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Seasonal Incidence of Different Sucking Pests of Chilli and their Natural Enemies under West Bengal Condition

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A B S T R A C T

Seasonal incidence of different sucking pests of chilli viz., thrips (*Scirtothrips dorsalis* Hood), mites (*Polyphagotarsonemus latus* Banks), Aphid (*Aphis gossypii* Glov.), Whitefly (*Bemesia tabaci* Genn.) and Jassids (*Amrsca bigutula* bigutula) and natural enemies like Coccinellids and spiders were worked out in the present study during 2016 at District Seed Farm (AB Block) of Bidhan Chandra Krishi Viswavidyalaya located at Kalyani, Nadia, West Bengal. Peak population of thrips was recorded to be in 18th standard week i.e. 12.58 per three leaves when the average temperature, relative humidity and weekly total rainfall were 31.2 0c, 66.79% and 17.8 mm respectively. For mite maximum population was recorded to be 28.55 per three leaves, when the average temperature, relative humidity and weekly total rainfall were recorded to be 31.040C, 74.29% and 71.1mm respectively. Similarly for Aphids peak population attained by 17th standard week i.e. 30.45 per three leaves when average temperature, relative humidity and weekly total rainfall were 33.760C, 67.29% and 0.0 mm respectively. Observation taken showed that whitefly incidence started from 1st standard week (0.44/three leaves) reaching a peak population in 44th standard week i.e. 6.22 per three leaves when the average temperature, relative humidity and weekly total rainfall were 27.720 C, 84.00% and 7.4mm respectively. Highest population of jassids reaching in 20th standard week i.e. 1.45 per three leaves when the average temperature, relative humidity and weekly total rainfall were 29.050 C, 79.86% and 67.5 mm respectively. Regarding natural enemies the observation was taken as coccinellid beetle per plant and found that coccinellid population was at its peak during 43rd standard meteorological week i.e. 18.22 per plant when average temperature, relative humidity and weekly total rainfall were 28.290 C, 80.07% and 0.0 mm respectively and Population of spiders were found to be maximum during 35th standard meteorological week i.e. 3.00 per plant when average temperature, relative humidity and weekly total rainfall were 29.060 C, 61.57% and 16.2 mm respectively.

Introduction

Chilli (*Capsicum annuam* L.) is an important spice crop as well as vegetable crop grown all over India. In India, chilli is cultivated in an area of 7.67 lakh hectares and the production is estimated at 12.34 lakh tones. Regular pest surveillance and monitoring their activity in relation to prevailing weather conditions is a quite essential step taken forward to evolve an effective and economically sound pest management programme. Among the different insect pests of chilli, aphid (*Aphis gossypii* Glov.), whitefly (*Bemisia tabaci* Genn.), thrips *(Scirtothrips dorsalis* Hood*)* mite (*Polyphagotarsonemus latus Banks*), and jassid (*Amrasca bigutula bigutula*.), were most important to cause substantial damage to chilli plant. Studies on population dynamics of pests and their relationship with meteorological parameters is a pre-requisite for formulation of pest management approach. In view of this, a regular surveillance and monitoring programme is essential to develop a forecasting system through manipulating interaction between crop phenology and insect incidence to avoid synchronization between peak period of pest infestation and vulnerable stage of crop growth. The relationship between the pests and prevailing weather conditions is a very important aspect of studies since knowledge of this relationship helps us to know the time of pest incidence as well as to take appropriate measures of pest control. But, this relationship is not simple, always due to they are multitude of different factors and their interactions. Most of the Conventional chemicals are broad spectrum, persistent in nature and having long residual action. The indiscriminate use of broad spectrum chemicals have resulted in reduction in biodiversity of natural enemies, outbreak of secondary pests and development of resistance to pesticides, pesticides induced resurgence and contamination of food and eco-system (Singh, 2000). So conservation of natural enemies like coccinellid beetles and spiders in the chilli ecosystem should be essential for sustainable management of insect pests of chilli.

Materials and Methods

Location

The experiment was conducted at the District Seed Farm (A-B Block) of Bidhan Chandra Krishi Viswavidyalaya located at Kalyani, Nadia, West Bengal in experimental field during the year 2016-2017. The geographical details of the site are 23° N latitude, 89° E longitude and 9.75 meter above mean sea level (MSL).

Soil

The soil of the experimental field was typically gangetic alluvial soil (Entisol) having sandy clay loam texture with good drainage facility, neutral in reaction and moderate in fertility

Seasonal incidence of major insect pests of chilli

Season of experiment

The present experiment was conducted during January, 2016 to January, 2017.

Lay out of the experiment

The experiment was conducted in a Randomized Block Design (RBD) with 3 replications and 8 treatments.

Planting materials

For the experiment, chilli cultivar named ―Bullet (*Capsicum annum* var. annum L.; Family- Solanaceae) was considered which is a very common cultivar used by the farmers of

West Bengal. Bullet Chillies are well known due to their bullet like shape and size, these are a Jalapeno type popular in Indian cuisine for the hot, light and fresh flavor.

Planting of crops for the incidence experiment have been taken 4 times for the year 2016 and reading of incidence has been taken throughout the year from active growth period of the crop.

Recording of meteorological data

The meteorological data on different abiotic factors viz. temperature (maximum & minimum in °C), relative humidity (maximum & minimum in %), total rainfall (in mm) wind speed (Km/hr), and bright sunshine hours (hr) during the period of investigation were collected from the AICRP on Agro meteorology, BCKV, Kalyani.

Methodology

Incidence of yellow mite, chilli, thrips, aphid, whitefly and jassid was recorded at an interval of 3 days. Pest counts were made from 3 top leaves of 5 randomly selected plants per plot. The leaves thus collected from the fields were put in a zip lock polypropelene bag and brought to the laboratory for observation under stereo- zoom binocular microscope (Olympus SZ-40) for estimation of population of thrips and mites. Observation of whitefly population was done by shaking the base of chilli plant and recording the number of whitefly through naked eye. Population of aphid, jassid and whitefly nymph was observed by using hand lens. Predators like coccinellid beetle and spider were recorded through naked eye.

Natural enemies namely spider and coccinelid predators (*Coccinella septempunctata, Coccinella transversalis, Cheilomenes sexmaculata, Micraspis discolor*) were also recorded for study the correlation between them and different weather factors.

Statistical analysis

Seasonal incidence of all the insect pests taken into consideration was recorded as insect count /three leaves at an interval of seven days whole round the year. The influence of different weather parameters like maximum temperature, minimum temperature, Maximum relative humidity, Minimum relative humidity and sunshine hours on population dynamics of, thrips, aphid, whitefly, jassid and naturally occurring predators had been investigated through correlation studies, calculating respective ―r (correlation coefficient) through Pearsons correlation.

Results and Discussion

Seasonal incidence of thrips (*Scirtothrips dorsalis* Hood)

Observations recorded from thrips/three leaf states that first incidence of population was recorded from 1st week of January and it was nearly constant upto 4th standard week and then the population declined gradually upto 8th standard week. Peak population was recorded to be in 18th standard week i.e., 12.58/three leaves when the average temperature, relative humidity and weekly total rainfall were 31.2 0c, 66.79% and 17.8 mm respectively. The lowest population recorded was found in 5th standard meteorological week i.e., 0.11/ 3 leaf when the average temperature, relative humidity and weekly total rain fall were 21.52 ^{0} C, 70.50 % and 0.0 mm respectively.

Correlation studies (Table 1) between thrips population and weather parameters revealed that population of thrips showed significant positive correlation with average temperature, maximum and minimum temperature and a

significant negative correlation with maximum relative humidity while non-significant positive correlation with temperature difference and non-significant negative correlation with relative humidity (minimum and average) and weekly rainfall. This can be inferred as activity of thrips population increases with high temperature, high relative humidity and decreases with rainfall but population increases with the rise of temperature difference. The results were confirmed by Bhede *et al.*, (2008) and Patel *et al.*, (2009) (Fig. 1).

Seasonal incidence of Mite (*Polyphagotarsonemus latus* Banks)

Population studies on mites observed as mite/three leaves stated that the mite infestation started from 1st SMW (1.00 mites/ three leaves) and the population tends to remain at a range of 1-6 mites/three leaves upto 7th SMW. A drastic increase in population was noticed in 8th SMW (12.22 mites/ three leaves) and then gradually declined upto 10thSMW. Then mite population suddenly increased from 13th SMW upto 19thSMW,where peak population was recorded to be 28.55/three leaves, when the average temperature, relative humidity and weekly total rainfall were recorded to be 31.04^{0}C, 74.29% and 71.1mm respectively. It was followed by gradually decline in population upto 25th SMW, leading to lowest recorded population i.e. 0.11/three leaves.

Correlation studies (Table 2) between mites population and weather parameters revealed that mites population showed a significant positive correlation with temperature difference, maximum temperature and average temperature while it showed significant negative correlation with relative humidity (maximum, minimum, average). A non-significant negative correlation was found between mite population and weekly total rainfall. The population of mites showed a non-significant positive correlation with minimum temperature. This inference drawn from correlation studies gives a account of mite population to increase with high temperature and temperature difference, while decreases with high relative humidity and heavy weekly total rainfall. The result was confirmed by Lingeri *et al.*, (1998), Bhede and Vosle (2008), Patil *et al.*, (2009) and Chaven *et al.*, (2003) (Fig. 2).

Seasonal incidence of Aphid (*Aphis gossypii* Glov.)

The incidence of aphid started from 1st standard week i.e. 1.22 per three leaves; with peak population attained by 17th standard week i.e. 30.45 per three leaves when average temperature, relative humidity and weekly total rainfall were 33.76^{0}C, 67.29% and 0.0 mm respectively. Again population gradually declined from 18th to 26th standard week attaining lowest population in 33rd standard week. It is notably observed there was no incidence of aphids during 38th and 39th standard week (Fig. 3).

Correlation studies revealed that the aphid population had a non-significant positive correlation with temperature difference while non-significant negative correlation with rainfall (weekly total) and relative humidity (minimum, average). On the contrary it showed significant positive correlation with temperature (maximum, minimum, average) while showed significant negative correlation with maximum relative humidity (Table 3).

This indicates that activity of aphid population increases with increase in maximum, minimum and average temperature and decreases with rainfall. The pest population decreases under warm humid conditions. This result is also similar with the findings of Meena *et al.*, (2013) and Butani (1970).

Table.1 correlation co-efficient between thrips and weather parameters

Environmental parameter		Correlation co-efficient (r)	Co-efficient of determination (R^2)	Regression equation
Temperature $_0$C	Maximum	0.652**	0.426	Y = 0.757x+28.86
	Minimum	0.361**	0.130	Y =0.594x+19.47
	Difference	0.157	0.037	Y = 0.214x+8.84
	Average	0.511**	0.181	Y=0.727x++23.58
Relative Humidity (%)	Maximum	(-)0.352*	0.124	Y = 0.346x+94.90
	Minimum	(-)0.145	0.021	Y=-0.663x+65.92
	Average	(-)0.186	0.035	Y =-0.504x+80.41
Weekly rainfall (mm)	Total	(-)0.114	0.013	Y=1.501x++36.75

*Significant at 5% level of significance
**Significant at 1% level of significance

Table.2 Correlation co-efficient between mite and weather parameters

Environmental parameter		Correlation co-efficient (r)	Co-efficient of determination (R_2)	Regression Equation
Temperature $_0$C	Maximum	0.693**	0.480	y=0.291x+29.24
	Minimum	0.267	0.071	Y=0.159x++20.44
	Difference	0.352*	0.123	y = 0.132x++8.81
	Average	0.469**	0.220	Y=0.225x+24.84
Relative Humidity (%)	Maximum	(-)0.478**	0.228	y = -0.170x+95.08
	Minimum	(-)0.395**	0.156	Y=-0.656x+69.46
	Average	(-)0.422**	0.178	Y=-0.413x+82.27
Weekly rainfall(mm)	Total	(-)0.241	0.058	Y=-1.152x+41.53

*Significant at 5% level of significance
**Significant at 1% level of significance

Table.3 Correlation co-efficient between aphid and weather parameters

Environmental parameter		Correlation co-efficient (r)	Co-efficient of determination (R^2)	Regression Equation
Temperature ^{0}C	Maximum	0.614**	0.377	Y = 0.251x+30.39
	Minimum	0.351*	0.113	Y =0.217x+20.32
	Difference	0.130	0.016	Y = 0.047x+9.77
	Average	0.487**	0.237	Y =0.227x+25.51
Relative Humidity (%)	Maximum	(-)0.409**	0.167	Y =-0.142x+94.38
	Minimum	(-)0.165	0.027	Y = -0.267x+64.89
	Average	(-)0.214	0.006	Y = -0.115x+77.61
Weekly rainfall (mm)	Total	(-)0.017	0.000	Y=-0.083x+30.95

*Significant at 5% level of significance
**Significant at 1% level of significance

Table.4 Correlation co-efficient between whitefly and weather parameters

Environmental parameter		Correlation co-efficient (r)	Co-efficient of determination (R^2)	Regression Equation
	Maximum	(-)0.109	0.012	Y = -0.256x+32.48
Temperature ^{0}C	Minimum	(-)0.295*	0.098	Y =-1.018x++23.82
	Difference	0.345*	0.119	Y =0.726x+8.89
	Average	(-)0.231	0.053	Y =-0.620x+28.03
Relative Humidity (%)	Maximum	(-)0.097	0.009	Y = -0.193x+93.75
	Minimum	(-)0.215	0.046	Y=-1.990x++66.37
	Average	(-)0.199	0.039	Y =-1.092x+80.06
Weekly rainfall (mm)	Total	(-)0.326*	0.106	Y=-8.699x+44.62

*Significant at 5% level of significance
**Significant at 1% level of significance

Table.5 Correlation co-efficient between jassid and weather parameters

Environmental parameter		Correlation co-efficient (r)	Co-efficient of determination (R^2)	Regression Equation
Temperature ^{0}C	Maximum	0.308*	0.095	Y = 3.874x+31.32
	Minimum	0.175	0.030	Y =3.123x+21.37
	Difference	0.066	0.004	Y =0.751x+9.94
	Average	0.244	0.059	Y =3.499x+26.34
Relative Humidity (%)	Maximum	(-)0.164	0.027	Y = 1.75x++93.77
	Minimum	(-)0.018	0.000	Y=0.906x++63.29
	Average	(-)0.045	0.002	Y =-1.328x+78.53
Weekly rainfall(mm)	Total	(-)0.009	9E-05	Y=-1.327x+30.66

*Significant at 5% level of significance
**Significant at 1% level of significance

Table.6 Correlation co-efficient between ladybird beetle and weather parameters

Environmental parameter		Correlation co-efficient (r)	Co-efficient of determination (R^2)	Regression Equation
Temperature ^{0}C	Maximum	0.349*	0.122	Y =0.277x+30.77
	Minimum	0.130	0.017	Y =0.146x+21.29
	Difference	0.183	0.033	Y = 0.130x+9.47
	Average	0.234	0.054	Y =0.211x+26.03
Relative Humidity (%)	Maximum	0.126	0.000	Y = 0.011x+93.49
	Minimum	(-)0.131	0.017	Y=-0.412x+65.04
	Average	(-)0.114	0.013	Y =-0.211x+79.27
Weekly rainfall (mm)	Total	(-)0.251*	0.063	Y=-2.257x+40.96

*Significant at 5% level of significance
**Significant at 1% level of significance

Table.7 Correlation co-efficient between spider and weather parameters

Environmental parameter		Correlation co-efficient (r)	Co-efficient of determination (R_2)	Regression equation
	Maximum	(-)0.114	0.013	Y =-0.628x+32.68
Temperature $_0$C	Minimum	0.117	0.013	Y =0.911x+21.08
	Difference	(-)0.313*	0.098	Y =-1.540x+11.59
	Average	0.022	0.000	Y =0.141x+26.88
Relative Humidity (%)	Maximum	0.145	0.021	Y =0.675x+92.77
	Minimum	0.149	0.022	Y=3.227x+59.95
	Average	0.152	0.023	Y =1.951x+76.36
Weekly rainfall (mm)	Total	0.201	0.040	Y=12.51x+18.13

*Significant at 5% level of significance
**Significant at 1% level of significance

Fig.1 Incidence of thrips as influenced by temperature, humidity and total rainfall during 2016

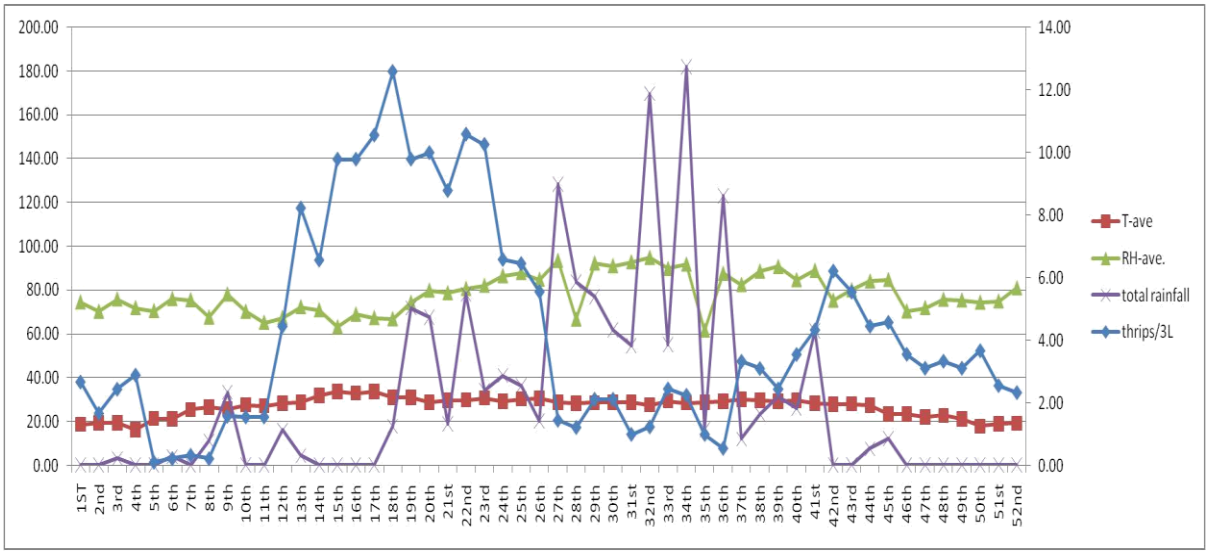


Fig.2 Incidence of mite as influenced by temperature, humidity and total rainfall during 2016

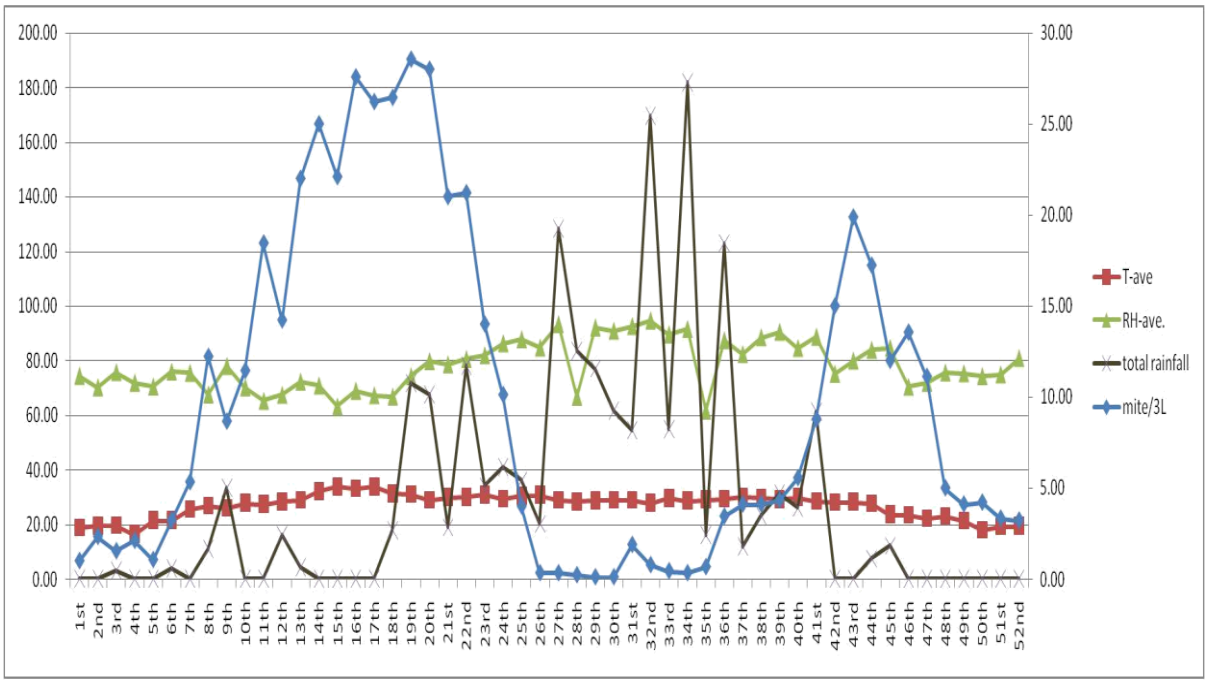


Fig.3 Incidence of aphid as influenced by temperature, humidity and total rainfall during 2016

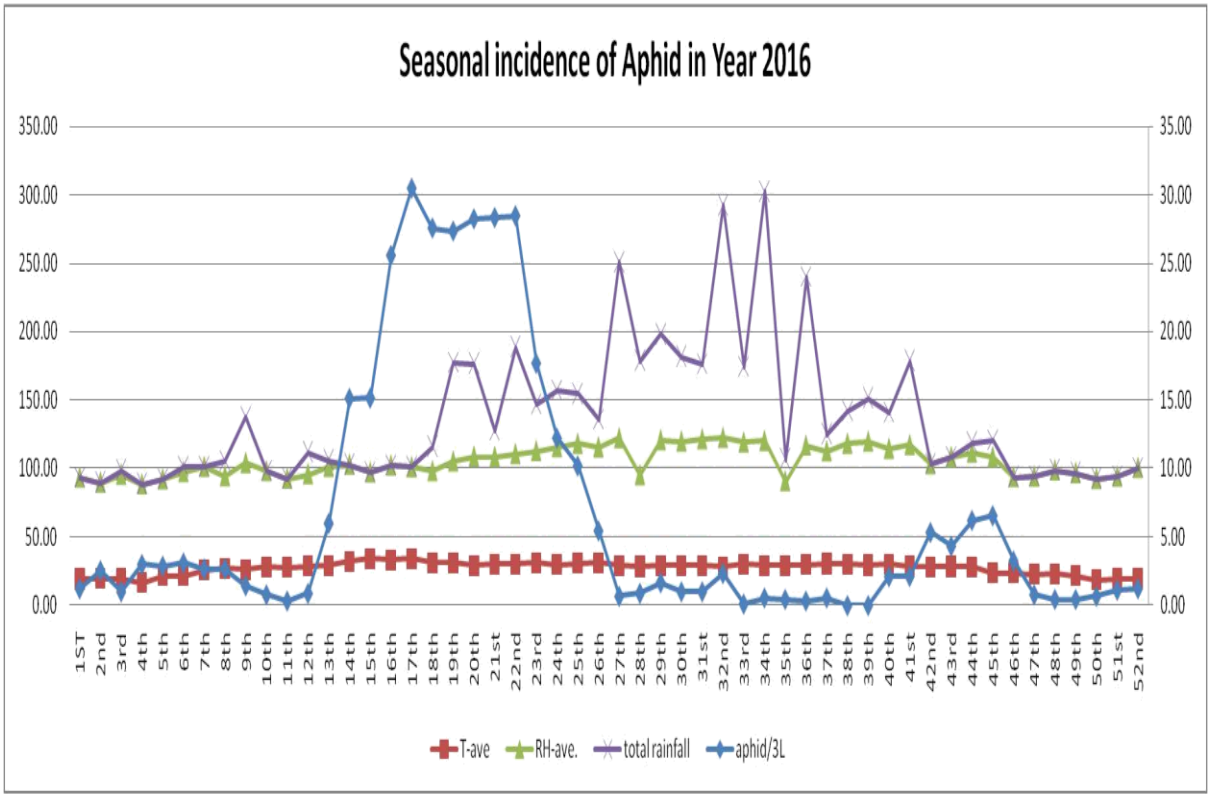


Fig.4 Incidence of whitefly as influenced by temperature, humidity and total rainfall during 2016

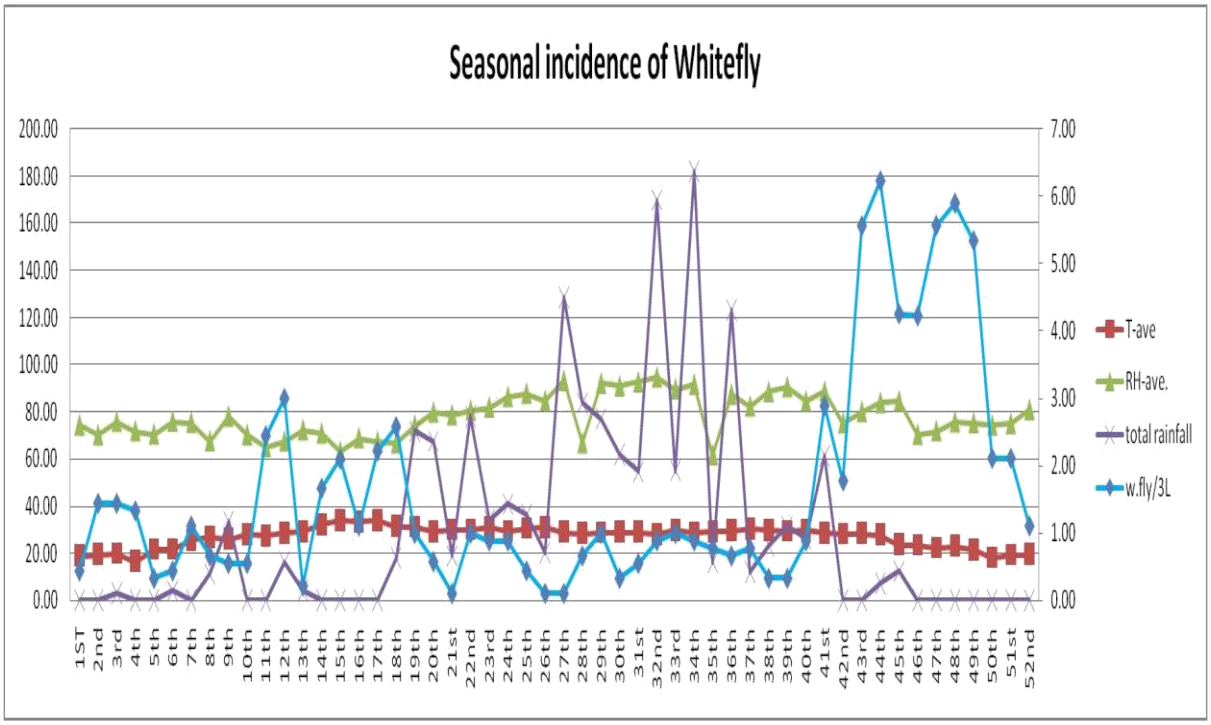


Fig.5 Incidence of jassid as influenced by temperature, humidity and total rainfall during 2016

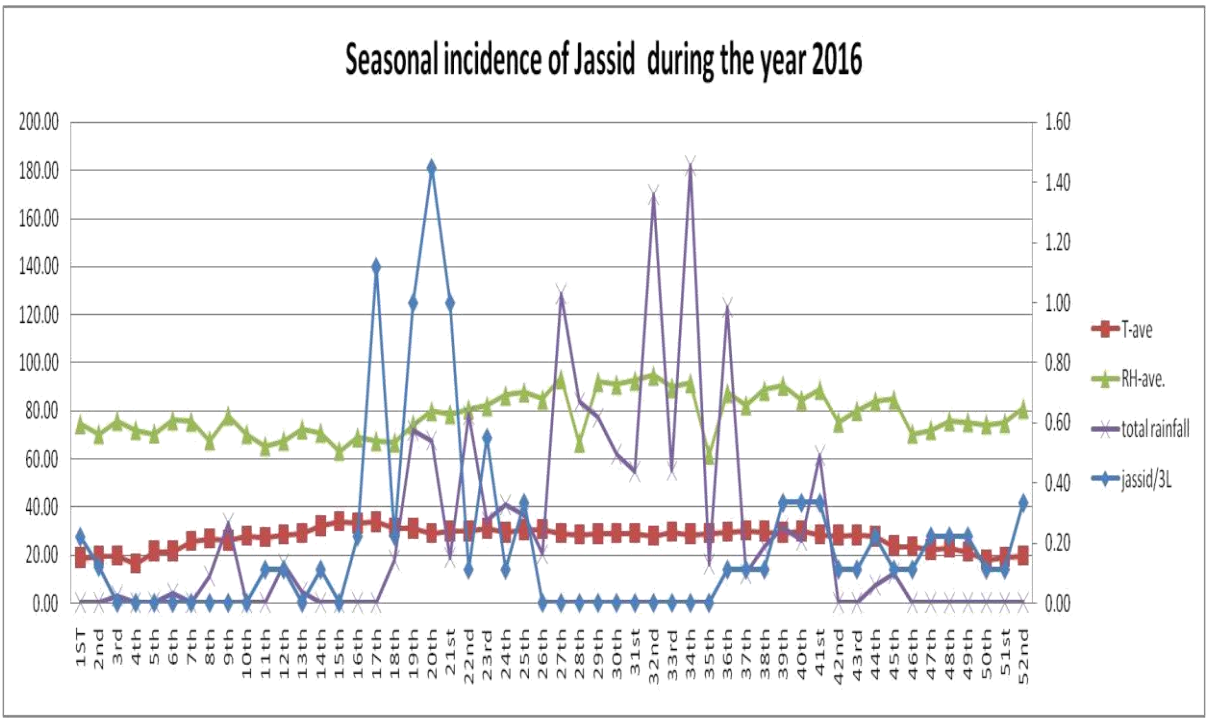


Fig.6 Incidence of coccinellid as influenced by temperature, humidity and total rainfall during 2016

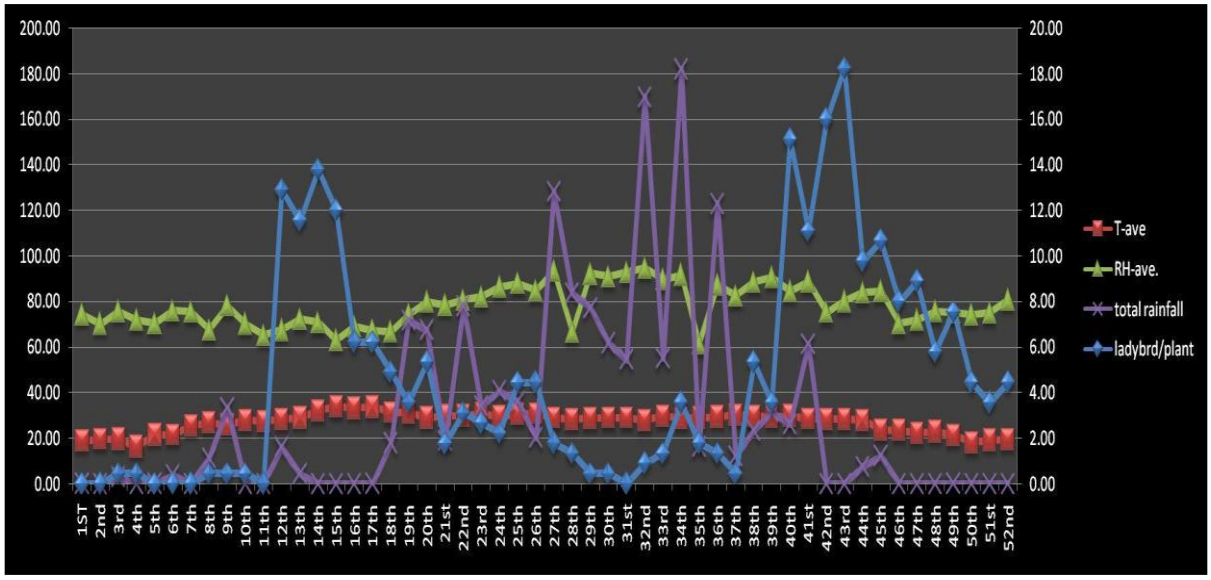
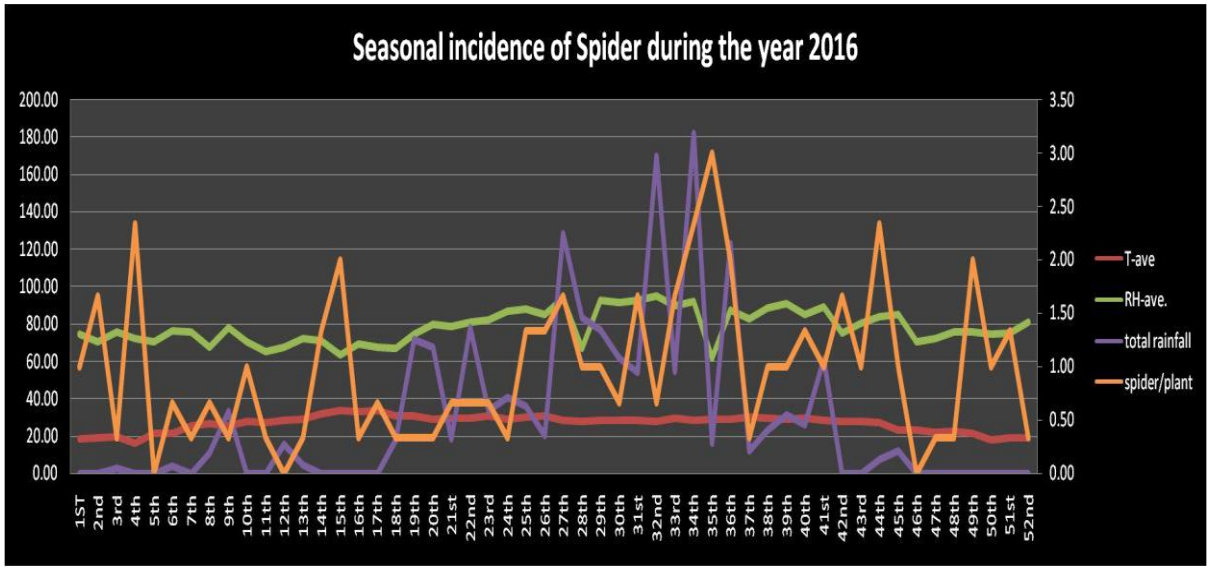


Fig.7 Incidence of spider as influenced by temperature, humidity during 2016



Seasonal incidence of Whitefly (*Bemesia tabaci* Genn.)

Observation taken showed that whitefly incidence started from 1st standard week (0.44/three leaves) reaching a peak population in 44th standard week i.e. 6.22 per three leaves when the average temperature, relative humidity and weekly total rainfall were 27.72^0 C, 84.00% and 7.4mm respectively.. Lowest Population was attained during 21st, 26th and 27th standard week i.e. 0.11 whitefly per three leaves (Fig. 4).

Correlation studies (Table 4) between whitefly population and weather parameters revealed that whitefly population showed significant positive correlation with

temperature difference while significant negative correlation with minimum temperature and weekly total rainfall. On the contrary non-significant negative correlation was found between whitefly populations and temperature (maximum, average) and relative humidity (maximum, minimum, average).

This indicates that activity of whitefly decrease with relative humidity, decrease in temperature and rainfall. This result is also similar with the findings of Khalid *et al.*, (2009).

Seasonal incidence of jassid (*Amrsca bigutula bigutula*)

Observations taken as jassid/three leaves revealed that infestation was started from 1st standard week (0.22/three leaves) with the peak population reaching in 20th standard week i.e 1.45 per three leaves when the average temperature, relative humidity and weekly total rainfall were 29.05^0 C, 79.86% and 67.5 mm respectively. It also states that the jassid population was found to be less or negligible in the whole year (Fig. 5).

Correlation studies (Table 5) between jassid population and weather parameter revealed that the population of jassids showed a significant positive correlation with maximum temperature while non-significant negative relation correlation with relative humidity (maximum, minimum, average) and weekly total rainfall.

On the contrary there was a non-significant positive correlation found between jassid population with temperature difference, minimum temperature and average temperature. This can be inferred that activity of jassids increases with temperature and decreases with heavy rains. The result is similar with the findings of Saini *et al.*, (2017).

Seasonal incidence of natural enemies present in chilli ecosystem coccinellids

Ladybird beetle is important biological agent of chilli pests assisting to reduce the damage of insect infestation appeared in the year 2016. Its occurrence and degree of infestation varied with season to season. The observation was taken as coccinellid beetle per plant and found that coccinellid population was at its peak during 43rd standard meteorological week i.e 18.22 per plant when average temperature, relative humidity and weekly total rainfall were 28.29^0 C, 80.07% and 0.0 mm respectively. Population was negligible during 1st, 2nd, 5th, 6th, 7th, 22nd and 31st standard week (Fig. 6).

Correlation studies (Table 6) between ladybird beetle population and weather parameters revealed that ladybird beetle population had a non-significant positive correlation with temperature difference, minimum temperature, average temperature and maximum relative humidity while non-significant negative correlation with relative humidity (minimum and average). A significant positive correlation found between coccinellid population and maximum temperature and significant negative correlation of coccinellid population with weekly total rainfall was reported.

Spider

Spider is an important predator of tomato plant and become active throughout the year. Incidence of predator activity studied in the year 2016. Population of spiders was found to be maximum during 35th standard meteorological week i.e. 3.00 per plant when average temperature, relative humidity and weekly total rainfall were 29.06^0 C, 61.57% and 16.2 mm respectively (Fig. 7). Abundance of spiders was found to be negligible during 5th, 12th and 46th standard meteorological week.

Correlation studies (Table 7) between spider population and environmental parameter revealed that spider population had a significant negative correlation with temperature difference. On the other hand non-significant negative correlation found between spider population and maximum temperature and non-significant positive correlation between spider and temperature (minimum, average), relative humidity (maximum, minimum, average) and weekly total rainfall.

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