Influence of prevailing weather parameters on population dynamics of leafhopper *Empoasca kerri* and thrips *Scirtothrips dorsalis* on groundnut in semi arid ecosystem of Rajasthan

ABSTRACT

The field experiment were conducted at Agronomy farm, S.K.N. College of Agriculture, Jobner during *Kharif*, 2020 and 2021 to know the population dynamics of leafhopper, *Empoasca kerri* Pruthi and thrips, *Scirtothrips dorsalis* Hood on groundnut. The primary focus of research on the effects of weather variables on insect ecology. The incidence of leafhopper, *E. kerri* and thrips *S. dorsalis* appeared in the fifth and fourth week of July in both the years and the population of leafhopper and thrips reached to its peak in the second and first week of September during *Kharif*, 2020 and 2021 respectively. The correlation studies indicated that the leafhopper and thrips population had significant positive correlation with relative humidity (r= 0.62 and r= 0.60) and (r= 0.77 and r= 0.75) during both the *Kharif* seasons 2020 and 2021 respectively. Whereas the leafhopper and thrips population had significant positive correlation (r= 0.59 and r= 0.61) respectively at minimum temperature in *Kharif* 2021.

Keywords: Correlation, groundnut, leafhopper, thrips

Introduction

"Groundnut, *Arachis hypogaea* (L.) also known as peanut belongs to family Fabaceae. In India it is an important crop and occupies second position among oilseed crops. Sucking pests are the major biotic constraints in groundnut production. Sucking pests suck the sap from tender plant parts as a result plant or parts of plant dry up. They feed on the plant sap (direct damage) and also act as vectors for plant viral diseases (indirect damage). Leafhoppers suck the sap from the leaves and petioles and mainly it prefers the first three terminal leaves and feeding symptoms induce yellowing of foliage that begins at the tip, known as hopper burn. Thrips mainly feed by lacerating and sucking the sap from leaves and the peanut stripe virus (PStV), peanut bud necrosis disease (PBND) are transmitted by thrips. The leafhoppers can cause up to 22 per cent of yield loss in groundnut (Vyas, 1984) [18] while thrips up to 17 to 40 per cent" (Ghewande, 1987) [2]. "Abiotic conditions such as temperature, relative humidity, sunlight, and rainfall have a significant impact on the population dynamics of any insect pest" (Saminathan *et al*., 2003) [16]. "The environment, the availability of a host, and the activity of natural enemies all play a role in an insect's survival, reproduction, and development. Weather parameters influence insect life cycles, reproduction, and outbreaks (Pedigo, 2004) [13], and fluctuation in these abiotic factors have a negative effect on insect population dynamics" (Prasad and Logiswaran, 1997) [14]. The purpose of these research is to demonstrate how interactions between individuals with specific traits give rise to population- and community-level occurrences. For a better understanding of how individual interactions with their physical surroundings and with other people translate into population and interspecific dynamics, it is highly recommended to investigate the impacts of weather on insects.

MATERIAL AND METHODS

The experimental study conducted at Agronomy farm, S.K.N. College of Agriculture, Jobner (Rajasthan) during *Kharif*, 2020 and 2021 to know the population dynamics of leafhopper and thrips on groundnut. The groundnut crop, variety RG-510 was sown on 8th July 2020 and 5th July 2021 in five plots. The plot size was 3.0 m x 2.0 m with row to row and plant to plant distance of 40 cm x 15 cm, respectively.

Method of observations

The population of leafhopper and thrips on groundnut were recorded at weekly interval early in morning hours. The population of leafhopper and thrips were recorded on three leaves per plant from the five selected and tagged plants from each plot. The population was counted by gently holding the leaf between the two halves of a petri plate and both nymphs as well as adults were counted with in it (Rawat and Sahu, 1973).[15]

Interpretation of data

To interpret the results of population dynamics of leafhopper and thrips on groundnut the simple correlation was computed between pest population and abiotic factors, *i.e*. minimum & maximum temperatures, relative humidity and rainfall was worked out using following formula.

$$r = \frac{N \sum xy - (\sum x)(\sum y)}{\sqrt{N\sum x^2 - (\sum x)^2 . N \sum y^2 - (\sum y)^2}}$$

Where,

r = Simple correlation coefficient
x = Independent variables *i.e.* abiotic components
y = Dependent variables *i.e.* pests
N = Number of observations

RESULTS AND DISCUSSION

The mean population of leafhopper and thrips and the standard meteorological week wise weather parameters are presented in Table 1 (*Kharif* 2020) and Table 2 (*Kharif* 2021). The findings of the present study and the related discussion are explained hereunder.

The incidence of leafhopper, *E. kerri* commenced in the fifth and fourth week of July in both the years and remained active throughout the crop season, up to second week of October during *Kharif*, 2020 and 2021, respectively. The peak population of 5.40 and 5.20 leafhopper per three leaves per plant was recorded in the second and first week of September during *Kharif*, 2020 and 2021, respectively, when the prevailing maximum temperature of 36.30^{0}C and 33.00^{0}C, minimum temperature of 21.10^{0}C and 23.60^{0}C, relative humidity of 67.00 per cent and 80.00 per cent and rainfall of 00.00 mm and 07.80 mm respectively. The correlation matrix indicated that leafhopper population had significant positive correlation (r= 0.62 and r= 0.77) with relative humidity during both the years and minimum temperature (r= 0.59) only during 2021.While, non significant correlation with other abiotic factors during both the years. The present findings are in conformity with the findings of Jyothrimai *et al.* (2002) [6] reported that "the activity of jassid on groundnut throughout the crop season and peak activity in mid September". Yadav *et al.* (2012) [19] found that "the incidence of jassid were commenced in the second week of August and touched its peak in the second week of September (13.56 jassid/ 3 leaves)". Khanpara and Acharya (2012) [8] reported that "the incidence of the pest commenced in the 3rd week of July (1.80 jassid nymphs/ 3 leaves), which gradually increased and attained peak (4.20 jassid nymphs/ 3 leaves) in the 2nd week of September after that the population decreased and disappear in the 3rd week of October". Similar observation work made by Harish *et al.* (2015) [4] and Mer *et al.* (2016) [9]. According to Ahir *et al.* (2017) [1] the "incidence of jassid started in the 2nd week of August and touched the peak in the 3rd week of September with 7.00 jassids/ 3 leaves". Nigude *et al.* (2018) [12] reported that "the incidence of jassid started in 2nd week of August and later on steadily increased and reached to its peak in the 1st week of September with 3.06 jassids/ 3 leaves". Gocher *et al.* (2019) [3] reported that "the leafhopper population commenced in the last week of July and reached to its peak in the second week of September". Nayak *et al.* (2019) [11] reported that "the leaf hopper population appeared during 33rd standard meteorological week and attained the peak population (5.68/ top 3 leaves) in the second week of September". The studies on correlation of leafhopper population with abiotic factors are supported by the findings of Jena and Kuila (1996) [5] reported that "the relationship between meteorological variables and per cent infestation of jassids had negative correlation with minimum temperature and positive correlation with maximum temperature, rainfall and relative humidity which is partially corroborates with present findings". According to Yadav *et al.* (2012) [19] the "leafhopper population had negative non significant correlation with temperature and positive correlation with relative humidity and total rainfall the findings are in close akin with present findings". Similar work was made by Mer *et al.* (2016) [9] and Saritha *et al.* (2020) [17]. Ahir *et al.* (2017) [1] reported that **"**the jassid population had negative correlation with temperature, whereas relative humidity and rainfall were found non significant and positive which is partially corroborates with present findings". Nigude *et al.* (2018) [12] reported that "the population of jassid was negatively non significant with temperature and rainfall and positively associated with relative humidity which is fully conformity with present findings". According to Gocher *et al.* (2019) [3] **"**the population of leafhopper had significant negative correlation with maximum temperature and significant positive correlation with relative humidity". Nayak *et al.* (2019) [11] reported that "the leaf hopper population had significant positive correlation with minimum temperature which is accordance to present findings".

The incidence of thrips, *S. dorsalis* started in the fifth and fourth week of July in both the years and remained active throughout the crop season upto second week of October during 2020 and 2021, respectively. The peak population of thrips 4.00 and 3.80 thrips per three leaves per plant was recorded in the second and first week of September during *Kharif*, 2020 and 2021, respectively. The correlation matrix showed that thrips population had significant positive correlation with relative humidity (r= 0.60 and r= 0.75) during both the years and with minimum temperature (r= 0.61) only during 2021.While, non significant relationship with other weather parameters during both the years. The present results corroborates with the findings of Yadav *et al.* (2012) [19] reported that "the incidence of thrips were commenced in the second week of August and touched the peak (4.16 thrips/ 3 leaves) in the fourth week of September". Similar work made by Harish *et al.* (2015) [4] and Naresh *et al.* (2017) [10]. According to Ahir *et al.* (2017) [1] **"**the incidence of thrips started in 2^{nd} week of August and attained peak in the 2^{nd} week of September which is partially agreement with present findings". Nigude *et al.* (2018) [12] reported that "the incidence of thrips started in 1^{st} week of August and reached to its peak in the 4^{th} week of September with 4.20 thrips/ 3 leaves". Nayak *et al.* (2019) [11] found that "thrips appeared during 33^{rd} standard meteorological week and reached to peak (3.84/ top bud leaves) in the second week of September which is close agreement with present results". Saritha *et al.* (2020) [17] reported that "the incidence of thrips has started on 27^{th} SMW and attained peak in the 31^{st} SMW (3.5 thrips/ plant) which is partially conformity with present findings". Yadav *et al.* (2012) [19] reported that "the correlation between thrips and temperature was negative but with relative humidity and total rainfall, the correlation was positive and non significant". Kandakoor *et al.* (2012) [7] reported that "the thrips population had positive correlation to maximum and minimum temperature which is contrary to present results". Harish *et al.* (2015) [4] and Naresh *et al.* (2017) [10] have also worked. Acoording to Ahir *et al.* (2017) [1] "the correlation between thrips population and temperature was negative but with total rainfall, the correlation was positive non significant and correlation with relative humidity was positively significant which is fully support with present result". Nigude *et al.* (2018) [12] reported that "the thrips population was negatively non significant with temperature and rainfall and positively significant correlation with relative humidity which is corroborates with present findings". Nayak *et al.* (2019) [11] found that "thrips population had significant positive correlation with minimum temperature which is close akin with present results". Saritha *et al.* (2020) [17] reported that "the thrips population had significant positive correlation with relative humidity and rainfall which is corroborate with present findings".

CONCLUSION

The important conclusions drawn from present investigation made on population dynamics of leafhopper and thrips on groundnut. The incidence of leafhopper, *E. kerri* and thrips *S. dorsalis* appeared in the fifth and fourth week of July in both the years. The population of leafhopper and thrips reached to its peak in the second and first week of September during *Kharif*, 2020 and 2021 respectively. The correlation studies indicated that the leafhopper and thrips population had significant positive correlation with relative humidity (r= 0.62 and r= 0.60) and (r= 0.64, r= 0.77 and r= 0.75) during both the *Kharif* seasons 2020 and 2021 respectively. Whereas the leafhopper and thrips population had significant positive correlation with (r= 0.59 and r= 0.61) minimum temperature in *Kharif*, 2021.

REFERENCES

1. Ahir, K.C., Saini, A., Rana, B.S. and Dangi, N.L. (2017). Population dynamics of sucking pests in relation to weather parameter in groundnut, *Arachis hypogaea* L. *Journal of Entomology and Zoology Studies*, 5: 960-963

2. Ghewande, M.P. (1987). Virus diseases of groundnut and their management. In: "Symposium on diseases of oilseed and pulse crops and their control". (Eds.S.C.Vyas and V.N. Shorofgf). Jawaharlal Nehru Krishi Vishwa Vidhyalaya, Indore, M.P. pp. 62-67.

3. Gocher, S. and Ahmad, S. (2019). Seasonal incidence of major sucking insect pests of groundnut in relation to weather parameters of semi arid region of India. *International Journal of Current Microbiology and Applied Sciences*, 8: 1106-1111.

4. Harish, G., Nataraja, M.V., Jasrotia, P., Holajje, P., Savaliya, S.D. and Gejera, M. (2015). Impact of weather on the occurrance pattern of insect pest on groundnut. *Legume Research*, 38: 524-535.

5. Jena, B.C. and Kuila, B. (1996). Jassid infestation in groundnut and its chemical control. *Indian journal of entomology*, 58: 378-381.

6. Jyothirmai, T., Krishna, T.M., Ramaiah, M., Padmavathamma, K. and Rao, A.R. (2002). Efficacy of different insecticides against jassids on groundnut. *Journal of Entomological Research*, 26: 291-295.

7. Kandakoor, S.B., Khan, H.K., Gowda, G.B., Chakravarthy, A.K., Kumar, C.T.A. and Venkataravana, P. (2012). The incidence and abundance of sucking insects pests on groundnut. *Current Biotica*, 6: 342-348.

8. Khanpara, A.V. and Acharya, M.F. (2012). Seasonal incidence and heat unit requirement of Jassid, *Empoasca kerri* Pruthi in groundnut under Saurashtra conditions. *Journal of Agrometeorology*, 14: 79-81.

9. Mer, A.N., Parmar, G.M., Vikani, R.M. and Kelaiya, D.S. (2016). Effect of climatic factors on incidence of jassid, *Empoasca kerri* Pruthi infesting groundnut. *International Journal of Plant Protection*, 9: 608-610.

10. Naresh, T., Ramakrishna, R.A., Murali Krishna, T. and Devaki, K. (2017). Seasonal incidence and population dynamics of thrips in groundnut, *Arachis hypogaea* L. during rabi season. *Current Biotica,* 10: 280-289.

11. Nayak, T.K., Deole, S., Shaw, S.S. and Mehta, N. (2019). Seasonal incidence of sucking insect pests infesting groundnut crop at Raipur. *Journal of Entomology and Zoology Studies,* **7**: 83-87.

12. Nigude, V.K., Patil, S.A. and Bagade, A.S. (2018). Seasonal incidance of sucking pests of groundnut *Arachis hypogaea* L. *International Journal of Current Microbiology and Applied Sciences,* **7:** 558-561.

13. Pedigo, L.P. (2004). Entomology and Pest Management (4^{th} edi.). New Delhi, India: Prentice-Hall of India Pvt. Ltd.

14. Prasad, S.G. and Logiswaran, G. (1997). Influence of weather factors on population fluctuation of insect pest of brinjal at Madurai, Tamil Nadu. *Indian Journal of Entomology,* 59: 385-388.

15. Rawat, R.R. and Sahu, H.R. (1973). Estimation of losses in growth and yield of okra due to *Empoasca devastans* Dist and *Earias spp. Indian Journal of Entomology*, 35: 252-254.

16. Saminathan, V.R., Jayaraj, S. and Regupathy, A. (2003). Correlation between coccinellids, *Menochilus sexmaculatus* Fab. (Coleoptera: coccinellidae) on cotton and major weather factors in Southern Tamil Nadu. *Madras Agricultural Journal,* 90: 363-365.

17. Saritha, R., Sirisha, A.B.M., Haseena, S.K. and Sujatha, V. (2020). Impact of weather on incidence of sucking pests in groundnut. *Journal of Entomology and Zoology Studies,* 8: 1157-1163.

18. Vyas, H.N. (1984). Losses due to insect pests in groundnut, *Arachis hypogaea*. Proceedings of the all India workshop on crop losses on insect pests. *Indian Journal of Entomology,* 2: 312-317.

19. Yadav, P.C., Sharma, U.S., Ameta, O.P. and Padiwal, N.K. (2012). Seasonal incidence of major sucking insect pests of groundnut, *Arachis hypogaea* L. *Indian Journal of Applied Entomology,* 26: 57-59.

Table1. Population dynamics of leafhopper and thrips on groundnut in relation to weather parameters in *Kharif*, 2020

SMW	Date of observations	Temperature (^{0}C)		Mean relative humidity (%)	Total Rainfall (mm)	Leaf hopper/three leaves	Thrips/ three leaves
		Max.	Min.				
31	29.07.20	36.00	24.20	69	0.00	1.40	0.60
32	05.08.20	32.90	23.00	83	47.40	3.00	1.28
33	12.08.20	33.10	23.50	86	57.40	3.76	2.80

34	19.08.20	30.20	22.00	87	39.40	4.20	3.40
35	26.08.20	31.10	21.50	83	27.80	4.00	3.20
36	02.09.20	31.70	21.30	84	24.40	4.16	3.60
37	09.09.20	36.30	21.10	67	0.00	5.40	4.00
38	16.09.20	37.30	21.50	63	01.30	4.00	3.08
39	23.09.20	36.90	20.80	59	03.20	3.60	2.00
40	30.09.20	37.00	14.30	47	0.00	2.40	1.20
41	07.10.20	36.60	16.50	43	0.00	1.20	0.88
42	14.10.20	35.00	20.30	44	0.00	1.00	0.80
Correlation coefficient with max. temp.						NS	NS
Correlation coefficient with min. temp.						NS	NS
Correlation coefficient with relative humidity						0.625*	0.602*
Correlation coefficient with rainfall						NS	NS

SMW = Standard meteorological weeks

* = Significant at 5 per cent level

NS = non significant

Table2. Population dynamics of leafhopper and thrips on groundnut in relation to weather parameters in *Kharif*, 2021

SMW	Date of observations	Temperature (^{0}C)		Mean relative humidity (%)	Total Rainfall (mm)	Leaf hopper/ three leaves	Thrips/ three leaves
		Max.	Min.				
30	26.07.21	31.80	24.30	65	55.40	2.08	1.88

31	02.08.21	30.10	22.80	89	98.90	3.00	2.20
32	09.08.21	33.50	23.20	75	02.40	2.60	2.00
33	16.08.21	35.60	22.10	65	00.00	1.20	1.80
34	23.08.21	33.60	23.80	73	10.80	3.60	2.40
35	30.08.21	32.80	22.50	75	25.40	3.88	2.48
36	06.09.21	33.00	23.60	80	07.80	5.20	3.80
37	13.09.21	32.50	22.60	78	01.60	4.00	3.40
38	20.09.21	31.60	22.30	79	38.20	4.20	3.60
39	27.09.21	31.70	22.60	77	08.20	3.40	3.20
40	04.10.21	33.40	21.50	69	33.00	2.20	1.80
41	11.10.21	35.50	16.50	50	00.00	0.60	0.40
Correlation coefficient with max. temp.						NS	NS
Correlation coefficient with min. temp.						0.590*	0.619*
Correlation coefficient with relative humidity						0.772*	0.755*
Correlation coefficient with rainfall						NS	NS

SMW = Standard meteorological weeks

NS = non significant * = Significant at 5 per cent level