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

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ABSTRACT

Population dynamics of the fall army worm (FAW) *Spodoptera frugiperda* on maize was carried out at the research field of Tamil Nadu Agricultural University, Coimbatore (kharif and rabi, 2018 and 2019). The results revealed that maximum FAW trap catches were obtained during 34th (7.6 moths/ trap) and 5th (7.8 moths/ trap) standard weeks (SW) of kharif and rabi seasons of 2018, respectively. During 2019, a more or less similar trend was observed with a maximum during 31st (7.2 moth/ trap) and 48th (8.2 moth/ trap) SW of kharif and rabi seasons, respectively. Correlation with weather factors indicated a significant negative correlation with evening relative humidity (RH) and significant positive correlation with morning RH during 2019-20. No significant effect of weather factors was observed during 2018-19 except for a significant positive correlation with evening RH and rainfall. The correlation between larval counts and pheromone trap catches were significantly positive with r-value of 0.55 and an R^2 value of 0.907 during 2018-19.

Key words: Maize, *Spodoptera frugiperda*, population dynamics, trap catches, temperature, relative humidity, rainfall, correlation and regression coefficients, pheromone trap, larval counts

The fall army worm (FAW) *Spodoptera frugiperda* (J E Smith) (Lepidoptera: Noctuidae) is the recent invasive polyphagous pest in India (Shylesha et al., 2018; Mallapur et al., 2018). Yield loss as high as 34% due to *S. frugiperda* had been reported (Cruz,1999; Williams and Davis,1990). Population dynamics/ fluctuations of any pest species are influenced by environmental factors such as temperature, rainfall/ precipitation and relative humidity (Prasad et al., 2008.). It has been proven that sex pheromone is a potential tool for monitoring of insect pest species and its management through mating disruption or male annihilation. Thus, developing an effective integrated management strategy for *S. frugiperda* in its new habitat (i.e., India), requires information on its population dynamics. Hence, this study on the influence of weather factors on the seasonal incidence of *S.frugiperda*.

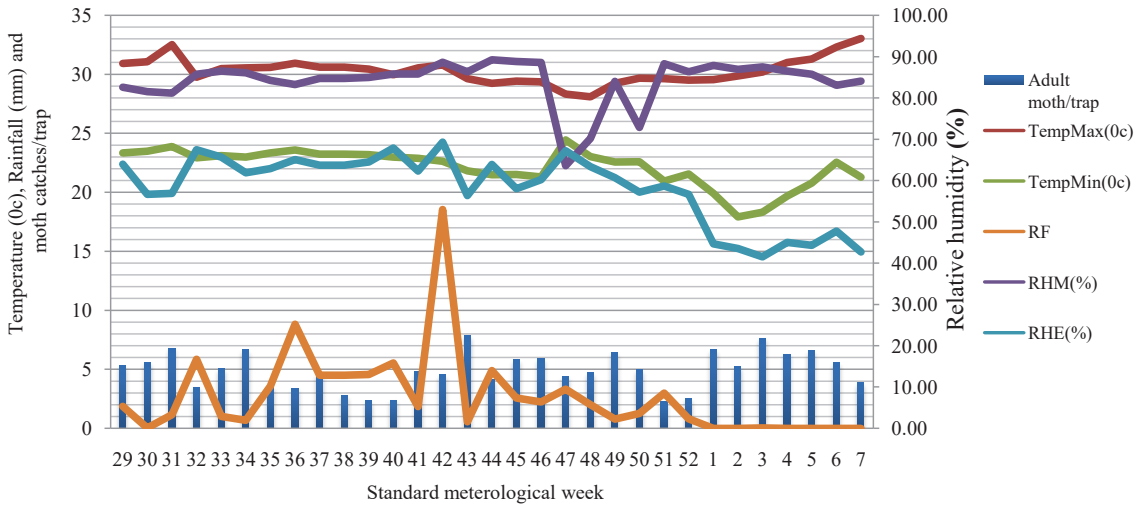
MATERIALS AND METHODS

Field experiments on maize (CO-H6) were conducted at the Research field of Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu for two seasons (kharif and rabi) during 2018-19 and 2019-20 with standard maize cultivation practices under irrigated conditions. Funnel type pheromone traps and sex pheromone septa manufactured by Pheromone Chemicals (India) Pvt. Limited, Hyderabad were used for monitoring *S. frugiperda* moths @ 12.5 traps/ ha installed 10 days after sowing at a height of 2 m above ground level at three field sites. Pheromone traps were undisturbed with the activity of cultivation of crops. Septa and lure were changed periodically on exhaustion at 15 days interval throughout the season. Trap catches of moths were sorted and counted, and in males in which markings were not clear, genitalia were dissected to confirm the identity. To ascertain the relationship between moth catches and larval counts, fields were sampled from maize emergence until tasseling and silking stages. Data pertaining to the larval incidence was observed from 20 randomly selected plants following 'W' pattern in a zigzag manner at weekly intervals (Prasanna et al., 2018). All the open leaves and whorls of selected plants were observed thoroughly for larvae in a non-destructive manner to allow continuous collection over the crop cycle (VE: emergence, V1: first leaf collar to V(n): n^{th} leaf collar). Data on maximum and minimum temperature, morning and evening RH, rainfall (mm) were obtained from the Meteorological unit of Agroclimatic Research Centre, TNAU, Coimbatore. Weekly trap catches were recorded

as number of moths/ trap. Spearman's correlation analysis was performed to determine correlations between moth catches and weather data. Correlation and regression an analysis was done using SPSS 16.0 software. A one-way ANOVA was conducted to assess statistically significant differences in FAW density across maize development stages.

RESULTS AND DISCUSSION

Trap captures of *S. frugiperda* varied significantly in different weeks of growing season (kharif and rabi) in 2018 and 2019. Trap catch data indicate that the *S. frugiperda* survived year round in this location; in 2018, the incidence was maximum during 34th (7.6 moth/ trap) and 5th (7.8 moth/trap) standard weeks (SW) of kharif and rabi seasons, respectively (Fig. 1); during 2019, a more or less similar trend was observed with a maximum during 31st (7.2 moths/ trap) and 48th SW (8.2 moth/ trap), kharif and rabi seasons and the least during 44th (1.2 moth/ trap) and 6th SW (1.9 moth/ trap). Pooled data revealed that peak activity was during 43rd SW (7.85 moths/ trap). These results are in accordance with earlier results of Kumar et al. (2020) who observed its peak incidence in second fortnight of July 2019 and minimum in second fortnight of October during kharif season. Similarly, Nboyine et al. (2020) reported that the moth trap catches increased from July and peak was during August; thereafter moth catches declined significantly. During kharif 2018, the trap catches revealed a non significant positive correlation with maximum temperature (r=0.127), minimum temperature (r=0.073) and significant negative correlation with evening RH (r=-0.714) and rainfall (r=-0.763) while non significant negative correlation with morning RH. No significant impact of weather was noticed during rabi 2018 and about 81.3% and 26.2% variation in moth trap catches was due to all weather factors considered in multiple regression for both kharif and rabi seasons, respectively (Fig. 1). During kharif 2019, correlation coefficient with maximum temperature and morning RH were non-significant and positive (r=0.438 and 0.217) while with rainfall it was significant and positive (r=0.088). Multiple regression indicated that about 43.0 and 51.4% variation in trap catches is contributed by the weather factors. The pooled data revealed that maximum temperature (r = 0.61) and evening RH (r = 0.59) had significant correlation with trap catches during kharif season, while during rabi season all the weather



Correlation coefficients and regression- incidence of S. frugiperda vs. weather factors

Year		Max.Temp(^{0}C)	Min.Temp(^{0}C)	Mor. RH (%)	Eve. RH (%)	Rainfall (mm)
2018-19	Kharif	0.127	0.073	-0.493	-0.714*	-0.763*
(Moth trap	Y=37.892+(-0.934X_1)+(1.144X_2)+(-0.081X_3)+(-0.373X_4)+(-0.123X_5)+1.107					R^2 = 0.813
catches)	Rabi	-0.211	0.211	0.108	-0.241	-0.206
	Y=26.698+(-1.123X_1)+(0.961X_2)+(0.078X_3)+(-0.272X_4)+(-0.297X_5)+2.098					R^2 = 0.262
2019-20	Kharif	0.438	-0.115	0.217	-0.387*	0.088*
(Moth trap	Y=-18.218+(0.429X_1)+(-0.133X_2)+(0.268X_3)+(-0.148X_4)+(0.035X_5)+1.663					R^2 = 0.430
catches)	Rabi	0.340	-0.435	0.268*	-0.485*	-0.364*
	Y=88.327+(2.849X_1)+(1.091X_2)+(0.106X_3)+(0.557X_4)+(0.087X_5)+1.472					R^2 = 0.514

Fig. 1. Population dynamics of *S. frugiperda* on maize (pooled data, kharif and rabi, 2018, 2019)

parameters exhibited a nonsignificant correlation. Paul and Deole (2020) and Kumar et al. (2020) reported that larvae of *S. frugiperda* exhibited a significant negative correlation with total rainfall and RH, which are in conformity with this study. On the contrary Nboyine et al. (2020) reported that moth trap catches of *S. frugiperda* had a significant and positive correlation with rainfall (r=0.714).

There was no significant difference in *S. frugiperda* density across maize growth stages during 2018 and 2019. During early plant stages (V2-V3), first and second instar were predominant, and about two to three larvae/ plant were found while in V11-V12 maize growth stage *S. frugiperda* in late larval stage were more frequently observed in 2018 and a similar trend was also observed in 2019. *S. frugiperda* is known to prefer feeding in the vegetative stages of maize within whorl (Capinera, 2008) and the results from this study show that *S. frugiperda* larvae builds up until V8-V10 and then decreased from V11-V12. Murua et al. (2006) reported that *S. frugiperda* infestations displayed a plant age-dependent response with the VE– V3 stages being the most preferred stages. Bessera et al. (2002) and Granger et al. (2020) reported that the distribution of *S. frugiperda* larvae and eggs varied according to the phenological stage of the crop. Nboyine et al. (2019) with correlation studies indicated that weekly trap catches of *S. frugiperda* were linearly and positively correlated with larval counts in maize. It is concluded that understanding the population dynamics will be helpful in formulating IPM strategies against *S. frugiperda*.

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