

Seasonal Incidence and Effect of Abiotic Factors on Population Dynamics of Sucking Insect Pest Complex of Groundnut

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/CJAST/2021/v40i1831440

Editor(s):

(1) Dr. Hamid El Bilali, University of Natural Resources and Life Sciences (BOKU), Austria.

Reviewers:

(1) Shyamrao Kulkarni, India.

(2) M. Sessa Mahalakshmi, ANGRAU, India.

Complete Peer review History: <https://www.sdiarticle4.com/review-history/71787>

Original Research Article

**Received 16 May 2021
Accepted 26 July 2021
Published 30 July 2021**

ABSTRACT

Studies on seasonal incidence of sucking insect pests carried out with three dates of sowing viz., early (July 15th), normal (July 30th) and late (August 15th) revealed that the incidence of leafhoppers, aphids and thrips started from 5 to 14 DAS (days after sowing) and continued till harvesting. In early sown crop, the incidence of leafhoppers started from 31 SW and incidence of aphids and thrips started from 30 SW and continued up to 42 and 43 SW for leafhoppers and aphids, respectively and 41 SW for thrips. In normal sown crop, incidence of leafhoppers and aphids started from 32 SW and incidence of thrips started from 31 SW and continued till the end of 45 SW for all the three pests. In late sown crop, the incidence of leafhoppers started from 35 SW and incidence of aphids and thrips started from 34 SW and continued up to 46 and 47 SW for leafhoppers and aphids, respectively and 46 SW for thrips. Correlation studies revealed that incidence of leafhoppers exhibited significant negative correlation with maximum temperature ($r = -0.467, -0.442$ and -0.464) and rainfall ($r = -0.518, -0.529$ and -0.742) during all the three dates of sowing (early, normal and late, respectively) and significant negative correlation with minimum temperature in late sown crop ($r = -0.448$). Aphids exhibited significant negative correlation with maximum temperature ($r = -0.469, -0.521$ and -0.472) and rainfall ($r = -0.443, -0.450$ and -0.721) in all the three dates of sowing (early, normal and late,

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respectively) while significant negative correlation with minimum temperature in early and late sown crop with r values -0.519 and -0.324. Thrips exhibited significant positive correlation with maximum temperature ($r = 0.522, 0.459$ and 0.447), significant negative correlation with rainfall ($r = -0.458, -0.465$ and -0.451) during three dates of sowing (early, normal and late, respectively) while significant negative correlation with relative humidity in early sown crop ($r = -0.616$) and significant positive correlation with minimum temperature in early sown crop ($r = 0.463$).

Keywords: Aphids; leafhoppers; thrips; seasonal incidence; groundnut.

1. INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is grown globally and is a major oilseed crop in Asia and Africa. India has harvested 1.2 metric tonnes of groundnut per hectare from 5600 thousand hectares with an overall production of 6500 thousand metric tonnes during 2020-21 (USDA, [1]). Andhra Pradesh alone contributed a production of 8.50 lakh tones from 6.61 lakh hectares with a productivity of 1285 kg ha^{-1} . Amongst different districts of Andhra Pradesh, In Chittoor, groundnut is grown in an area of 1.08 lakh hectares, with a total production of 2.04 lakh tonnes and productivity of 1732 kg ha^{-1} (*Kharif*) and 3050 kg ha^{-1} (*Rabi*) (Directorate of Economics and Statistics [2]).

A total of 13 species of sucking insect pests were found feeding and damaging groundnut crop [3]. The major sucking insect pest complex of groundnut includes thrips, *Scirtothrips dorsalis* Hood, *Frankliniella schultzei* Trybom, *Thrips palmi* Karny, *Caliothrips indicus* Bagnall; leafhopper, *Empoasca kerri* Pruthi; aphid, *Aphis gossypii* Glover and few minor sucking pests [4]. According to Ahir et al. [5] the mean yield data recorded from protected and unprotected plots indicated that insect pests caused 35.71 per cent loss in yield, equivalent to a loss of 8.05 q/ha. Baskaran and Rajvel, [6] recorded 15.7 per cent avoidable yield loss of Groundnut due to sucking pests. The information regarding the correlation between various weather parameters and incidence of different sucking insect pests at different growth stages of groundnut will be of great help for formulating better Integrated Pest Management practices because weather parameters decide the population buildup and severity of the pest. Though there are several reports of incidence of sucking insect pests of groundnut in relation to weather parameters, most of them are area specific and as such seasonal incidence of sucking insect pests of groundnut in relation to weather parameters in Chittoor district of Andhra Pradesh is scanty. Hence, this experiment has been framed with an

objective to establish a correlation between various abiotic factors and sucking pests viz., leafhoppers, aphids and thrips.

2. MATERIAL AND METHODS

Popular variety Dharani was used for conducting the experiment and the seed material was procured from Institute of Frontier Technology (IFT), Regional Agricultural Research Station (RARS), Tirupati. The crop was sown during early *Kharif*, 2019-20 at three different dates of sowing with fortnightly intervals i.e., Early: 15th July 2019, Normal: 30th July 2019, Late: 15th August 2019 at College Farm of S. V. Agricultural College, Tirupati. Seeds were sown in plot of 5 m × 5 m with row to row spacing of 30 cm and with plant to plant spacing of 10 cm. Two seeds per hill were sown by dibbling, gap filling was done 10 days after germination and thinning was completed 15 days after sowing leaving one healthy plant per hill. The incidence of sucking insect pests of groundnut was recorded starting from 20 Days After Sowing (DAS) at weekly intervals. Ten plants were selected randomly and data was recorded on population of sucking insect pests viz., leafhoppers, aphids and thrips present on these randomly selected plants upto harvesting stage of crop at weekly intervals by using following methods. The observations on population of leafhoppers from the top three leaves, aphids on top 2 cm shoot length and top 3 leaves and thrips from top three leaves and flowers were recorded at weekly intervals during morning hours on ten randomly selected plants. Meteorological data viz., minimum and maximum temperatures, relative humidity, bright sunshine hours and rainfall during the crop growth period were collected daily from meteorological observatory of Regional Agricultural Research Station and compiled to standard weeks (SW), Tirupati. The mean insect population was worked out and data was correlated with weather parameters. Data collected at weekly intervals on population of various sucking insect pests of groundnut was subjected to simple correlation analysis with weather parameters viz., minimum

and maximum temperatures, relative humidity, bright sunshine hours and rainfall to work out the correlation coefficients.

3. RESULTS AND DISCUSSION

Seasonal incidence of sucking insect pest complex viz., leafhoppers, aphids and thrips in groundnut was studied during *Kharif*, 2019 with three dates of sowing viz., early (July 15th), normal (July 30th) and late (August 15th).

3.1 Population Dynamics of Leafhoppers

In early sown crop (July 15th) the incidence of leafhoppers was observed from 31 SW (Standard Week) (2.1 hoppers/ten plants) and increased during 34 SW (6.4 hoppers/ten plants) and reached peak during 39 SW (8.4 hoppers/ten plants) and then decreased reaching 4.6 hoppers/10plants at 43 SW. In normal sown crop (July 30th) the incidence started during 32 SW (2.1 hoppers/ten plants) and increased during 36 SW (7.1 hoppers/ten plants) and reached peak at 39 SW (7.6 hoppers/ten plants) and then started decreasing and reached 3.9 hoppers/ten plants at 45 SW. In late sown crop (August 15th) the incidence of leafhoppers started during 35 SW (1.6 hoppers/ten plants) and increased during 39 SW (6.2 hoppers/ten plants) and reached peak at 45 SW (6.6 hoppers/ten plants) and then decreased to 2.3 aphids/ten plants at 47 SW (Table 1 and Fig. 1).

Correlation studies (Table 2) revealed that, incidence of leafhoppers with weather parameters showed significant negative correlation with maximum temperature ($r = -0.467$) and rainfall ($r = -0.518$) in early sown crop. However, incidence of leafhoppers had shown a negative correlation with minimum temperature ($r = -0.250$) and positive correlation with relative humidity ($r = 0.208$) and sunshine hours ($r = 0.012$) but these were non-significant in early sown crop. In normal sown crop, leafhopper population had shown significant negative correlation with maximum temperature ($r = -0.442$) and rainfall ($r = -0.529$). However, incidence of leafhoppers had shown a negative correlation with minimum temperature ($r = -0.378$) and positive correlation with relative humidity ($r = 0.318$) and sunshine hours ($r = 0.011$) but these correlations were non-significant. In late sown crop, population of leafhopper had shown significant negative correlation with maximum temperature ($r = -0.464$), minimum temperature ($r = -0.448$) and

rainfall ($r = -0.742$). However, incidence of leafhoppers has shown positive correlation with relative humidity ($r = 0.330$) and sunshine hours ($r = 0.199$) but the correlation was non-significant (Table 2). The regression equations were also fitted to explain the combined influence of all weather parameters under study on the population dynamics of leafhoppers and the studies indicated that weather factors influenced population dynamics of leafhoppers from 60% to 64% (based on R^2 values) in all the three dates of sowing (Table 3).

Current results are in alignment with those of Rathode [7] who opined that leafhopper incidence had significant negative correlation with rainfall. Kandakoor et al. [3] also noticed that leafhopper incidence showed non-significant positive correlation with relative humidity and sunshine hours in groundnut crop. Present results are in conformity with Mer et al. [8] who reported a significant negative correlation of leafhopper population with weather factors viz., maximum temperature and rainfall. Choudhary et al. [9] reported that leafhoppers on groundnut were observed throughout the groundnut growing season and reached their peak in the third, second and fourth week of September with a mean population of 7.50 leafhoppers. Similarly, Nigude et al. [10] also reported a non-significant negative correlation between population of leafhoppers with temperature and rainfall. Gocher and Ahmad [11] reported that incidence of leafhoppers in groundnut had shown significant negative correlation with maximum temperature.

3.2 Population Dynamics of Aphids

In early sown crop (July 15th), the incidence of aphids was observed at 30 SW (1.6 aphids/ten plants) and increased during 36 SW (23.6 aphids/ten plants) and reached peak during 41 SW (25.6 aphids/ten plants) and then decreased reaching 18.2 aphids/10 plants at 43 SW. In normal sown crop (July 30th), the incidence started during 32 SW (2.1 aphids/ten plants) and increased during 36 SW (13.6 aphids/ten plants) and reached peak at 39 SW (24.6 aphids/ten plants) and then started decreasing and reached 7.6 aphids/ten plants at 45 SW. In late sown crop (August 15th), incidence of aphids was observed during 34 SW (5.6 aphids/ten plants), reached peak during 39 SW (23.6 aphids/ten plants) and then started decreasing during 44 SW (20.8 aphids/ten plants) and reached 7.8 aphids/ten plants at 47 SW (Table 1 and Fig. 1).

Table 1. Population Dynamics of sucking insect pests on groundnut during *kharif*, 2019-20

Standard week	Date and Month	Max. Temp. (°C)	Min. Temp. (°C)	RH (%)	Rain fall (mm)	Sunshine hours (hr/day)	Mean no. of sucking insect pests (nymphs and adults) per 10 plants								
							Leafhoppers			Aphids			Thrips		
							D1	D2	D3	D1	D2	D3	D1	D2	D3
29 SW	16-22 July	38.10	28.48	48.2	0.2	4.08	0	-	-	0	-	-	0	-	-
30 SW	23-29 July	36.87	25.60	57.35	4.71	6.65	0	-	-	1.6	-	-	4.2	-	-
31 SW	30 July – 5 Aug	35.97	25.67	62.93	4.88	4.41	2.1	0	-	2.1	0	-	5.6	0.2	-
32 SW	6-12 Aug	34.2	25.40	64.71	3.54	2.5	4.6	2.1	-	5.6	2.1	-	8.5	6.6	-
33 SW	13-19 Aug	34.64	26.48	57.79	0.28	2.4	0.6	0.2	0	0.2	0.6	0	0.7	3.3	0
34 SW	20-26 Aug	35.78	27.57	56.36	0.00	3.85	6.4	4.4	0	14.6	11.6	5.6	2.1	1.9	3.6
35 SW	27 Aug -02 Sep	34.17	25.28	68.29	16.85	3.17	5.2	6.9	1.6	23.9	12.2	1.6	5.6	5.8	5.6
36 SW	03-09 Sep	31.58	23.77	69.43	8.57	4.55	6	7.1	2.7	23.6	13.6	10.3	4.6	4.5	6.9
37 SW	10-16 Sep	33.64	24.90	70.43	4.74	4.37	0.5	0.2	0.6	1.1	1.1	0.6	1.8	0.5	0.3
38 SW	17-23 Sep	32.90	24.34	67.14	3.71	2.17	1.6	2.1	1.3	1.6	3.6	4.2	0.6	0.2	0.6
39 SW	24-30 Sep	33.12	24.25	71.00	18.25	6.11	8.4	7.6	6.2	21.2	24.6	23.6	2	4.8	6.6
40 SW	01-07 Oct	30.42	23.62	85.43	13.51	2.38	0.6	0.5	1.8	3.1	0.6	0.8	5.2	3.6	7.5
41 SW	15-21 Oct	31.37	25.32	72.29	0.57	5.07	5.2	6.4	4.6	25.6	17.6	22.5	4.2	4.5	4.8
42 SW	22-28 Oct	33.85	25.07	71.07	12.02	8.81	5.8	5.6	5.6	21.5	21.5	19.4	1.2	2.1	2.6
43 SW	29 Oct -04 Nov	29.02	23.58	86.65	6.25	3.29	4.6	5.9	5.2	18.2	16.6	17.4	0.5	1.9	2.4
44 SW	05-11 Nov	29.37	23.54	82.71	3.48	4.60	-	4.8	4.9	-	7.4	20.8	-	1.2	0.8
45 SW	12-18 Nov	28.98	21.71	75.5	7.51	5.44	-	3.9	6.6	-	7.6	21.6	-	4.2	6.2
46 SW	19-25 Nov	31.95	21.40	72.29	0.00	6.14	-	-	4.5	-	-	14.8	-	-	1.2
47 SW	26 Nov-1 Dec	29.70	21.54	72.29	1.85	6.22	-	-	2.3	-	-	7.8	-	-	0.6

Table 2. Correlation co-efficients between weather variables and sucking insect pests in groundnut during *kharif*, 2019-20

Weather parameters	Correlation coefficients (r)								
	Leafhoppers			Aphids			Thrips		
	Early sown crop	Normal sown crop	Late sown crop	Early sown crop	Normal sown crop	Late sown crop	Early sown crop	Normal sown crop	Late sown crop
Maximum temperature	-0.467 **	-0.442**	-0.464**	-0.469**	-0.521*	-0.472**	0.522*	0.459**	0.447**
Minimum temperature	-0.250 NS	-0.378 NS	-0.448**	-0.519*	-0.324 NS	-0.515*	0.463**	0.233 NS	0.278 NS
Relative humidity	0.208 NS	0.318NS	0.330 NS	0.336 NS	0.440 NS	0.262 NS	-0.616*	-0.386 NS	-0.356 NS
Rainfall	-0.518 *	-0.529*	-0.742*	-0.443 **	-0.450**	-0.721*	-0.458**	-0.465**	-0.451**
Sunshine hours	0.012 NS	0.011 NS	0.199 NS	0.158 NS	0.041 NS	0.166 NS	0.093 NS	0.203 NS	0.262 NS

*Significant at 0.05 (two-tailed)

**Significance at 0.01 (two-tailed)

NS- Non significant

Table 3. Regression analysis of sucking insect pests in groundnut in relation to weather parameter during *kharif*, 2019-20

Sl. No.	Name of the sucking insect pest	Date of sowing	Regression equation	R ² - Value
1	Leafhoppers	Early (15.7.2019)	Y = 46.76-1.78X1+1.36X2-0.33X3+0.30X4+0.68X5	0.60
2	Leafhoppers	Normal (30.7.2019)	Y= 48.63-2.70X1+2.52X2-0.35X3+0.43X4+0.61X5	0.64
3	Leafhoppers	Late (15.8.2019)	Y=12.24-0.6X1+0.28X2+0.02X3+0.09X4+0.79X5	0.61
4	Aphids	Early (15.7.2019)	Y=187.86-8.93X1+7.31X2-1.20X3+1.26X4+2.88X5	0.77
5	Aphids	Normal (30.7.2019)	Y=53.62-5.95X1+7.07X2-0.62X3+1.04X4+2.85X5	0.76
6	Aphids	Late (15.8.2019)	Y=60.17-3.88X1+2.90X2-0.16X3+0.12X4+3.58X5	0.62
7	Thrips	Early (15.7.2019)	Y=-1.64+0.82X1-0.44X2+0.09X3+0.04X4-0.43X5	0.46
8	Thrips	Normal (30.7.2019)	Y=46.09-1.55X1+1.11X2-0.30X3+0.34X4-0.22X5	0.48
9	Thrips	Late (15.8.2019)	Y =44.91-1.28X1+0.65X2-0.25X3+0.38X4-0.14X5	0.57

Y = Population of Insect, X1= Maximum Temperature (°C), X2= Minimum Temperature (°C)

X3= Relative Humidity (%), X4 = Rain fall (mm), X5 = Sunshine hours (hours / day)

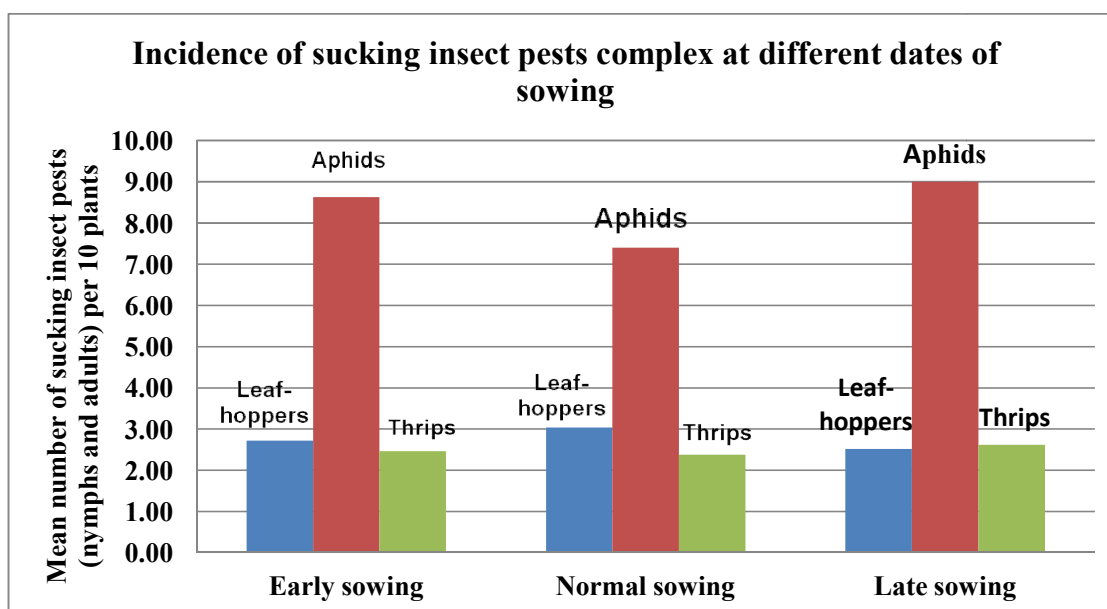


Fig. 1. Incidence of sucking insect pest complex in groundnut at different dates of sowing

Correlation studies between the incidence of aphids and weather parameters in early sown crop revealed significant negative correlation with maximum temperature ($r = -0.469$), minimum temperature ($r = -0.519$) and rainfall ($r = -0.443$). However, incidence of aphids had shown positive correlation with relative humidity ($r = 0.336$) and sunshine hours ($r = 0.158$) but these were non-significant in early sown crop. In normal sown crop, aphid population had shown significant negative correlation with maximum temperature ($r = -0.521$) and rainfall ($r = -0.450$). However, incidence of aphids has shown negative correlation with minimum temperature ($r = -0.324$) and positive correlation with relative humidity ($r = 0.440$) and sunshine hours ($r = 0.041$) but these correlations were non-significant. In late sown crop, aphid population has shown significant negative correlation with maximum temperature ($r = -0.472$), minimum temperature ($r = -0.515$) and rainfall ($r = -0.721$). However, incidence of aphids has shown positive correlation with relative humidity ($r = 0.262$) and sunshine hours ($r = 0.166$) but the correlation was non-significant (Table 2). The regression equations were also fitted to explain the combined influence of all weather parameters under study on the population dynamics of aphids and the studies indicated that weather factors influenced population dynamics of leafhoppers from 62% to 77% (based on R^2 values) in all the three dates of sowing (Table 3).

Similar results were reported by Nandagopal et al. [12] who reported that incidence of aphids has shown significant negative correlation with maximum and minimum temperatures in groundnut crop. Similar results were reported by Rathode [7] who observed that aphid population showed significant negative correlation with maximum temperature and did not show significant correlation with other weather factors viz., relative humidity and minimum temperature. Choudhary et al. [9] reported that population of *A. craccivora* has touched peak in the second, third and fourth week of September with a mean population of 8.60 aphids. Kandakoor et al. [3] noticed that aphid population has shown a significant negative correlation with rainfall. Gocher and Ahmad [11] observed that aphid population has shown significant negative correlation with maximum temperature.

3.3 Population Dynamics of Thrips

In early sown crop, the incidence of thrips was observed at 30 SW (4.2 thrips/ten plants) and reached peak during 32 SW (8.5 thrips/ten plants) and decreased reaching 5.2 thrips/ten plants at 40 SW and finally reached 0.5 thrips/ten plants at 43 SW. In normal sown crop, the incidence was very high during the initial stage, started during 31 SW (0.2 thrips/ten plants) and immediately reached peak in the next standard week i.e., 32 SW (6.6 thrips/ten plants) due to high temperatures and then decreased during 41

SW (4.5 thrips/ten plants) and reached 4.2 thrips /ten plants at 45 SW. In late sown crop, incidence of thrips was observed at 34 SW (3.6 thrips/ten plants) reached peak during 36 SW (6.9 thrips/ten plants) and decreased with great fluctuation during 44 SW (0.8 thrips/ten plants) with increase at 45 SW (6.2 thrips/ten plants) and decreased at 47 SW (0.6 thrips/ten plants) (Table 1 and Fig. 1).

Correlation studies between the incidence of thrips and weather parameters in early sown crop revealed significant positive correlation with maximum temperature ($r = 0.522$), minimum temperature ($r = 0.463$) and significant negative correlation with rainfall ($r = -0.458$) and humidity ($r = -0.616$). However, incidence of thrips had shown positive correlation with sunshine hours ($r = 0.093$) and was non-significant. In normal sown crop, thrips population had shown significant positive correlation with maximum temperature ($r = 0.459$) and significant negative correlation with rainfall ($r = -0.465$). However, incidence of thrips had shown negative correlation with relative humidity ($r = -0.386$) and positive correlation with sunshine hours ($r = 0.203$) but these correlations were non significant. In late sown crop, thrips population had shown significant positive correlation with maximum temperature ($r = 0.447$), and significant negative correlation with rainfall ($r = -0.451$). However, incidence of thrips has shown negative correlation with relative humidity ($r = -0.356$) and positive correlation with sunshine hours ($r = 0.262$) but the correlation was non-significant in late sown crop (Table 2). The regression equations were also fitted to explain the combined influence of all weather parameters under study on the population dynamics of thrips and the studies indicated that weather factors influenced population dynamics of leafhoppers from 46% to 75% (based on R^2 values) in all the three dates of sowing (Table 3).

Similar results were reported by Nandagopal et al. [13] who reported that thrips incidence has shown significant negative correlation with rainfall. Kandakoor et al. [3] noticed that thrips showed non significant positive correlation with minimum temperature and sunshine hours in groundnut crop. Choudhary et al. [9] reported that population of *S. dorsalis* on groundnut crop was recorded throughout the growing season and highest number of thrips / 3 leaves were recorded in the second, third, and fourth week of September with a mean population of 4.0 thrips/3 leaves. Similarly Vijayalakshmi et al. [14] also reported that population of thrips had shown non

significant positive correlation with minimum temperature and non significant negative correlation with relative humidity. Naresh et al. [15] noticed that thrips population has shown significant positive correlation with maximum temperature and did not show correlation with other weather factors like relative humidity and sunshine hours which were in accordance with present results. Nigude et al. [10] observed that incidence of thrips population had shown non-significant negative correlation with rainfall.

4. CONCLUSION

Correlation studies revealed that incidence of leafhoppers exhibited significant negative correlation with maximum temperature and rainfall during all the three dates of sowing (early, normal and late, respectively) and significant negative correlation with minimum temperature in late sown crop. Aphids exhibited significant negative correlation with maximum temperature and rainfall in all the three dates of sowing while significant negative correlation with minimum temperature in early and late sown crop. Thrips exhibited significant positive correlation with maximum temperature, significant negative correlation with rainfall during three dates of sowing while significant negative correlation with relative humidity in early sown crop and significant positive correlation with minimum temperature in early sown crop. Upon consideration of R^2 values on a higher note, weather factors influenced population of leafhoppers, aphids and thrips up to an extent of 64%, 77% and 57% respectively.

COMPETING INTERESTS

Authors have declared that no competing interests exists.

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