Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2023; 11(5): 33-39

Received: 05-06-2023
Accepted: 10-07-2023

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Seasonal incidence of fall armyworm, *S. frugiperda* in maize

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DOI: https://doi.org/10.22271/j.ento.2023.v11.i5a.9229

Abstract
The activity of FAW in maize was observed throughout the crop period during *rabi*, 2019-20 and 2020-21. The activity commenced (3.50 & 4.00 larvae/10 plants; 58.33 & 60.00% plant damage, respectively) in the 3rd week of November (46th SMW) and continued till the 2nd week of February (6th SMW). After the appearance of FAW, it gradually increased and reached its peak (7.67 & 7.83 larvae/10 plants; 81.67 & 83.33% plant damage, respectively) during the 4th week of December (51st SMW). In the following week, it gradually declined and reached 1.67 and 1.83 larvae per 10 plants along with 58.33 and 60.00 per cent of plant damage during the 2nd week of February (6th SMW), respectively. The per cent cob damage began from the 3rd week of January (2nd SMW) and it was 23.33 and 26.67 per cent during 2019-20 and 2020-21, respectively. Thereafter, it continuously increased and lasted up until the crop was harvested on the 2nd week of February (6th SMW), when it hit 55.00 and 58.33 per cent for both years, respectively. The incidence of FAW exhibited a highly significant positive association with minimum temperature and evening relative humidity. The maximum temperature showed a significant positive correlation, whereas rainfall and evaporation showed a significant negative correlation with the population build-up of FAW.

Keywords: Fall armyworm (FAW), standard meteorological week (SMW), correlation

Introduction

Invasive alien species cause a serious threat to agriculture and cost billions of dollars in terms of reduced production and productivity. A recent study showed that about 1300 species of invasive insect pests and pathogens have been introduced into 124 countries (Paini *et al*., 2016) [1]. The Fall Armyworm is one of them an invasive pest of maize that is native to the United States of America (Anonymous, 2019a) [2]. It has not been detailed in any other portion of the world except the North, Central and South United States of America up to 2015. Then, it was reported in the African continent which caused serious damage to maize crops in January 2016 (Goergen *et al*., 2016) [3]. In India, it was reported in maize crops in different areas of Karnataka on 18th May 2018 (Sharanabasappa *et al*., 2018) [4]. The potential FAW has come to India and Indo-china by characteristic relocation from Africa with the help of the Somali Flight. After the first time report of FAW on maize in Karnataka, later it was reported from different parts of the country (Deole and Paul, 2018 [5]; Sisodiya *et al*., 2018 [1]; Meena *et al*., 2019 [7]; Dhar *et al*., 2019 [8]; Jitendra *et al*., 2019 [9] and Kerketta *et al*., 2020 [10]).

FAW can be a cosmopolitan pest because it attacked more than 100 hosts (Wiseman *et al*., 1966) [11]. It brought about principal damage to economically important cultivated grasses such as rice, maize, sorghum, and sugarcane as well as horticultural crops like cabbage, beet, tomato, potato and onion other than cotton, pasture grasses, peanut, soybean, alfalfa and millets (Chapman *et al*., 2000) [12].

In general, the maize infestation by FAW ranged from 26.4 to 55.9 per cent and impacted yield of 11.57 per cent (Baudron *et al*., 2019) [13] but, it's the severity of damage varies from region to region. According to the initial reports, FAW had been attributed to 33-36 per cent corn yield losses in India (Jagdish *et al*., 2019; Balla *et al*., 2019) [14, 15]. This pest becomes havoc in various states of India and it affected 1.4 lakh ha in Karnataka; 85,000 ha in Madhya Pradesh; 59,000 ha in Rajasthan; 2000 ha in Maharashtra; 1,747.9 hectares in Mizoram; 200 ha in Tamil Nadu and 137 ha in Andhra Pradesh (Anonymous, 2019b) [16].

In nature, the distribution and abundance of animals are determined by the combined effect of different components of environments (Andrewartha and Birch, 1954) [17]. Among the various factors; temperature, humidity, rainfall, the intensity of light and other physical factors play a vital role in population fluctuations of any pest species and have a direct influence on their abundance (Atwal and Bains. 1974) [18]. Therefore, a study on the population dynamics of the pests provides a base for devising ecologically sound and eco-based programmers for their management.

Materials and Methods

The field experiment on the seasonal incidence of FAW in maize was conducted at Entomology farm, B. A. College of Agriculture, Anand Agricultural University, Anand during *rabi*, 2019-20 and 2020-21. The maize variety GAYMH-3 was grown in the 16.4 x 12. 6 m plot with 60 x 20 cm spacing as well as all standard agronomical practices except the application of insecticide.

For recording the various observations, the whole plot was divided into six equal quadrates and each measuring 3.6 x 5.6 m. The ten plants were selected randomly from each quadrate for recording the above observations. The number of the larvae and damaged and healthy plants were recorded at the weekly intervals after germination of the crop up to the harvest of the crop while damaged and healthy cobs were recorded at weekly intervals starting with cob formation continuing through harvest. Per cent plants and cobs damage were estimated using healthy and damaged plants and cobs.

The data of environment factors *viz*., maximum (MaxT) and minimum (MinT) temperature, morning (RH1) and evening (RH2) relative humidity, evaporation (EP), bright sunshine (BSS), wind speed (WS), morning (VP1) and evening (VP2) vapour pressure were correlated with the larval population of *S. frugiperda*. Week-wise data on various weather parameters were recorded by the Department of Meteorology, B. A. College of Agriculture, Anand Agriculture University, Anand during 2019-20 and 2020-21 and were used for correlation coefficient analysis. A simple correlation was worked out between the weather parameters and FAW by adopting a standard statistical procedure (Steel and Torrie, 1980) [19].

Result and Discussion

Incidence of *S. frugiperda*

Based on larval population First Year (*Rabi*, 2019-20)

The periodical week-wise data on the number of larvae per 10 plants are shown in Table 1. According to data, the fall armyworm activity was started (3.50 larvae/10 plants) from the 3rd week of November (46th Standard Meteorological Week) up to the 2nd week of February (6th SMW) with a range of 1.67 to 7.67 larvae per 10 plants. The larval population fluctuated during the crop period and was found throughout the study period. After the appearance of FAW, the larval population increased 1.5 times (6.00 larvae/10 plants) during 1st week of December (48th SMW) and peaked (7.67 larvae/10 plants) in the 4th week of December (51st SMW). In the subsequent week, it gradually decreased and reached 1.67 larvae per 10 plants in the 2nd week of February (6th SMW). Thus, relatively higher activity (6.00 to 7.67 larvae/10 plants) was observed during the 1st week of December (48th SMW) to the 4th week of December (51st SMW) *i.e*., Knee-high stage to tasseling stage of maize. During the relatively higher activity time, the maximum temperature was 34.97, 32.21, 30.21 and 30.21 °C, the minimum temperature was 19.57, 20.14, 19.97 and 18.93 °C, morning relative humidity was 90.57, 73.29, 87.43 and 82.57 per cent, evening relative humidity was 54.00, 51.00, 46.14 and 55.57 per cent, evaporation was 2.41, 3.36, 2.54 and 2.50 mm, windspeed was 2.39, 5.09, 2.76 and 4.00 hour per day and morning vapour pressure was 15.96, 11.89, 10.81 and 11.31 mm of Hg, respectively. However, the lower larval population was observed during the early whorl and late reproductive stages.

Second Year (*Rabi*, 2020-21)

The periodical week-wise data on the incidence of fall armyworm in maize are given in Table 2. As per the previous year, the FAW activity began (4.00 larvae/10 plants) from the 3rd week of November (46th SMW) until the 2nd week of February (6th SMW). The larval population of *S. frugiperda* ranged between 1.83 to 7.83 larvae per 10 plants during its period of activity. The larval population fluctuated and was observed throughout the crop period. After the arrival of FAW, it increased by about 1.5 times (6.67 larvae/10 plants) during the 1st week of December (48th SMW) and reached its peak (7.83 larvae/10 plants) during the 4th week of December (51st SMW). Thereafter, the incidence progressively decreased until it reached 1.83 larvae per 10 plants on the 2nd of February (6th SMW). Thus, there was noticeably higher activity of FAW (6.67 to 7.83 larvae/10 plants) was observed between the 1st week of December (48th SMW) and the 4th week of December (51st SMW) *i.e*., between Knee-high stage and tasseling stage of maize. In this time range, the maximum temperature was 33.43, 32.71, 32.58 and 31.57 °C, the minimum temperature was 19.57, 19.14, 17.93 and 17.98 °C, morning relative humidity was 76.57, 87.86, 74.14 and 82.00 per cent, evening relative humidity was 41.57, 40.14, 62.43 and 54.29 per cent, evaporation was 3.57, 2.83, 2.00 and 2.71 mm, windspeed was 4.27, 1.46, 2.29 and 3.74 hour per day and morning vapour pressure was 12.21, 11.94, 14.62 and 9.33 mm of Hg, respectively. While the lower larval population was seen throughout the early whorl and late reproductive stages.

The present findings are very closely in agreement with Asangi's (2020) [20] finding, which noted the incidence of *S. frugiperda* in maize from the 2nd week of November (47th SMW; 2nd WAS) to the 2nd week of February (6th SMW; 14th WAS). But, it is more or less in conformity with below workers because Bajirao (2020) [21] noted the occurrence of FAW between the 1st week of November (44th SMW; 3rd WAS) and persisted through the 3rd week of January (3rd SMW; 14th WAS) in maize whereas Bagoji (2022) [22] recorded the activity of *S. frugiperda* in sweet corn from the 3rd week of December (51st SMW; 3rd WAS) to the 1st week of March (10th SMW; 14th WAS).

Anandhi *et al*. (2020) [23] estimated seasonal incidence of FAW during *kharif* (1.02 to 3.36 larvae/plant) and *rabi* (0.82 to 2.28 larvae/plant) in the Cauvery Delta Zone of Tamil Nadu. According to Asangi (2020) [20], the initial (0.08 larva/plant) activity of FAW in the 3rd week of November (47th SMW) and it peaked (0.88 larva/plant) during the 4th week of January (1st SMW) and the 11th week after sowing of maize. Then it continuously decreased throughout the crop period. According to Bagoji (2022) [22], the FAW activity started (0.10 larvae/plant) in the 3rd week of December (51st SMW; 3rd WAS) and then it gradually increased and peaked (0.77 larvae/plant) during the 2nd week of February (7th SMW; 11th WAS). In the subsequence week, it continues to decrease (0.10 larvae/plant) up to the 1st week of March (10th SMW; 14th WAS). Thus, the above reports are more or less tally with the present findings.

Wyckhuys *et al*. (2006) [24] recorded that the fall armyworm infestation was lowest during the early whorl (1.45±71.85%) and post-whorl stage (3.94±76.56%) and it's highest during the whorl stage (5.13±75.49%). Kuate *et al*. (2019) [25] found a negative correlation between the incidence of FAW and the age of the plants. Thus, the findings of the above workers are more or less in conformity with the present findings.

Based on plant damage (%)

First Year (*Rabi*, 2019-20)

The percentage of the damaged plants by fall armyworm is shown in Table 1. The periodical week-wise data indicated that the plant damage by fall armyworm coincided with the larval population. It started (16.67% damaged plants) from the 3rd week of November (46th SMW) and continued through the 2nd week of February (6th SMW). The FAW caused damage to plants that ranged from 16.67 to 81.67 percent. The percentage of plants damaged by FAW fluctuated throughout the crop period. Following the beginning of FAW, plant damage increased threefold (51.67% damaged plant) during 1st week of December (48th SMW) and peaked (81.67% damaged plants) in the 4th week of December (51st SMW). Later, it began to gradually decrease and fell to 58.33 per cent of plant damage on the 2nd week of February (6th SMW). Between the first week of December (48th SMW) and 4th week of December (51st SMW) or from the knee-high stage to the tasseling stage of maize, a considerably greater per cent of damaged plants (51.67 to 81.67% damaged plant) by FAW were detected. During this period, the major meteorological parameters like; the maximum temperature was 34.97, 32.21, 30.21 and 30.21 °C,

the minimum temperature was 19.57, 20.14, 19.97 and 18.93 °C, morning relative humidity was 90.57, 73.29, 87.43 and 82.57 per cent, evening relative humidity was 54.00, 51.00, 46.14 and 55.57 per cent, evaporation was 2.41, 3.36, 2.54 and 2.50 mm, windspeed was 2.39, 5.09, 2.76 and 4.00 hour per day and morning vapour pressure was 15.96, 11.89, 10.81 and 11.31 mm of Hg, respectively.

Second Year (*Rabi*, 2020-21)

The results on per cent of the damaged plants by FAW are given in Table 2. According to data, the per cent damaged plants by fall armyworm corresponded to the larval population of FAW and As per the previous year, it began (18.33% damaged plants) in the 3rd week of November (46th SMW) and lasted until the 2nd week of February (6th SMW), with a range of 18.33 to 83.33 per cent. With the commencement of FAW, plant damage increased 3 times (58.33% damaged plant) in 1st week of December (48th SMW) and peaked (83.33 per cent damaged plants) in the 4th week of December (52nd SMW). In the subsequent week, it progressively decreased until it reached 60 per cent plant damage in the 2nd week of February (6th SMW). Thus, there was a considerably greater per cent of damaged plants by FAW (58.33 to 83.33% damaged plant) observed between the 1st week of December (48th SMW) and the 4th week of December (52nd SMW) *i.e*., Knee-high stage to tasseling stage of maize. In this time range, the major abiotic factors like; the maximum temperature was 33.43, 32.71, 32.58 and 31.57 °C, the minimum temperature was 19.57, 19.14, 17.93 and 17.98 °C, morning relative humidity was 76.57, 87.86, 74.14 and 82.00 per cent, evening relative humidity was 41.57, 40.14, 62.43 and 54.29 per cent, evaporation was 3.57, 2.83, 2.00 and 2.71 mm, windspeed was 4.27, 1.46, 2.29 and 3.74 hour per day and morning vapour pressure was 12.21, 11.94, 14.62 and 9.33 mm of Hg, respectively.

This finding is less or more by the reports of Asangi (2020) [20] who noted the damaged plants varied from 8.33 to 58.31 per cent. According to Patel (2020) [26], the percentage of plant infestation that was caused by FAW ranged from 10.00 to 81.66 per cent. Reddy (2020) [27] reported the maximum number of damaged plants by FAW on sweet corn was 89.13 per cent. Sunitha (2020) [28] observed a minimum plant infestation (16.67%) during the 1st week of December and a maximum plant infestation (60.00%) was recorded in the 2nd week of October. Chaudhary (2021) [29] noted the damaged plants by fall armyworm in maize varied from 06.40 to 72.24 per cent. Bagoji (2022) [22] recorded per cent damaged plants by fall armyworm in sweet corn which ranged from 3.33 to 66.88 per cent. However, it does not agree with Ahir's (2021) [30] finding who noted the percentage of plant infestation that was caused by FAW ranged from 13.33 to 33.33 per cent.

Based on cob damage (%)

First Year (*Rabi*, 2019-20)

The results of the per cent of cob damage per 10 plants are presented in Table 1. The periodical week-wise data showed that the per cent cob damage caused by fall armyworm initiated during the 3rd week of January (2nd SMW) or baby corn (Blister) stage was 23.33 per cent. Thereafter, it gradually increased until the 2nd week of February (6th SMW), when it hit 55.00 per cent.

Second Year (*Rabi*, 2020-21)

The data on per cent of cob damage per 10 plants are presented in Table 2. Similar to the previous year, the data revealed that the per cent cob damage by fall armyworm was initiated (26.67%) during the 3rd week of January (2nd SMW) or baby corn (blister) stage. Then, it gradually increased until it reached 58.33 per cent during the 2nd week of February (6th SMW).

According to Rodríguez-del-Bosque *et al*. (2011) [31], the FAW caused damage to maize shanks and cobs between 10 and 50 per cent. Chimweta *et al*. (2020) [32] estimated FAW damage caused to leaves, silk, and corncobs in maize and it ranged from 46.66 to 60.33 per cent. Patel (2020) [26] recorded cob damage caused by fall armyworm in maize ranging from 46.66 to 60.33 per cent. Thus, the above reports more or less tally with the present findings whereas Ahir's (2021) [30] report does not tally with the current finding because they noted very little cob damage (12.22 to 36.67%) caused by FAW in maize.

Correlation Coefficient between Weather Parameters and Incidence of *S. frugiperda* in Maize

The population of insect pests is never truly constant. Any insect pest's population density can alter depending on many abiotic factors like temperature, rainfall, humidity etc. It is possible to determine the effect of various weather parameters on the incidence of FAW in maize by using the simple correlation between the weekly mean population of FAW and the weekly mean value of different weather parameters.

Based on larval population

First Year (*Rabi*, 2019-20)

The data on the correlation between weather parameters and the larval population of *S. frugiperda* infesting maize are presented in Table 3. Data revealed that the minimum temperature (r = 0.686) and evening relative humidity (r = 0.709) both had a highly significant positive relationship with the larval population of fall armyworm. While maximum temperature (r = 0.536) exhibited a significant positive correlation and wind speed (r = 0.183), evening vapour pressure (r = 0.035) and bright sunshine hours (r = 0.005) had a non-significant positive correlation. The evaporation (r = -0.660) and rainfall (r = -0.601) showed a significant negative correlation while morning relative humidity (r = -0.169) and morning vapour pressure (r = - 0.204) had a non-significant negative correlation.

Second Year (*Rabi*, 2020-21)

The results of the investigation into the relationship between weather parameters and the larval population of *S. frugiperda* in maize are presented in Table 3. Data showed similar results to the previous year in that the minimum temperature (r = 0.670) and evening relative humidity (r = 0.686) showed a highly significant positive association. While maximum temperature (r = 0.583) exhibited a significant positive correlation and wind speed (r = 0.250), morning vapour pressure (r = 0.200), bright sunshine hours (r = 0.027), rainfall (r = 0.391) and evening vapour pressure (r = 0.409) all had a non-significant positive correlation. However, evaporation (r = -0.547) showed a significant negative correlation and morning relative humidity (r = -0.175) had a non-significant negative correlation.

Rojas *et al*. (2004) [33] found a positive correlation of male FAW with wind speed and temperatures and a negative correlation with relative humidity. Bajirao (2020) [21] recorded the population of fall armyworm showed a significant positive correlation with minimum temperature (r = 0.557) and maximum temperature (r = 0.216) while a negative correlation with morning relative humidity (r = -0.368). Kumar *et al*. (2020) [34] revealed that the maximum temperatures (r = 0.720) had a significant positive correlation while relative humidity (r = - 0.674) and rainfall (r = - 0.744) showed a significant negative correlation with the population of *S. frugiperda*. Manohar (2020) [35] reported a significant positive correlation with minimum temperature (r = 0.661), maximum temperature (r = 0.581) and bright sunshine hours (r = 0.701) while a negative relationship with morning relative humidity (r = -0.507) and evening relative humidity (r = -0.410). Kavitake (2021) [36] found a significantly positive correlation between the maximum temperature (r = 0.780) and minimum temperature (r = 0.130) while a significantly negative relationship with relative evening humidity (r = -0.410) and rainfall (r = -0.530). Thus, the present findings are more or less in agreement with the reports of earlier researchers.

The current investigation does not tally with a highly significant negative correlation between wind speed (r = -0.890) and evening relative humidity (r = -0.904) as noted by Patel (2020) and Bagoji (2022) [22], respectively as well as Chaudhary (2021)'s report who recorded a positive correlation with morning relative humidity (r = 0.040) whereas others weather parameters are more or less confirm to present finding.

All above researchers found that the population of fall armyworm exhibited a significantly positive correlation with temperature and a significantly negative- correlation with relative humidity and rainfall with the population build-up of FAW. The present findings are more or less agreed with the above researchers.

Table 1: Seasonal incidence of *S. frugiperda* in maize in relation to different weather parameters (2019-20)

Month	Week	SMW	WAS	No. of larva(e)/10 plants	Plant damage (%)	Cob damage (%)	MaxT (oC)	MinT (oC)	RH (%)	RH (%)	EP (mm)	BSS (hr/day)	WS (km/hr)	VP1 (mm of Hg)	VP2 (mm of Hg)	RF (mm)
November	II	45	2	0.00	00.00	-	28.84	14.51	92.43	39.43	3.40	06.40	2.16	19.29	20.23	4.40
	III	46	3	3.50	16.67	-	32.14	16.21	89.57	45.29	3.10	08.09	1.87	16.19	15.20	0.00
	IV	47	4	4.83	38.33	-	31.36	17.79	91.00	45.71	2.64	07.27	1.46	14.46	15.06	0.00
December	I	48	5	6.00	51.67	-	34.97	19.57	90.57	54.00	2.41	06.69	2.39	15.96	16.96	0.00
	II	49	6	6.83	70.00	-	32.21	20.14	73.29	51.00	3.36	09.33	5.09	11.89	13.89	0.00
	III	50	7	7.33	76.67	-	30.21	19.97	87.43	46.14	2.54	08.73	2.76	10.81	14.12	0.00
	IV	51	8	7.67	81.67	-	30.21	18.93	82.57	55.57	2.50	08.04	4.00	11.31	14.59	0.00
January	I	52	9	5.33	78.33	-	31.50	18.24	70.00	37.63	2.71	06.10	3.35	08.37	15.86	0.00
	II	1	10	4.50	73.33	-	25.46	12.69	89.43	48.43	2.39	06.71	3.27	10.40	11.54	0.00
	III	2	11	3.50	68.33	23.33	26.57	13.81	79.71	44.14	3.24	07.97	4.60	10.11	10.57	0.00
	IV	3	12	4.17	68.33	38.33	29.64	9.67	87.00	48.43	2.93	08.94	3.39	08.29	10.84	0.00
	V	4	13	3.83	63.33	45.00	27.79	12.96	84.43	43.71	3.17	08.99	3.00	09.87	11.19	0.00
February	I	5	14	3.17	60.00	51.67	26.43	10.99	83.29	37.29	3.80	09.26	3.36	08.49	09.47	0.00
	II	6	15	1.67	58.33	55.00	23.64	12.13	75.00	36.00	4.20	10.07	4.33	08.31	09.78	0.00

Where,						
	SMW:	Standard Meteorological Week	WAS:	Week After Sowing	Max T:	Maximum Temperature
	MinT:	Minimum Temperature	RH1:	Morning Relative Humidity	RH 2:	Evening Relative Humidity
	EP:	Evaporation	BSS:	Bright Sunshine Hours	WS:	Wind Speed
	VP1:	Morning Vapour Pressure	VP2:	Evening Vapour Pressure	RF:	Rainfall

Table 2: Seasonal incidence of *S. frugiperda* in maize in relation to different weather parameters (2020-21)

Month	Week	SMW	WAS	No. of larva(e)/ 10 plants	Plant damage (%)	Cob damage (%)	MaxT (oC)	MinT (oC)	RH1 (%)	RH2 (%)	EP (mm)	BSS (hr/day)	WS (km/hr)	VP1 (mm of Hg)	VP2 (mm of Hg)	RF (mm)
November	II	45	2	0.00	00.00	-	29.01	14.79	80.74	29.57	3.40	9.31	1.87	12.00	10.52	0.00
	III	46	3	4.00	18.33	-	30.14	19.07	78.93	39.57	3.14	8.46	2.57	14.03	14.07	0.00
	IV	47	4	5.33	38.33	-	33.63	17.21	80.86	42.94	3.73	8.70	3.14	11.34	12.04	0.00
December	I	48	5	6.67	58.33	-	33.43	19.57	76.57	41.57	3.57	8.39	4.27	12.21	12.99	0.00
	II	49	6	7.17	71.67	-	32.71	19.14	87.86	40.14	2.83	9.49	1.46	11.94	12.81	0.00
	III	50	7	7.83	80.00	-	32.58	17.93	74.14	62.43	2.00	4.76	2.29	14.62	15.06	16.40
	IV	51	8	7.83	83.33	-	31.57	17.98	82.00	54.29	2.71	8.81	3.74	09.33	11.16	0.00
January	I	52	9	6.00	80.00	-	26.81	19.25	73.63	48.00	3.10	9.24	3.73	08.33	09.28	0.00
	II	1	10	4.83	76.67	-	25.71	14.93	77.43	47.57	2.61	4.09	3.40	10.06	11.45	0.00
	III	2	11	3.83	71.67	26.67	27.50	12.07	88.86	59.43	2.90	5.56	3.94	12.63	16.03	0.00
	IV	3	12	4.33	68.33	36.67	29.21	13.64	91.14	44.43	2.77	8.64	1.76	11.09	12.93	0.00
	V	4	13	3.83	65.00	48.33	26.86	11.14	80.94	37.67	3.27	9.44	3.14	08.75	09.38	0.00
February	I	5	14	3.17	61.67	51.67	26.86	10.86	82.57	35.79	3.46	4.10	2.69	08.50	09.07	0.00
	II	6	15	1.83	60.00	58.33	26.64	11.00	79.71	23.43	3.83	7.02	2.71	08.44	07.09	0.00

Where,						
	SMW:	Standard Meteorological Week	WAS:	Week After Sowing	MaxT:	Minimum Temperature
	MinT:	Minimum Temperature	RH1:	Morning Relative Humidity	RH2:	Evening Relative Humidity
	EP:	Evaporation	BSS:	Bright Sunshine Hours	WS:	Wind Speed
	VP1:	Morning Vapour Pressure	VP2:	Evening Vapour Pressure	RF:	Rainfall

Table 3: Correlation coefficient between larval population and damaged plants due to *S. frugiperda* with weather parameters in maize

Weather parameters	Correlation coefficient (r) (n = 14)			
	Rabi, 2019-20		*Rabi*, 2020-21	
	Larvae	Damaged plant (%)	Larvae	Damaged plant (%)
Maximum Temperature (MaxT), °C	0.536*	-0.154	0.583*	-0.270
Minimum Temperature (MinT), °C	0.686**	0.080	0.670**	-0.145
Morning Relative Humidity (MoRH),%	-0.169	-0.549*	-0.175	-0.052
Evening Relative Humidity (EvRH),%	0.709**	0.258	0.686**	0.544*
Evaporation (EP)	-0.660*	-0.254	-0.547*	-0.458
Bright Sunshine Hours (BSS), hr/day	0.005	0.265	0.027	-0.463
Wind Speed (WS), km/hr	0.183	0.639*	0.250	0.394
Morning Vapour Pressure (MoVP), mm of Hg	-0.204	-0.822**	0.200	-0.307
Evening Vapour Pressure (EvVP), mm of Hg	0.035	-0.553	0.409	0.027
Rainfall (mm/day)	-0.601*	-0.692**	0.391	0.294

* Significant at 5% level
** Significant at 1% level

Conclusion

The relatively higher activity of FAW was observed during the 1st week of December to the 4th week of December i.e., Knee-high stage to tasseling stage of maize for both years, respectively. So, Farmer should adopt an appropriate management strategy during the Knee-high stage to tasseling stage of maize.

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