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INFLUENCE OF ENVIRONMENTAL FACTORS ON THE POPULATION DYNAMICS OF CHILLI THRIPS, *Scirtothrips dorsalis* (HOOD) AND APHID, *Aphis gossypii* (GLOVER)

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KEYWORDS

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Environmental effects

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ABSTRACT

Insect pests continue to pose a major threat for achieving higher production of chilli crop. The experiment was conducted to study population dynamics of chilli thrips and aphids at Varanasi on 100 m² unsprayed field during 2016-17. The chilli thrips and aphid population were counted from ten randomly selected chilli plants and the abiotic factors like temperature, relative Humidity (RH), rainfall were also recorded. Result of the study revealed that chilli thrips population first appeared during the third week of September and reached its peak during the third week of October. However, the incidence of the aphid population commenced from the fourth week of September and attained peak population levels during the fourth week of October. Further the correlation analysis of abiotic factors with chilli thrips population showed that the positive correlation with maximum temperature whereas, a negative correlation with relative humidity during morning, relative humidity during evening, minimum temperature and rainfall were also observed. While the aphid population showed positive correlation with maximum temperature. However, negative correlations were observed with relative humidity during morning, relative humidity during evening, rainfall and minimum temperature. These results of present study help in the development of the forecasting model and timely preparedness to manage pest problems and prevent crop losses.

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1 Introduction

Chilli (*Capsicum annuum* L.) which is an important vegetable cash crop in India and is grown for the demand of its pungent fruits, both green and ripe (latter dried form) to added pungency to the food. As a condiment, it has become indispensable in every Indian home. It is also used medicinally, and in chutneys and pickles (Das, 2013). The world consumption of chillies and paprika is going up due to the increasing popularity of ethnic foods. India is the largest producer as well as consumer of chilli in the world with the production of 3634 (in '000 MT) but its production pattern is highly erratic (Anonymous, 2017). Although the crop has excellent export potential in addition to national demand, it contributes to its low productivity through multiple limiting factors. The sustainability in chilli production is threatened by many biotic stresses such as several insect pests and diseases (Hanumanthappa et al., 2018). Insect pests continue to pose a major threat for achieving higher production of chilli crops and about 57 species of pests were recorded by Reddy & Puttaswamy (1984) which attacked on chilli crop and causes yield losses to range between 50 to 90 per cent (Rajput et al., 2017).

The results of the survey conducted by Asian Vegetable Research and Development Centre (AVRDC) indicated that the major sucking insect pests that attack chilli are thrips (*Scirtothrips dorsalis* Hood) and aphids (*Myzus persicae* Sulzer, *Aphis gossypii* Glover) in Asia (Anonymous, 1987). Chilli thrips, *S. Dorsalis* is regarded to be one of the most damaging pests and may lose 30 to 50% of the plant under serious infestation (Bhede et al., 2008). Thrips can cause damage to chilli directly by feeding on leaves, fruits or flowers. Feeding injury from thrips on leaves may affect leaf size, affect carbon allocation in the plant (Welter et al., 1990; Shipp et al., 1998) and reduce photosynthetic capacity (Tommasini & Maini, 1995). Thrips also cause indirect damage by transmitting the number of plant virus genera (Jones, 2005). The aphid is also one of the most important constraints in chilli production. Aphid became the most destructive insect pests of chilli in India and did huge economic damage. One recent study reported that severely infested chilli plant almost failed to produce any fruits or produced a bare minimum number of deformed fruits (Shi et al., 2011). Under favorable conditions, aphid reproduces at a faster rate and may cause damage to 15-30% of total chilli production (Das, 2013). Climatic factors such as temperature, relative humidity and rainfall are also known to have a significant influence on insect population fluctuation (Sharma et al., 2018). The basic information on the relative occurrence and population dynamics are necessary before deciding the strategy for management of any insect pest (Manjunatha et al., 2001; Meena et al., 2013). Knowledge of the seasonal abundance and population build up trend is essential to ensure timely preparedness to manage pest problems and prevent crop losses and it also to help

in the development of the forecasting model which is a useful tool to predict likely incidence of the insect pests on the crop. In this regard, the present investigation was carried out to estimate population dynamics of chilli thrips and aphids on chilli in relation to weather parameters.

2 Materials and Methods

2.1. Experimental site

The experiment was conducted during the year 2016-17 at the Vegetable Research Farm, B.H.U., Varanasi, India. Varanasi lies between 24° 56' N to 25° 35' N Latitude and 82° 14' E to 83° 24' E Longitude and the elevation is 82 m above the mean sea level, almost in the centre of Indo-Gangetic belt and it possesses sub-tropical climate. Pure seeds of the test variety, Bhagyalakshmi (G-4) were raised in the nursery on the experimental site on 3rd August 2016. Other care was taken as per the recommendations to maintain the nursery under unsprayed conditions.

2.2. Field preparation and transplanting

Summer ploughing was given to the main field with the aim of exposing eggs and another stage of harmful insect pests and under-ground reproductive parts of weeds. A bulk plot of 100 m² was raised to study the population dynamics of chilli thrips and aphid. Thirty days old seedlings were transplanted in the main field on 2nd September 2016 with a plant spacing of 60×45 cm. All the recommended agronomic practices like weed control, fertilizer application and irrigations were followed except for chemical treatment of the experimental plot.

2.3. Pest sampling

The observations of pest population were recorded in these unprotected plot at 7 days interval (Standard weeks) from 7 days after transplanting (DAT) up to crop harvesting. The population of chilli thrips and aphids were counted on fully opened leaves from ten randomly selected plants and three leaves (One from the top, middle and lower canopy) from each plant were taken for recording the pest population. The population of both nymphs and adults were counted early in the morning before 8 AM when the pests were not much active.

2.4. Meteorological data

Weather data were recorded simultaneously from the metrological observatory available at agricultural research farm, institute of agricultural Sciences, BHU, Varanasi and correlated with the occurrence of the pest population. A simple correlation coefficient method was adopted to work out the relationship between the occurrence of the pest and the weather parameters.

2.5. Statistical analysis

Weekly data of pest population was correlated with the prevailing climatic factors such as maximum temperature, minimum temperature, morning and evening relative humidity and rainfall was analyzed by calculating respective “r” (correlation coefficient) with the help of SPSS (Statistical Package for Social Sciences) software.

3 Results

3.1. Chilli thrips

The data present in Table 1 revealed that the chilli thrips population was initially observed on 38th Standard Week (SW)

i.e., at 12 days after transplantation with a mean population of 0.28 thrips per leaf and the corresponding average maximum and minimum temperature prevailed during the initial infestation were 31.2^oC and 25.6^oC, respectively and average morning and evening relative humidity was 92% and 82%, respectively. The population of thrips increased from 39th SW and reached a peak level (4.47 thrips/leaf) on 43th SW (Figure 1). The pest population had a gradual decline after 43rd SW and reached its minimum population (0.21 thrips / leaf) during 1st SW, corresponding to a peak and minimum temperature of 20.10 ^oC and 11.60 ^oC respectively, while the relative moisture of morning and evening was 95% and 76% respectively. Table 2 showed that the correlation between chilli thrips population and the major weather parameters. The findings disclosed that the population of chilli thrips showed a

Table 1 Seasonal incidence of chilli thrips and aphids on chilli during 2016-17

Standard week	Month- date	Rainfall mm	Temperature ^o C		Relative humidity %		Mean no. of thrips/ leaf	Mean no. of aphid/leaf
			Max.	Min.	Morn.	Even.		
36	Sep 02-08	31.1	31.6	26.2	90	80	0	0
37	09-15	2.6	31.4	26.4	91	80	0	0
38	16-22	64.8	31.2	25.6	92	82	0.28	0
39	23-29	115.8	28.6	24.0	95	88	0.21	0.38
40	30-06	2.6	32.4	26.3	88	74	1.09	0.54
41	Oct 07-13	1.5	32.0	23.4	87	61	2.28	2.48
42	14-20	0.0	32.4	18.4	74	43	3.17	3.25
43	21-27	0.0	32.4	17.9	74	43	4.47	4.65
44	28-03	0.0	31.4	16.6	77	43	3.89	6.87
45	Nov 04-10	0.0	29.2	15.3	80	45	3.06	5.14
46	11-17	0.0	29.0	13.8	77	42	3.25	4.81
47	18-24	0.0	27.3	11.7	72	42	2.87	4.32
48	25-01	0.0	25.4	13.2	79	56	2.54	3.56
49	Dec 02-08	0.0	20.3	16.3	94	78	0.95	2.45
50	09-15	0.0	20.2	10.0	94	73	0.48	2.01
51	16-22	0.0	23.3	9.8	89	50	0.54	1.67
52	23-31	0.0	20.5	10.9	94	69	0.34	0.84
1	Jan 1-7	0.0	20.1	11.6	95	76	0.21	0.69
2	8-14	0.0	20.7	8.2	91	44	0.00	0.48
3	15-21	0.0	23.0	8.8	90	49	0.00	0.31

Max.- Maximum, Min.- Minimum, Morn.- Morning, Even.- Evening

Table 2 Correlation Coefficient (r) of chilli thrips and aphids on chilli with prevailing weather parameters during 2016-17

Parameters	Maximum Temperature	Minimum temperature	Morning relative humidity	Evening relative humidity	Rainfall
Chilli thrips	0.484*	-0.042	-0.912**	-0.693**	-0.326
Aphids	0.255	-0.243	-0.817**	-0.703**	-0.377

*Correlation is significant at $P \leq 0.05$; **Correlation is significant at $P \leq 0.01$

Figure 1 Influence of abiotic factors on the population chilli thrips and aphid

positive significant correlation with maximum temperature ($r = 0.484$). Again, there was a negative significant correlation of pest count with morning relative humidity ($r = -0.912$) and evening relative humidity ($r = -0.693$) and a negative non-significant correlation with minimum temperature ($r = -0.042$) and rainfall ($r = -0.326$).

3.2. Aphids

The data presented in Table 1 revealed that the incidence of aphid was initially observed on 39th SW *i.e.*, at 18th day after transplantation with a mean population of 0.38 aphids per leaf and corresponding average maximum and minimum temperature prevailed during the initial infestation were 28.6°C and 24.0°C, respectively and morning relative humidity and evening relative humidity was 95% and 88%, respectively. The population of aphid had increased from 39th SW with 0.38 aphids/leaf and attained its peak level (6.87 aphids/leaf) on 44th SW (Figure 1). After 44th SW, the pest population gradually declined and reached its minimum of 0.31 aphids/leaf during 3rd SW and the corresponding peak and minimum temperatures were 23.0 °C and 8.8 °C respectively, while the relative humidity in the morning and evening was 90% and 49% respectively

The correlation between population of chilli thrips and abiotic factors shown in Table 2. The results indicated that the correlation between the aphid population and maximum temperature ($r = 0.255$) was positive but non-significant while, negative non-significant correlation was observed with minimum temperature (-0.243). Further, a negative significant correlation was reported between the pest population and morning relative humidity ($r = -0.817$) and evening relative humidity ($r = -0.703$) and a negative non-significant correlation with rainfall (-0.377) were also notice during the experimental period.

4 Discussion and Conclusion

The results of the present investigation showed that the incidence of thrips population was commenced during the 3rd week of September and the pest population reached its peak level during the 4th week of October. Earlier, Patel et al. (2009) and Barot et al. (2012) reported similar observation that the incidence of *S. dorsalis* on chilli crop commenced from the first week of September and continue up to the harvest of the crop being peak activity was recorded in November. Further, Meena et al. (2013) reported that peak population of the thrips occurred during the 41th standard week (October) and Chandra & Rana (2014) also

observed that the population of *S. dorsalis* on chilli crop attained its peak at the beginning of autumn season (first half of October 2013). The correlation between population of chilli thrips and abiotic factors shown in Table 2. The chilli thrips populations during the season revealed a significant positive correlation with maximum temperature while, non-significant negative correlation with minimum temperature and rainfall. However, a significant negative correlation observed with morning and evening relative humidity. The results are in close accordance with Pathipati et al. (2014) who also observed that the thrips population had a negative correlation with minimum temperature, morning and evening relative humidity, rainfall and positive correlation with maximum temperature. Further, Asma & Hanumantharaya (2015) also recorded a highly significant and positive correlation of thrips with maximum temperature. Lingeri et al. (1998) also reported that thrips population increased during the dry period with lower minimum temperature, while Kumar et al. (2006) and Meena et al. (2013) reported that the thrips showed a negative correlation with relative humidity.

Whereas, the incidence of the aphid population was first observed during the 4th week of September and reached to a peak during the 44th standard week (October) thereafter pest population declined. These observations are in close accordance with the results obtained by Roopa & Kumar (2014) that the infestation of aphid started during the third week of September. The incidence was observed throughout the cropping season and peak incidence was attained during the third and fourth week of October. These results are also in close confirmation with Bharadiya & Patel (2005) who reported that the peak activity of aphid, *A. gossypii*, during third week of November. Meena et al. (2013) observed that the aphids appeared little late during the year in chilli crop. The correlation analysis of pest populations was positive non-significant with maximum temperature. However, a negative and non-significant correlation was observed with minimum temperature and rainfall whereas, a negative and highly significant correlation was found with morning relative humidity and evening relative humidity. These results are in close association with the findings of Yadav et al. (2014) who reported a negative correlation between the temperature, humidity and rainfall with aphid population. Further, Debaraj & Singh (2004) reported the negative correlation between temperature and aphid infestation. Roopa & Kumar (2014) also revealed that the aphid population exhibited a negative correlation with maximum temperature, minimum temperature and sunshine hours.

From the above findings it can be concluded that the peak period of chilli thrips population was recorded in the third week of October (43rd standard week) and the aphid population was recorded highest in the fourth week of October (44th standard week). The correlation analysis with abiotic factors revealed that

temperature showed a positive impact on the population of chilli thrips and aphid, while relative humidity and rainfall showed a negative impact on the population of chilli thrips and aphid. These findings could help in the development of the forecasting model which will be a useful tool to predict likely incidence and intensity of the insect pests on the crop to ensure timely preparedness to manage pest problems and prevent crop losses.

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Conflict of Interest

Authors would hereby like to declare that there is no conflict of interests that could possibly arise.

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