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Seasonal incidence of thrips and relation to abiotic factors in chilli (*Capsicum annum* L.)

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Abstract
The present study was carried out to find the correlation between the incidence of *Scirtothrips dorsalis* with weather variables during *kharif* 2015-16 and *kharif* 2016-17 respectively. The data on the seasonal incidence during both the seasons of investigation *viz.*, *kharif* 2015-16 and 2016-17, The *Scirtothrips dorsalis* incidence was observed from transplanting to harvesting stage and the highest thrips population were recorded during January 3rd week (3rd standard week) with 24.82 thrips per five leaves in *kharif* 2015-16. While during *kharif* 2016-17 it was December last week (52nd std. week) with 17.01 thrips per five leaves. The relationship between the thrips population with preceding one week (one week lag) weather parameters during *kharif* 2015-16 revealed that there was a significant negative correlation was observed between weather parameters of maximum temperature (-0.51**), minimum temperature (-0.80**), mean temperature (-0.87**), rainfall (-0.55**), rainy days (-0.59**) at 1% level of significance. During *kharif* 2016-17, maximum temperature (-0.59**), minimum temperature (-0.83**), evening relative humidity (-0.66**), rainfall (-0.59**), rainy days (-0.67**) and mean temperature (-0.87**) were negatively significant with the thrips population at 1% level of significance.

Keywords: Chilli, *Scirtothrips dorsalis*, seasonal incidence, correlation

1. Introduction
Chilli (*Capsicum annum* L.), is an important vegetable and condiment crop grown throughout the world and it has immense commercial, dietary and therapeutiuc values. It is a rich source of A, C, E and P and an alkaloid capsacin, which has high medicinal value and is used in many pharmaceutical preparations. Among the different countries India (25%) is the leader in chilli production followed by China (24%) and Pakistan (7.2%). The bulk share of chilli production in the world is held by Asian countries. In India chilli is cultivated in an area of 774.9 lakh ha with an annual production of 1492.1 lakh tones [1]. Important chilli growing states in India are Andhra Pradesh, Telangana, Karnataka, Maharashtra and Tamilnadu which constitute nearly 75 per cent of the total area under chilli. Area under chilli crop in Andhra Pradesh and Telangana is around 1.72 lakh ha which is about 25.12 per cent of the total area in India. In Telangana State it is grown in 73,000 hectares with 2,53,000 tonnes production from major chilli growing areas such as Khammam, Warangal, Mahabubnagar and Ranga Reddy districts [2]. Although the crop has great export potential besides the domestic requirement, a number of limiting factors contribute to its low productivity. Among these various biotic stresses, ravages caused by insect pests are significant. The pest spectrum in chilli is complex with more than 293 insects and mites species debilitating the crop in field as well as in storage [3]. Among these, chilli thrips, *Scirtothrips dorsalis* Hood has become the most notorious and pernicious pest on chilli. The overall reduction in fruit yield of chilli due to thrips and mites damage was up to 34 per cent [4]. These pests not only cause a reduction in yield, but also act as vectors for several viral diseases and cause complete failure of crop and various biotic (pest and diseases), abiotic (rainfall, temperature, relative humidity and light intensity) and phenological factors (flower and fruit drop) limits the yield and quality of the chilli. Due to variation in the agro climatic conditions of different regions, the nature and extent of damage caused by thrips varies. Environmental factors play an important role in determining the seasonal abundance and damage caused by the insect pest. Hence it is necessary to study the influence of various abiotic factors effecting the population fluctuation of thrips in chilli crop. These studies would give an idea about the peak period of their activity which in turn may be helpful in developing better pest management strategies.

2. Materials and methods

To study the seasonal incidence of chilli thrips, 100 m^2 the chilli crop was grown in the field with a spacing of 45×30 cm. The study was carried out during *kharif* 2015-16 and 2016-17 at Horticulture Garden, College of Agriculture, Rajendranagar, Hyderabad. The seeds of LCA 334 were raised in the nursery and six weeks old seedlings were transplanted in the main field. All the recommended agronomic practices except plant protection measures were followed for raising the crop. Observations were recorded in five plants of each treatment. Data was recorded starting from transplanting to harvest at weekly intervals as per the standard weeks. The thrips population was counted on five randomly selected plants, from five terminal leaves of each plant. The data obtained in the seasonal incidence studies of chilli thrips were subjected to correlation and multiple regression with various weather parameters *viz*., maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, rainfall, sunshine hours, evaporation etc [5].

3. Results and discussion

3.1 Seasonal incidence of chilli thrips, *Scirtothrips dorsalis* Hood

Seasonal abundance of chilli thrips were recorded from unprotected chilli crop at weekly intervals during *kharif* 2015-16 and 2016-17 and the results were presented in tables 1 and 3.2 and fig 1. The observations were recorded starting from transplanting to harvest at weekly intervals as per the standard weeks. The thrips population was counted on five randomly tagged plants, from five terminal leaves of each plant from each replication.

3.1.1. Seasonal incidence of *S. dorsalis* on chilli in *kharif* 2015-16

Observations on the incidence of thrips on chilli during *kharif* 2015-16 revealed that the activity of *S. dorsalis* on chilli started from fourth week of September during 39th standard week (Table 1) and it continued throughout the crop growth period. Population of *S. dorsalis* recorded on chilli leaves ranged from 2.94 to 24.82 thrips (per five leaves). The population of thrips increased gradually from fourth week of September (39th standard week) and attained a first peak during the second week of December (50th standard week) with 20.54 thrips per five leaves, while the second peak during January 3rd week (3rd standard week) with 24.82 thrips per five leaves. There after the population showed decreasing trend and the population counts reduced to 2.10 thrips per five leaves by the end of crop growth period *i.e.* during the 9th standard week.

3.1.2 Seasonal incidence of *S. dorsalis* on chilli in *kharif* 2016-17

During *kharif* 2016-17 incidence of thrips population started from first week of October (during 40th standard week) and it continued throughout the crop growth period. Population of *S. dorsalis* recorded on chilli ranged from 0.10 to 17.01 thrips per five leaves. The population of thrips increased gradually from first week of October (40th standard week) and attained a peak during December last week (52nd standard week) with 17.01 thrips per five leaves. There after the population showed decreasing trend and the population counts reduced to 1.89 per five leaves by the end of crop growth period *i.e.* during the 8th standard week (Table 2).

3.2 Effect of abiotic factors on the incidence of chilli thrips *S. dorsalis* in chilli

The seasonal incidence data of chilli thrips collected at weekly intervals were subjected to correlation with weather parameters of one week lag during *kharif* 2015-16 and 2016-17 and the results obtained were presented in tables 3 and 4.

3.2.1 *Kharif* 2015-16

Correlation coefficients between *S. dorsalis* population and weather parameters of one week lag (Table 3) indicated that among the various weather parameters, significant negative correlation was observed between weather parameters of maximum temperature (-0.51**), minimum temperature (-0.80**), mean temperature (-0.87**), rainfall (-0.55**), rainy days (-0.59**) at 1% level of significance while evening relative humidity was found negatively significant (-0.50*) at 5% level of significance with *S. dorsalis* population. The other parameters of morning relative humiditiy (-0.39) and evaporation (-0.33) showed negatively non significant while sunshine hours (0.39) and wind speed (0.04) showed a significant effect on *S. dorsalis* population.

3.2.2 *Kharif* 2016-17

Correlation studies during *kharif* 2016-17 revealed that maximum temperature (-0.59**), minimum temperature (-0.83**), evening relative humidity (-0.66**), rainfall (-0.59**), rainy days (-0.67**) and mean temperature (-0.87**) were significant and negatively correlated with the thrips population at 1% level of significance while sunshine hours (0.53**) was significant and positively correlated with thrips population at 1% level of significance. The morning relative humidity (-0.27), wind speed (-0.11) and evaporation (-0.07) were non significant with the *S. dorsalis* population in chilli during *kharif* 2016-17 (Table 4).

The seasonal incidence of thrips results observed the peak activity of chilli thrips during 1st standard week in Andhra Pradesh, Bapatla [6]. The variation in the peak activity of thrips observed in different regions could be attributed to the variation in ecological conditions, date of transplantation and the chilli varieties used in the study. Thrips population observed that negative relationship with temperature and rainfall [7]. In another study observed negative correlation between *S. dorsalis* population and minimum temperature [8] [9-10]. The thrips population buildup a significant negative relationship of weather parameters with maximum and minimum temperatures [11]. These findings indicated that population build-up of *S. dorsalis* population on leaves was mainly influenced by temperature and rainfall and other parameters like relative humidity, evaporation and sunshine hours did not show any significant effect on the population buildup of thrips population in chilli.

4. Conclusion

The present study was conducted during *kharif* 2015-16 and *kharif* 2016-17 to observe the seasonal incidence and its relation to abiotic factors. The *Scirtothrips dorsalis* incidence was observed from transplanting to harvesting stage and the highest thrips population were recorded during January 3rd week (3rd standard week) with 24.82 thrips per five leaves in *kharif* 2015-16. While during *kharif* 2016-17 it was December last week (52nd std. week) with 17.01 thrips per five leaves. The relationship between the thrips population with preceding one week (one week lag) weather parameters during *kharif* 2015-16 revealed that there was a significant negative correlation was observed between weather parameters of

maximum temperature (-0.51**), minimum temperature (-0.80**), mean temperature (-0.87**), rainfall (-0.55**), rainy days (-0.59**) at 1% level of significance. During *kharif* 2016-17, maximum temperature (-0.59**), minimum temperature (-0.83**), evening relative humidity (-0.66**), rainfall (-0.59**), rainy days (-0.67**) and mean temperature (-0.87**) were negatively significant with the thrips population at 1% level of significance.

Table 1: Seasonal incidence of chilii thrips *Scirtothrips dorsalis* on chilli during *kharif* 2015-16

SMW	Date & Month	Thrips per 5 leaves	Temperature (^{0}C)		Mean Relative Humidity (%)		Rainfall (mm)	Rainy Days	Mean Sunshine (hrs day^{-1})	Wind speed (km hr^{-1})	Mean evaporation (mm day^{-1})	Mean Temp(^{0}C)
			Maximum	Minimum	I	II						
36	03 – 09 (Sept)	0	33.4	22.9	88.4	59.1	30.8	3	7.2	1.4	5.6	28.2
37	10 – 16	0	28.4	21.9	95.9	85.7	92.0	4	1.7	0.8	2.5	25.1
38	17 – 23	0	30.4	22.2	89.6	61.0	43.4	2	4.4	1.2	3.5	26.3
39	24 – 30	2.94	31.9	22.3	89.4	57.6	2.0	0	7.2	0.2	4.3	27.1
40	01 – 07 (Oct)	2.32	31.4	21.1	96.0	55.0	34.6	2	5.8	0.2	3.4	26.3
41	08 – 14	3.50	33.4	19.6	88.4	37.4	0.0	0	7.9	0.1	4.5	26.5
42	15 – 21	5.75	32.8	19.1	91.7	42.0	0.0	0	8.4	0.6	4.5	26.0
43	22 – 28	8.82	32.4	18.1	89.3	43.6	0.0	0	8.9	1.8	4.7	25.3
44	29 - 04 (Nov)	10.49	31.3	20.7	91.7	50.9	18.3	1	7.3	1.3	3.6	26.0
45	05 – 11	12.38	31.3	17.4	90.6	73.6	0.0	0	7.3	2.3	4.4	24.3
46	12 – 18	13.24	30.0	15.8	85.1	52.9	0.0	0	6.7	2.4	4.0	22.9
47	19 – 25	14.53	29.4	19.1	83.0	53.9	0.8	0	6.6	1.4	3.9	24.2
48	26 – 02 (Dec)	15.95	30.4	17.8	87.4	47.0	0.0	0	7.7	0.6	3.8	24.1
49	03 – 09	18.06	29.4	14.4	91.7	36.7	1.4	0	7.0	0.4	3.5	21.9
50	10 – 16	20.54	32.2	17.0	90.0	37.0	0.0	0	7.6	0.7	3.9	24.6
51	17 – 23	18.27	32.4	15.7	92.9	35.3	0.0	0	8.9	0.9	4.2	24.1
52	24 – 31	18.03	30.0	11.1	73.3	24.6	0.0	0	8.8	0.8	3.9	20.6
1	01 – 07 (Jan)	20.38	30.4	11.8	84.1	26.0	0.0	0.0	9.6	0.9	3.9	21.1
2	08 – 14	22.57	29.2	11.0	78.4	25.6	0.0	0	9.1	1.2	3.9	20.1
3	15 – 21	24.82	29.1	16.6	76.6	36.4	0.0	0	6.8	1.6	3.7	22.9
4	22 – 28	23.65	29.1	15.6	79.4	37.3	0.0	0	7.2	1.6	3.8	22.4
5	29-04 (Feb)	20.73	32.9	13.6	70.7	25.6	0.0	0	9.7	1.2	4.6	23.3
6	05-11	14.42	32.6	16.9	81.3	32.7	0.0	0	8.7	1.2	4.8	24.8
7	12-18	10.92	32.9	17.3	80.4	29.4	0.0	0	8.6	2.3	6.0	25.1
8	19-25	4.63	35.4	17.4	78.0	25.4	0.0	0	9.5	1.9	6.5	26.4
9	26-04 MAR	2.10	33.3	21.4	80.4	37.1	0.0	0	7.1	2.9	6.2	27.3

* SMW- Standard Metrological Wee

Table 2: Seasonal incidence of chilli thrips *Scirtothrips dorsalis*on chilli during *kharif* 2016-17

SMW	Date & Month	Thrips per 5 leaves	Temperature (^{0}C)		Mean Relative Humidity (%)		Rainfall (mm)	Rainy Days	Mean Sunshine (hrs day^{-1})	Wind speed (km hr^{-1})	Mean evaporation (mm day^{-1})	Mean Temp(^{0}C)
			Maximum	Minimum	I	II						
36	03-09 (Sept)	0	30.1	21.6	90.1	59.1	19.2	2	7.2	0.0	4.3	25.9
37	10-16	0	27.7	22.1	93.1	81.9	128.2	6	0.9	0.0	2.6	24.9
38	17-23	0	28.6	21.9	94.1	85.1	105.4	4	2.5	0.0	2.6	25.3
39	24-30	0	27.9	22.0	97.0	78.9	70.6	3	2.1	0.0	2.5	24.9
40	01-07 (Oct)	0.10	30.1	21.9	90.3	65.9	4.4	1	5.7	0.0	3.8	26.0
41	08-14	1.53	29.9	20.8	94.4	50.9	27.8	3	5.3	0.0	3.1	25.3
42	15-21	2.98	30.6	14.6	92.7	34.1	0.0	0	9.2	0.0	4.0	22.6
43	22-28	4.75	30.2	15.1	91.9	38.3	0.0	0	8.8	0.0	4.1	22.7
44	29-04 (Nov)	5.86	30.9	19.9	84.0	47.1	0.0	0	7.0	0.0	3.6	25.4
45	05-11	7.10	30.1	12.3	88.0	28.7	0.0	0	8.5	0.0	3.8	21.2
46	12-18	9.92	29.8	15.7	88.7	44.9	0.0	0	6.5	0.0	3.3	22.8
47	19-25	12.04	29.7	9.8	89.7	28.1	0.0	0	8.7	0.0	3.6	19.8
48	26-02 (Dec)	12.41	30.8	10.0	90.9	31.4	0.0	0	8.3	0.0	3.3	20.4
49	03-09	15.06	29.1	14.0	92.6	42.3	0.0	0	7.4	0.0	3.1	21.5
50	10-16	16.01	27.9	13.1	86.3	51.3	2.0	0	6.7	0.0	3.1	20.5
51	17-23	16.48	29.4	9.5	88.3	24.0	0.0	0	9.1	0.0	3.6	19.5
52	24-31	17.01	29.4	8.9	91.4	31.0	0.0	0	9.0	0.0	3.5	19.2
1	01 – 07 (Jan)	16.82	29.1	9.7	89.6	29.7	0.0	0.0	8.8	0.0	3.4	19.4
2	08 – 14	15.05	29.3	13.2	84.0	38.0	0.0	0.0	7.6	0.8	3.4	21.25
3	15 – 21	13.83	28.2	11.4	89.1	31.7	0.0	0.0	7.7	1.2	3.6	19.8
4	22 – 28	13.01	29.9	14.7	85.9	38.4	0.0	0.0	7.6	3.0	4.3	22.3
5	29-04 (Feb)	12.51	31.3	12.7	86.3	27.7	0.0	0.0	9.0	3.3	4.4	22.0
6	05-11	8.90	31.9	13.6	78.0	28.4	0.0	0.0	9.3	3.0	4.6	22.75

7	12-18	4.69	30.8	13.8	87.4	32.7	0.0	0.0	9.4	4.6	5.3	22.3
8	19-25	1.89	35.4	13.8	70.7	20.4	0.0	0.0	10.3	3.0	5.8	24.6

* SMW- Standard Metrological Week

Table 3: Correlation coefficients between chilli thrips *S. dorsalis* and weather parameters (one week lag) during *Kharif*, 2015-16

Observatory weather parameters	Correlation coefficients (r)
Maximum temperature	-0.51**
Minimum temperature	-0.80**
Morning relative humidity (RH I %)	-0.39
Evening relative humidity (RH II %)	-0.50*
Rainfall (mm)	-0.55**
Rainy days (R.D)	-0.59**
Sunshine hours (S.S.H)	0.39
Wind speed (W.S) Km/h	0.04
Evaporation (E. pan) (mm)	-0.33
Mean temperature	-0.87**

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

Table 4: Correlation coefficients between chilli thrips *S. dorsalis* and weather parameters (one week lag) during *Kharif*, 2016-17

Observatory weather parameters	Correlation coefficients (r)
Maximum temperature	-0.59**
Minimum temperature	-0.83**
Morning relative humidity (RH I %)	-0.27
Evening relative humidity (RH II %)	-0.66**
Rainfall (mm)	-0.59**
Rainy days (R.D)	-0.67**
Sunshine hours (S.S.H)	0.53**
Wind speed (W.S) Km/h	-0.11
Evaporation (E. pan) (mm)	-0.07
Mean temperature	-0.87**

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

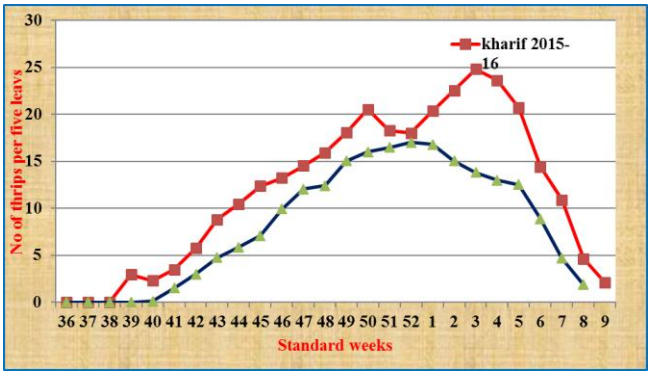

Fig 1: Seasonal incidence of *Scirtothrips dorsalis* on chilli during *kharif* 2015-16 and 2016-17

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