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Effect of meteorological factors on the population dynamics of insect pests of tomato

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Insect-pests are a major determinant in reducing the agricultural production and productivity in India. Tomato (*Solanum lycopersicum* Mill), being the world's fourth most cultivated crop, with a production estimated at 130 million tonnes and an acreage of 5.2 million hectares is an indispensible vegetable crop world over and, of course, for India. In India, it is cultivated in 0.61 million hectare with a productivity of 18.5 tons/ha (Anonymous, 2010). Although the total cultivated area and production of tomato in our country have increased gradually over the last few years but the productivity is still very low compared to the average of the world yield of 26.29 tons/ha (Anonymous, 2010). Among the factors responsible for low yield of tomato, insect pests viz., the fruit borer, *Helicoverpa armigera* (Hubner) and sucking insect pests viz. whitefly, *Bemesia tabaci* Genn., Jassids, *Amrasca biguttulla biguttulla* (Ishida), thrips, *Thrips tabaci* Lind., Serpentine leaf miner, *Liriomyza trifolii* (Burgess) are highly destructive causing serious damage and are responsible for lowering the yield of tomato crop (Lal *et al*., 2008). Any pest management programme will require the use of monitoring practices to be effective. It is, therefore, imperative to study the population fluctuation of the crop pest in relation to weather parameters that largely direct the activity of a given species of insect pest. Therefore, keeping in view the economic importance of the crop and the magnitude of the damage caused by various insect pests, the present study was carried out to study the population build up of major insect pests on tomato in relation to these abiotic factors.

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The replicated field experiment trial using Pusa Ruby variety of tomato was conducted at University Research Farm, Chatha, Jammu during 2010. The main field selected for each experiment was ploughed for three times. The seeds were sown under natural conditions with recommended package of practices of University. The plot size was 3x2.5m. One month old seedlings were transplanted at a distance of 60x45cm. The experiment was replicated six times. The experiment was conducted under pesticide free condition. The occurrence / incidence of insect pests were recorded from sowing to harvest of the crop. Observations on the population of sucking insect pests was recorded on three leaves one each from top, middle and bottom canopy of the five plants selected randomly in each replication. Observation of leaf minor incidence to each stage of the plant at the initial mining and per cent miner infestation was recorded on 5 randomly selected tagged plants. The incidence of foliage feeders was recorded in terms of damage to leaves and the incidence of fruit borer was recorded by counting total number of fruits with the damaged ones. Weekly data on meteorological parameters viz., maximum and minimum temperature, morning and evening relative humidity, sunshine hours, and rainfall were collected from Division of Agro-Meteorology, SKUAST of Jammu and same were subjected to simple correlation and regression studies (Senedcor and Cochran, 1967).

The fruit borer (*Helicoverpa armigera* Hubner) population was first recorded in the 14th standard week (2.50 borer/plant) with a population peak of 13.70 borer/ plant during the 21st standard week. The borer, *H. armigera* population exhibited significant positive correlation with the temperature (maximum, minimum) (r=0.921, 0.626) but positive and non-significant with sunshine hours (r =0.246) (Table 1). These results are supported by Khan *et al*., (2003) who reported that mean temperature were positively correlated with infestation. A significant negative correlation between

Table 1. Correlation of insect pests with weather parameters on tomato cv. *Pusa ruby*

Insect pests	Temperature (°C)		Relative humidity (%)		Rainfall Mm	Sunshine hours
	Maximum	Minimum	Maximum	Minimum		
Fruit borer	0.921**	0.626*	-0.700**	-0.641*	-0.420	0.246
Aphids	0.576*	0.215	-0.506	-0.381	-0.613*	0.343
Mealy bug	0.757**	0.956**	-0.649*	-0.576*	0.166	0.330
Leaf miner	0.522*	0.125	-0.304	-0.262	-0.471	-0.228
Whitefly	0.803**	0.764**	-0.683*	-0.699*	-0.028	0.450

borer population and maximum and minimum relative humidity (r = -0.700, -0.641) but non-significant negative with rainfall (r = -0.420). Multiple regression coefficient of determination (R^2) established that weather factors influenced the field incidence of *H. armigera* larvae to the extent of 96.80 per cent (R^2=96.80) (Table 2). These results are in conformity with Sharma *et al.* (2010) who reported that fruit borer have a negative significant correlation with mean relative humidity but non-significant negative correlation with rainfall.

Table 2. Multiple regression equation of insect pests with weather parameters

Insect pests	Regression equation	
Fruit borer	Y_1=-1.594+1.536X_1-1.493X_2-0.468X_3+0.361X_4+0.153X_5-0.216X_6	0.971**
Aphids	Y_1=29.516+3.262X_1-4.814X_2-1.329X_3 + 1.007X_4 + 0.380X_5 + 1.003X_6	0.730 ^{NS}
Mealy bug	Y_1=4.023-0.180X_1+2.409X_2-0.635X_3+0.344X_4+0.154X_5-1.065X_6	0.967**
Leaf miner	Y_1=3.307+0.931X_1-0.973X_2-0.297X_3+0.326X_4+0.067X_5-0.623X_6	0.870*
Whitefly	Y_1=17.084+0.941X_1-1.397X_2-0.546X_3+ 0.273X_4 + 0.247X_5 + 0.399X_6	0.890*

The aphid (*Lipaphis erysimi* Kaltenbach) population was first recorded in the 14th standard week (4.50 aphids/ plant) with a peak of 24.50 aphids/ plant during the 22th standard week and afterwards, there was a steady decline in the aphid population. Aphid population was positively but non significantly correlated with the maximum, minimum temperature (r=0.576, 0.215) and sunshine hours (r= 0.343) and negative non-significantly with relative humidity (Maximum and Minimum) (r = -0.506, -0.381) and rainfall (r =-0.613) (Table 1). The multiple linear regression analysis showed that all the weather parameters together were responsible for 73.00 per cent (R^2 value) of total variation of aphid population (Table 2). These results are in conformity with Mahmood *et al.*, (1990) that the mean temperature has a positive but non-significant correlation with the density variation of aphids. However, the increase in rainfall and relative humidity decrease the number of aphids per leaf non-significantly.

The mealy bug, *P. solenopsis* population appeared in the 15th standard week (0.40 mealy bug/ plant). The population peaked to 23.50 mealy bug/ plant during the 26th standard week. Mealy bug population exhibited positive and significant correlation with the temperature (maximum, minimum) (r=0.757, 0.956) and positive but non significant with rainfall and sunshine hours (r = 0.166, 0.330). The relative humidity (maximum, minimum) was significant and negatively correlated (r = -0.649, -0.576) with mealy bug (Table 1). The multiple linear regression analysis showed that all the weather parameters together were responsible for 96.70 per cent (R^2 value) of total variation of aphid population (Table 2).

The Serpentine leaf minor, *Liriomyza trifolii* (Burgess) population appeared in the 14th standard week (1.10 miners/plant). The population peaked to 7.80 miners/ plant during the 22nd standard week and afterwards, there was a steady decline in the aphid population. The leaf miner population was positively significantly correlated with maximum temperature (r = 0.522); positively but non significantly with minimum temperature (r=0.125). Relative humidity (maximum r = -0.304; and minimum r= -0.262), rainfall (r=-0.471) and sunshine hours (r = 0.228) was negatively correlated with leaf minor (Table 1). The multiple linear regression analysis showed that all the weather parameters together were responsible for 87.00 per cent (R^2 value) of total variation of aphid population (Table 2). These results are in conformity with those of Senguttuvan (1999) reported a significant and positive associations of damage and leaf miner population with maximum temperature.

Weather parameters played a significant role in the development of whitefly (*B. tabaci*) population on tomato. The population of *B. tabaci* was noticed in the 14th standard meteorological week and attained its peak during 22nd standard meteorological week. The correlation studies between whitefly and abiotic factors showed positive correlation for temperature (maximum and minimum) and sunshine hours, while the correlation was negative relative humidity (maximum and minimum) and rainfall (Table 1). The multiple linear regression analysis showed that all the weather parameters together were responsible for 89.00 per cent (R^2 value) of total variation of whitefly population (Table 2). The results of present studies are in accordance with Ashfaq *et al.* (2010), Kaur *et al.* (2010) and Sarangdevot *et al.* (2010) reported that the whitefly population was positively correlated with mean temperature and negatively correlated with mean relative humidity. The positive correlation between the temperature and whitefly population can be attributed to the enhanced rate of development and reproduction of whitefly and it has been found that the ovipositional activity of whitefly is maximum between 33ºC to 37ºC. The negative association between the whitefly population and relative humidity and rainfall is due to the *B. tabaci* adults which were largely controlled by rains particularly when their were regular heavy showers and strong winds. Cooler weather and high relative humidity and rainfall are detrimental to whitefly population and spread. Hence a strategy should be planned to minimize the pest and disease attack either by manipulation in agronomic practices or chemical control.

References

Anonymous (2010) Indian tomato yet to sprout global demand. *The Hindu Business Line*, Monday, Jul 05, 2010.

Ashfaq M, Noor AM, Khuram Z, Nasreen A and Mansoor-ul-Hasan (2010) The correlation of abiotic factors and physico-morphic characteristics of (*Bacillus thuringiensis*) Bt transgenic cotton with whitefly, *Bemisia tabaci* (Homoptera: Aleyrodidae) and jassid, *Amrasca devastans* (Homoptera : Jassidae) populations. African Journal of Agricultural Research. 5(22): 3102-3107.

Khan BS, Afzal M and Murtaza MA (2003) Effect of abiotic factors against the infestation of American Bollworm (*Heliothis armigera* Hub.) on different varieties of cotton under unsprayed conditions. Journal of Biological Sciences. 3(1): 82-85.

Mahmood T, Khokhar KM, Banaras M and Ashraf M (1990) Effect of abiotic factors on population of okra. Pakistan Journal of Agriculture Research. 11(4): 284-286.

Kaur L, Gill KK, Cheema HK, Dhaliwal L K, Sirari A and Kingra PK (2010) Meteorological factors attributing yellow mosaic virus severity on greengram. Indian Journal of Agricultural Science 80 (11) : 1007-9.

Lal K, Milati SP, Singh K and Singh SN (2008) Bio-efficacy of betacyflurothrin, lamda cyhalothrin and imidacloprid against *Earias vittella* in okra. Annals of Plant Protection Sciences, 16: 21-24.

Sarangdevot SS, Kumar S, Naruka PS and Pachauri CP (2010) Population dynamics of whitefly, *Bemisia tabaci* (Genn.) of tomato in relation to abiotic factors. Pestology, 34(7) : 83-84.

Snedecor GW and Cochran WG (1967) Statistical Methods. *6th* Edition, Iowa State University Press, pp593.

Senguttuvan T (1999) Seasonal occurrence of groundnut leaf miner in relation to weather factors. International Arachis Newsletter, 19: 38-39.

Sharma RP, Swaminathan R and Bhati KK (2010) Seasonal incidence of shoot and fruit borer of okra with climatic factors in Udaipur region of India. Asian Journal Agricultural Research, 4(4): 232-236.