et al., 2018). Kumar et al. (2020) observed that occurrence of *S. frugiperda* in terms of larval population showed significant positive correlation with the maximum temperatures (r=0.7205) and significant negative correlation with relative humidity (r= -0.6739) and rainfall (r= -0.8293) in Perambalur district. Paul and Deole (2020) reported that *S. frugiperda* demonstrated a significant positive correlation with maximum temperature (r=0.586). Pradeep et al. (2022) reported that its infestation appeared soon after emergence of the crop. The larval counts were found higher in kharif than rabi. Maximum larvae/ plant was noticed in the early whorl stage in July (1.72), followed by August (0.70). However, the infestation gradually declined thereafter in September as the crop entered the reproductive stage.

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AUTHOR CONTRIBUTION STATEMENT

K C Ahir, M K Mahla and N L Dangi conceptualized and designed the study, K C Ahir conducted the study, Kuldeep Sharma and Beerendra Singh helped K C Ahir in taking the observations, analysed the data and authored the report under the supervision of M K Mahla.

CONFLICTS OF INTEREST

No conflict of interest

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