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Impact of Weather Parameters on Incidence of Aphids, *Myzus persicae* Sulzeron Chilli in Andhra Pradesh, India

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A B S T R A C T

To know the initial occurrence and subsequent build-up of aphids population on chilli crop in relation to weather parameters, the field experiments were carried out from 2010-2012 at Horticultural Research station, Lam, Guntur, Andhra Pradesh. Seasonal incidence of aphids was recorded from leaves and fruits at weekly intervals during the crop growth period. Based on the two years data, the results revealed that the infestation and severity of aphid population were highly influenced by weather parameters. In 2010-11, aphid incidence was initiated from 42thSTW week (1.51/leaf) and it continued up to the harvest of the crop 9th STW(1.25) with a peak activity at 50th STW (46.72). Correlation coefficients worked out between aphids population and weather parameters of preceding one week indicated that among the various weather parameters, significant positive correlation was observed between morning relative humidity (0.08**), evening relative humidity (0.53*) and minimum temperature (0.66**) whereas negative significant correlation was observed with maximum temperature (-0.24**) and rainy fall (-0.55**) with aphids population. Similar trend was observed at preceding two weeks weather parameters and aphids population in same year of study. Significant positive correlation was observed between morning relative humidity (0.01**), evening relative humidity (0.57*) and minimum temperature (0.68**) whereas negative significant correlation was observed with maximum temperature (-0.25**) and rainy fall (-0.56**) with aphids population. About 2011-12, incidence was initiated from 44th STW (2.79) and it continued up to the harvest of the crop 4th STW (3.42) with a peak activity during 1st STW (13.64) Correlation coefficients worked out between aphids population and weather parameters of preceding one week indicated that among the various weather parameters significant positive correlation was observed between weather parameters of morning relative humidity (0.46**), evening relative humidity (0.51*) and minimum temperature (0.36**) whereas negative significant correlation was observed with maximum temperature (-0.63**) and rainy fall (-0.36**) with aphids population. There was a similar trend in preceding two weeks weather data correlations with. Weather parameters of preceding two weeks indicated that among the various weather parameters significant positive correlation was observed between weather parameters of morning relative humidity (0.48**), evening relative humidity (0.47*) and minimum temperature (0.24**) whereas negative significant correlation was observed with maximum temperature (-0.62**) and rainy fall (0.32**) with aphids population. The combined effect of weather parameters on incidence of aphids was worked out; it showed that the variation in the incidence (62 to 74%) was contributed by the weather parameters.

Introduction

Chilli (*Capsicum annum* L.) is an important cash crop grown in Andhra Pradesh which has got both domestic and export market as vegetable and a condiment. Andhra Pradesh occupies a prime place in chilli cultivation (116,578 hectares)accounting for 49 % of the total cultivated area in the country (Chilli Outlook, January 2019) The cultivation of chilli has become capital intensive due to many production constrains of which the losses caused by pests in paramount (Rajpur *et al.,* 2008).

Nearly 25 insects have been recorded attacking chilli leaves and fruits in India (Butani, 1976). Various biotic (pest and diseases), abiotic (rainfall, temperature, relative humidity and light intensity) and phonological factors (flower and fruit drop) limits the yield and fruit quality of chilli (Hebbar *et al.,* 2011).

Among the biotic factors, insect pests reduce the quality of produce and even a small blemish on the fruit will drastically reduce its market value. As per Butani (1976) aphid, *Myzuspersicae* (Sulz.) is a important sucking pest in open and poly house conditions. Aphids are tiny yellowish soft-bodied insects; the adult is 1mm long and has two projections called cornicles on the dorsal side of abdomen.

Aphids are found in large colonies on underside of leaves and tender shoots. The nymphs and adults suck the sap. Therefore, the affected leaves turn yellow, get wrinkled and destorted. The insect also exude honeydew on which fungus develops, rapidly covers the plant with sooty mould that interferes with the photosynthetic activity of the plant. As a result, the growth of plant is stunted and yield is affected adversely. Besides, they act as a vector for transmitting the chilli mosaic virus and cause 20 to 30 per cent yield loss. Under uncontrolled conditions, losses were extended from 50 to 100 per cent due to aphids in chilli (Krishnakumar, 1995). Adults and apterous forms reproduce parthenogenitically. (Reddy and Kumar, 2006) As chilli is a cash crop, farmers were extensively using wide range of insecticides to control the chilli aphid in Andhra Pradesh resulted in development of resistance against Acephate and Imidacloprid it leads to increased number of sprays (Krishna Kumar *et al.,* 2009). This situation resulted pesticide residues in chilli export samples.

Due to variation in the agro climatic conditions of different regions, the nature and extent of damage caused by aphid varies. Environmental factors play an important role in determining the seasonal abundance and damage caused by the insect pests. Hence it is necessary to study the influence of various abiotic factors effecting the population fluctuation of aphid species 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. To know the initial occurrence and subsequent build-up of aphid population in both open and poly house conditions, to prevent the spread of viral diseases and timely management of the aphid population is the need of the day, keeping this in view the present study was done in chilli ecosystem of Andhra Pradesh.

Materials and Methods

The experiment was carried out under open field conditions at Horticultural Research Station, Lam Farm, Guntur, Andhra Pradesh from 2010 to 2012. The popularly grown chilli variety LCA-334 was used for the study. The experiment was laid out in 500 m ^{2}plot. The plot was divided into 5 quadrates

with a gap of 1m between each quadrate. Seeds of chilli variety LCA 334 were sown in the raised seed beds and one month old healthy seedlings were transplanted in the main field with a row to row and plant to plant distance of 60 cm x 60 cm. All the recommended agronomic practices like fertilizer application, weeding, hoeing, irrigation etc., were taken up at regular intervals. The crop was raised under unprotected conditions. Observations on aphids species (nymphs) inhabiting the leaves and fruits were recorded at weekly intervals in the chilli crop after noticing the aphids incidence and continued till the harvest of the crop.

For recording the pest incidence, 10 healthy plants were selected randomly from each quadrate and tagged. It is very difficult to take the population counts of the aphids species in the field as they are very minute, very active and inhabit the young terminal leaves.

Hence for taking the aphids counts and identifying different species inhabiting the leaves, young terminals were collected from ten plants of each quadrate. The aphids species inhabiting the terminal leaves were collected in 250 ml plastic containers and counted with hand lence.

Thus 10 samples from each quadrate were collected at weekly intervals. After collecting the samples, the labels containing the information about the date of observation and the quadrate from which the samples were collected were written and pasted on the container. The aphids species feeding on the chilli fruits were collected by gently tapping ten fruits from each quadrate in zip lock polythene bags and labelled for counting in the lab. The data was recorded as no. of aphids per plant and average no. per leaf.

The weather data was collected from the weather station located at Regional Agricultural Research Station (RARS), Lam, Guntur. The various weather parameters collected and utilized in the study were Maximum temperature (T. max), Minimum temperature (T. min), Morning Relative humidity (RH I) and Evening Relative humidity (RH II).

To find out the effect of various weather parameters on aphids population simple correlation coefficients were worked out between aphids population and observatory weather data of preceding one and two weeks. The correlation coefficients obtained were tested at five per cent and one per cent level of significance.

To find out the combined influence of all the weather parameters on aphids population the data were subjected to simple correlation and regression. Multiple regression equation also worked out to know the individual weather factors on Aphid population build up.

Results and Discussion

To find out the effect of individual abiotic factors on the population dynamics of aphids species infesting chilli leaves, flowers and fruits, the correlation coefficients were worked out between aphids population and weather parameters. While working out the correlation coefficients, aphids population of each standard week was correlated with preceding one and two weeks weather data which gave better correlation coefficients than with the present week weather data. The incidence of *M. persicae* in chillies was initiated from 42th STW week (1.51/leaf) and it continued up to the harvest of the crop 9th STW (1.25) with a peak activity at 50th STW (46.72) during 2010-11 (Table 1).

Correlation coefficients worked out between aphids population and weather parameters of preceding one week (Table 3) indicated that among the various weather parameters, significant positive correlation was observed

between morning relative humidity (0.08**), evening relative humidity (0.53*) and minimum temperature (0.66**) whereas significant negative correlation was observed with maximum temperature (-0.24**) and non-significant negative correlation with rainy fall (-0.55) with aphids population.

Similar trend was observed at preceding two weeks weather parameters and aphids population. Significant positive correlation was observed between morning relative humidity (0.04**), evening relative humidity (0.57*) and minimum temperature (0.68**) whereas significant negative correlation was observed with maximum temperature (-0.25**) and non-significant negative correlation with rain fall (-0.56) with aphids population. During 2011-12, incidence was initiated from 44th STW (2.79) and it continued up to the harvest of the crop 4th STW (3.42) with a peak activity during 1st STW (13.64) (Table 2). Correlation coefficients worked out between aphids population and weather parameters of preceding one week (Table 3) indicated that among the various weather parameters significant positive correlation was observed between weather parameters of morning relative humidity (0.46**), evening relative humidity (0.51*) and minimum temperature (0.36**) whereas significant negative correlation was observed with maximum temperature (-0.63**) and non-significant negative correlation with rainy fall (-0.36).

Table.1 Seasonal incidence of Chilli Aphids, *Myzus persicae* Sulzer during 2010-11

Standard week	Date & Month	Temperature (^{o} C)		Relative Humidity (%)		Rainfall (mm)	No. of Aphids/ leaf
		Max	Min	Morn	Eve		
42	Oct15-21. 2010	31.23	23.00	83.71	77.14	31.60	1.51
43	Oct22-28.	32.20	23.97	92.43	70.57	62.30	2.63
44	Oct 29-Nov4	29.80	23.56	92.57	81.86	48.80	5.11
45	Nov05-11	29.20	23.23	91.29	76.86	23.40	8.34
46	Nov12-18	29.97	23.74	86.43	74.29	27.80	12.19
47	Nov19-25	31.89	22.43	86.43	68.14	0.00	19.42
48	Nov26-Dec02	30.70	20.59	88.00	59.86	0.00	22.79
49	Dec03-09	26.76	20.51	85.00	71.29	115.30	4.19
50	Dec11-16	29.87	20.73	91.71	58.14	0.00	46.72
51	Dec17-23	27.94	14.61	83.14	46.43	0.00	44.38
52	Dec24-31	28.89	16.44	88.88	54.75	0.00	40.78
1	Jan 1-7,2011	29.24	17.34	84.57	49.00	0.00	39.11
2	Jan 8-14	30.27	15.23	80.29	43.57	0.00	35.22
3	Jan 15-21	31.24	16.91	93.43	46.29	0.00	33.19
4	Jan 22-28	31.24	15.63	95.14	45.91	0.00	30.78
5	Jan 29-4 Feb	31.74	17.43	95.29	46.86	0.00	24.70
6	Feb 5-11	32.77	16.13	89.86	41.29	0.00	22.14
7	Feb 12-18	33.61	17.41	77.14	40.57	0.00	12.33
8	Feb 19-25	30.07	20.84	93.14	63.86	7.70	4.14
9	Feb26-4rd March	33.11	19.47	87.14	47.29	0.00	1.25

Table.2 Seasonal incidence of Chilli Aphids, *Myzus persicae* Sulzer during 2011-12

Standard week	Date & Month	Temperature (^{o} C)		Relative humidity (%)		Rainfall (mm)	No. of Aphids/ leaf
		Max	Min	Morn	Eve		
42	Oct15-21,2011	34.69	23.4	79.43	58.43	27.4	0
43	Oct22-28.	31.66	24.63	76.71	60.43	35.4	0
44	Oct 29-Nov4	32.04	23.34	81.71	61.57	0	**2.79**
45	Nov05-11	33.01	18.54	73.42	44	0	**1.22**
46	Nov12-18	32.82	19.32	80.4	48.28	0	0
47	Nov19-25	31.91	19.05	75.57	45.85	0	0
48	Nov26-Dec02	32	21.81	80.42	51.28	0	0
49	Dec03-09	32.3	19.71	84	49.14	0	0
50	Dec11-16	32.04	19.64	84.85	47.14	0	0
51	Dec17-23	29.97	18.32	89.14	49.57	0	0
52	Dec24-31	35.21	19.52	96.28	54.42	59.9	0
1	Jan 1-7,2012	29.98	21.54	98.85	71.28	22.2	**13.64**
2	Jan 8-14	28.58	18.12	85.14	56	59.8	**12.72**
3	Jan 15-21	30.41	14.78	91.14	52.14	0	**9.7**
4	Jan 22-28	30.67	16.8	91	56.71	0	**3.42**
5	Jan 29-4 Feb	30.5	17.48	89.5	62	0	0

Table.3 Correlation co-efficient between Chilli Aphids, *Myzus persicae* Sulzer incidence and weather parameters (preceding one and two weeks from 2010 to 2012)

Observatory Weather Parameters	2010-11		2011-12	
	Preceding 1 Week	Preceding 2 Week	Preceding 1 Week	Preceding 2 Week
Maximum Temperature	-0.24**	-0.25**	-0.63**	-0.62**
Minimum Temperature	0.66**	0.68**	0.36**	0.24**
Morning Relative Humidity (RH-1%)	0.08**	0.04**	0.46**	0.48**
Evening Relative Humidity (RH-II %)	0.53**	0.57*	0.51*	0.47*
Rain fall (mm)	-0.55	-0.56	-0.36	-0.32

*Significant at 5 per cent level (r =0.46)
**Significant at 1 per cent level (r =0.01)

Table.4 Multiple regression equation developed for Chilli Aphids, *Myzus persicae* Sulzer incidence on chilli and weather parameters from 2010 to 2012)

Observation	Step down multiple linear equation	Co-efficient of determination (R^2)
2010-11 Preceding 1 week	Y= 212.58-5.94**T.max -1.44 T.Min +0.28* RH-1 +0.58* RH-1I+0.27 RF	0.71
2010-11 Preceding 2 week	Y= 210.93-5.83**T.max -0.03 T.Min +0.27* RH-1 +0.54* RH-1I+0.29 RF	0.74
2011-12 Preceding 1 week	Y= 43.13-1.44*T.max- 0.44* T.Min +0.03* RH-1- 0.19+ 0.04 RH--II+0.06RF	0.62
2011-12 Preceding 2 week	Y= 39.97-1.30* Tmax- -0.47 T. min * +0.07RH-I-0.22 RH-II+0.06RF	0.63

The correlation studies carried out with preceding two weeks weather data (Table 3) similar trend was observed in the correlations. Weather parameters of preceding two weeks indicated that among the various weather parameters significant positive correlation was observed between weather parameters of morning relative humidity (0.48**), evening relative humidity (0.47*) and minimum temperature (0.24**) whereas significant negative correlation was observed with maximum temperature (-0.62**) and non-significant negative correlation between rainy fall (0.32) and aphids population

The combined effect of weather parameters on incidence of aphids was worked by subjecting the data to develop multiple regression equation (Table 4), the variation in the percent aphid population incidence 62 to 74% was contributed by the weather parameters. Similar findings by Pathipati *et al.,* 2014 and Bindu and Patil 2000 as 81 % incidence was contributed by weather parameters. Combined effects of weather parameters of present findings were also similar to the findings of Rajput, 2017, Kumar Arvind and Kumar Akhilesh, 2015 and Deepak Kumar *et al.,* 2019. The variation in the peak activity of aphids observed in different regions could be attributed to the variation in ecological conditions, date of transplantation and the chilli varieties used in the study. The results strongly support the significant negative correlation with maximum temperature and rain fall where as positive correlation with minimum temperature, morning and evening relative humidity of prevailed weather parameters.

Similar results were reported by Subashree *et al.,* 2018, Ravi Kumar and Rafee, 2018, Shivanna *et al.,* 2011, Sunil Kumar, 2015, Meena *et al.,* 2003 and Venzon *et al.,* 2006. From the findings it was evident that population build-up of aphids population on leaves was mainly influenced by relative humidity and temperature.

The population levels also vary with year to year because of variations in the prevailed weather parameters. The overall results obtained from the seasonal incidence of chilli aphids and its relation with weather parameters clearly indicated the peak period of activity of aphids species was significantly influenced by weather parameters prevailed in and around the plant parts of chilli crop. The information obtained from these studies used in developing weather based pest prediction

models which in turn are helpful in taking up timely control measures.

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