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Influence of abiotic weather parameters on population dynamics of whitefly, *Bemisia tabaci* (Genn) on cotton

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ABSTRACT: Whitefly population/cotton leaf gradually increased starting from SMW 20 (Standard Meteorological Week) and peak population of whitefly reached during SMW 42 and thereafter its population decreased upto SMW 51. The correlation among whitefly population and weather factors showed that max temp (T_{max}), min temp (T_{min}), evening relative humidity (RH_e) and rainfall (RF) affected negatively to whitefly population. Positive correlation of whitefly population was obtained with morning relative humidity (RH_m) and sunshine h (SSH). Highest population of whitefly was observed during *kharif*, 1995. There was a sudden drop in whitefly count (0.367- 0.197) during *kharif*, 2001 to 2005 and then again increased in the following years. Probability density analysis revealed that maxi whitefly occurrence was observed when weekly T_{max} ranged between 34-36 °C , T_{min} between 24-26 °C , RH_m range 85-90 per cent, RH_e between 30-40 per cent and SSH between 8 to 8.5 h.

Key words: Correlation, cotton, weather parameters, whitefly

Cotton is one of the most important cash crops in India and played a dominant role in industrial and agricultural economy of the country. Among sucking pests, whitefly (*Bemisia tabaci* Genn) is designated as a key pest and vector of CLCuV and development of sootymould on the leaves. It is well established that population dynamics of this sucking pest is greatly influenced by its favourable weather conditions. Sharma *et al.,* 2004 studied the population dynamics of whitefly and its parasitoid on cotton and found that pest population had a non significant negative correlation with rainfall and relative humidity and positive correlation with temp. Present study was designed to acquire more insight about the exact role of different meteorological variables on population buildup of this pest though out the growing season.

MATERIALS AND METHODS

Cultural conditions : Variety HS 6 of cotton was sown in the month of May continuously from 1993 to 2009 in a plot measuring 50 x 50 m. All the recommended practices were followed and was kept unsprayed with any of the insecticides throughout the season.

Pest population assessment : The population of whitefly adults were recorded from 3 leaves each from top, middle and bottom from randomly selected 10 plants replicated 3 times. The above mentioned observations were recorded at weekly interval starting from vegetative phase to maturity in the crop seasons. The mean population of the whitefly was calculated as under :

$$\text{Mean whitefly population/leaf} = \frac{\text{Total adults on 30 plants at each level of canopy}}{90}$$

Weather variables : The weekly weather data of max temp (T_{max}), min temp (T_{min}), morning relative humidity (RH_m), evening relative humidity (RH_e), rainfall (RF) and bright sunshine h (SSH) were collected from Agrometeorology Observatory, Department of Agricultural Meteorology, CCSHAU, Hisar which was about 500 m away from the experimental field.

Statistical techniques : Boxplots were prepared by statistical programme R version 2.13.0 using the boxplot function to present whitefly population dynamics over the season. To determine effect of different abiotic factors on whitefly population as varied over standard meteorological weeks (SMWs), Pearson correlation coefficient was carriedout. Exact range of different abiotic factors in population buildup of whitefly was carried out with the

programme R (ver. 2.9.0) using packages MASS and fields and image function by preparing probability density image plots.

RESULTS AND DISCUSSION

Population dynamics : The population was noticed throughout the cotton growing season (Fig. 1) starting from very early vegetative stage (SMW 20) to late harvesting in SMW 52. The boxplots clearly indicate that whitefly/leaf remained low till SMW 32 and then there was continues increase in the count. The maxi population was recorded during SMW 42 when rainfall drops below 5 mm but T_{max} remained above 32°C. There was gradual decrease in the pest population as the crop approaches maturity associated with decrease in temp (T_{max} and T_{min}) and increase in relative humidity (RH_m and RH_e). The present findings are in line with the findings of Sharma *et al.*, 2004 who reported peak whitefly population in October with 6.43 and 10.5 whiteflies/3 leaves, respectively. Among the seasons, highest population of whitefly was observed during *kharif*, 1995. There was a sudden drop in whitefly count (0.197 – 0.367) during *kharif*, 2001 to 2005 and then again increased in the following years.

Correlation Study : The correlation among whitefly population and weather factors showed a negative relation with max temp (T_{max}), min temp (T_{min}), evening relative humidity (RH_e) and rainfall (RF). Positive correlation of whitefly population was obtained with morning relative humidity (RH_m) and sunshine h (SSH). But the correlation values were very low because of abrupt changes in weather trend over the season. However, splitting the season into halves gave a better understanding about the influence of different abiotic factors on whitefly population dynamics. During phase I, both the temp variables showed a significant negative relation in contrast to RH variables, which exhibited strong positive correlation. However, during phase II, correlations were just opposite for these variables with pest population. But rainfall and sunshine h remained positively correlated in

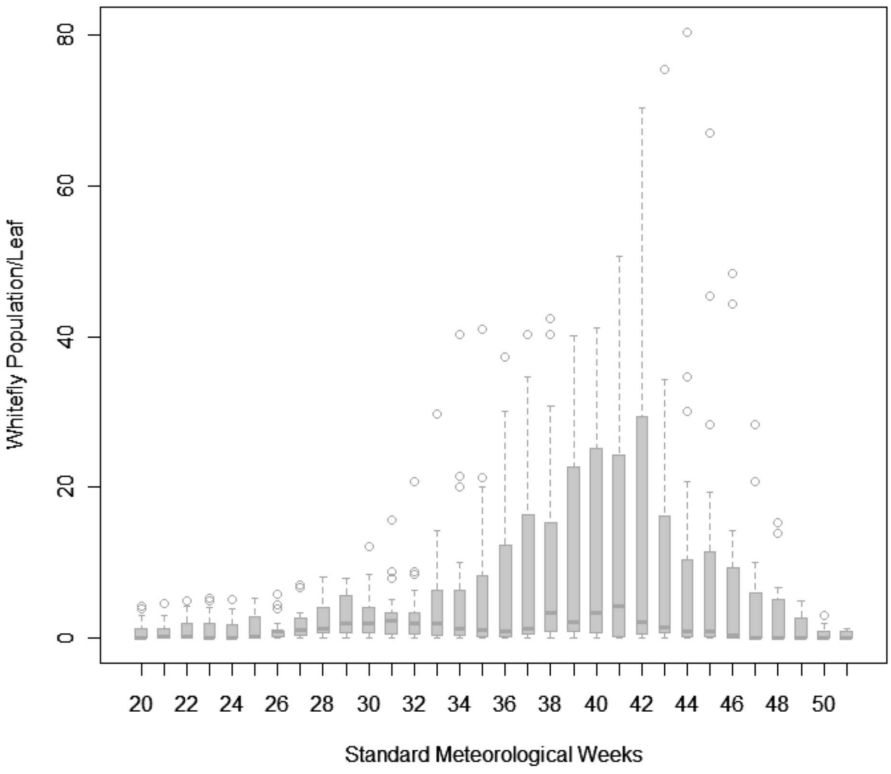

Fig. 1. Whitefly population dynamics

Table 1. Correlation coefficient between different abiotic factors and whitefly population

Abiotic Factors	Overall	PHASE I (SMW 20-SMW 38)	PHASE II (SMW 39-SMW 52)
Tmax(°C)	-0.03	-0.78	0.95
Tmin(°C)	-0.06	-0.54	0.91
RHm(%)	0.33	0.73	-0.95
RHe(%)	-0.08	0.56	-0.5
RF(mm)	-0.22	0.12	0.46
SSH(h)	0.69	0.45	0.85

both the phases (Table 1). Murugan and Uthamasamy, 2001 reported that meteorological parameters play an important role in the population fluctuation of sucking insect pests. Sharma *et al.,* 2004 reported that whitefly population had a non significant negative correlation with rainfall and relative humidity and positive correlation with temp. Vennila *et al.,* 2007a reported that high temp and scanty rainfall aggravate the severity of sucking pests.

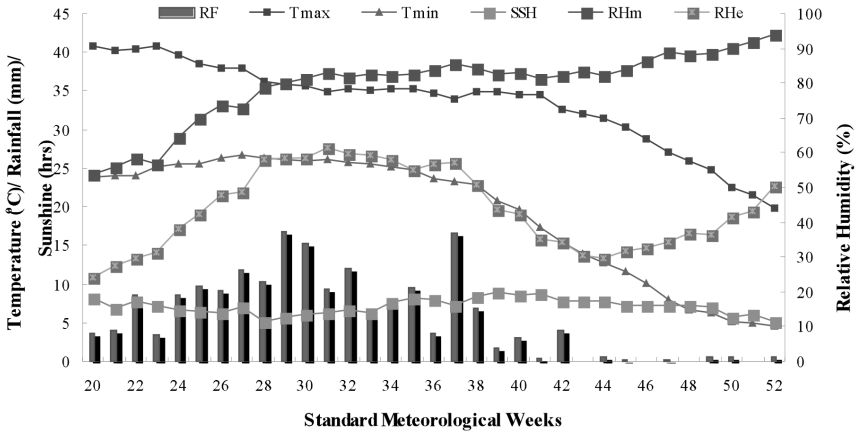

Fig. 2. Whitefly population dynamics weekly weather conditions (1993-2009)

Probability density analysis : Probability density analysis revealed that max whitefly occurrence was observed when weekly T_{max} ranges between 34-36 °C , T_{min} between 24-26 °C , RH_m range 85-90 per cent, RH_e between 30-40 per cent and SSH between 8 to 8.5 h. This study can further be utilized to develop a suitable model to forecast whitefly population in the field and to design appropriate control measure in a sustainable manner.

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