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Influence of weather parameters on population dynamics of whitefly in kharif legumes

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ABSTRACT

An experiment was conducted at instructional farm of College of Agriculture, Ganj basoda (M.P.) to know seasonal population dynamics of whitefly, Bemisia tabaci Genn. in green gram(Vigna radiata L. Wilczek), black gram(Vigna mungo L. Hepper) and soybean(Glycine max L. Muril) and their response to meteorological parameters during two consecutive kharif season 2016 of and 2017. The population of whitefly was found maximum (21.14, 27.89 and 24.19/plant) in 36th SMW on green gram, black gram and soybean, respectively. On the other hand, minimum population of whitefly was noted 3.19 in green gram, 2.69 in black gram and 1.50/plant in soybean during 38th, 29th and 30th SMW. The significant negative correlations were exhibited between mean population of whitefly and rainfall (r=-0.85, r=-0.65 and r=-0.76) whereas non significant positive correlation between mean population of whitefly and maximum temperature (r=0.39, r=0.57 and r=0.56) and minimum temperature (r=0.24, r=0.37 and r=0.20) on green gram, black gram and soybean respectively. Overall results revealed that weather parameters like rainfall, temperature, sunshine hours and relative humidity played as limiting factors for the buildup of whitefly population in green gram, black gram and soybean agro-ecosystem.

Keywords: Whitefly, *Bemisia tabaci*, green gram, black gram, soybean, population dynamics

INTRODUCTION

India has large acreage under food legumes, they are good sources of proteins, vitamins, minerals and it is the second important constituent of Indian diet after cereals. Unquestionably pulses have been considered as poor man's meat who cannot afford animal proteins and "rich man's vegetable". It contributes significantly to the nutritional food security of the country. Food legumes also provide oil and increase the soil fertility through fixation of nitrogen from environment and decrease the soil erosion (Prasad 2013&2017). In the Madhya Pradesh green gram (*Vigna radiata* L. Wilczek), black gram (*Vigna mungo* L. Hepper) and soybean (*Glycine max* L. Muril) are cultivating as a food legumes in *kharif* as well as in summer season. The productivity of food legumes is less than the potential yield of recommended varieties due to damage of various insect pest and poor management. The legume crops are prone to many insect pests. Insect pest *i.e.* sap suckers (Aphid, jassid, whitefly, thirps and green sting bug) and defoliators (semiloopers, hairy caterpillar, tobacco caterpillar) are predominant and play a vital role to diminish the yield. Out of sapsuckers white fly, *Bemisia tabaci* Genn. incidence of the fly is increasing year to year may be due to sole cropping (Shrivastava and Prajapati, 2012, Nitharwal, 2013 and Marabi *et al*, 2017). The present study was undertaken in Vidhayan Plaeatu of Madhya Pradesh to study the impact of abiotic factors on the population dynamics of whitefly on green gram, black gram and soybean agro-ecosystem.

MATERIALS AND METHODS

The food legumes *i.e. g*reen gram (*Vigna radiata* L. Wilczek), black gram (*Vigna mungo* L. Hepper) and soybean (*Glycine max* L. Muril) were sown at instructional farm of College of Agriculture, Ganj Basoda (M.P.) during *kharif* season of 2016 and 2017. All the recommended agronomic practices were followed from time to time to raise the crop successfully as per package of practices prescribed for the region except plant protection. The crop was regularly monitored after germination till harvest for the population dynamics of whitefly. Observations regarding the population of white fly were recorded at weekly intervals from six compound leaves (upper, middle, lower) per ten randomly selected plants. Number of insect (nymphs and adult) were recorded in the morning and cumulative population of whitefly on leaves per plant was calculated. Weekly data on temperature, relative humidity (R.H.), rainfall,

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wind speed and sunshine hours were obtained. Simple correlations and regressions were workout between population dynamic of whitefly and these parameters.

RESULTS AND DISCUSSION

Influence of weather parameters on whitefly

The results of population dynamics of whitefly on green gram and black gram in relation to weather parameters are presented in Table 1.The activity of white fly on green gram and black gram ranged from 3.19 to 21.14 and 2.69 to 27.89 whiteflies /plant, respectively. The minimum population of whitefly (2.69/plant) was recorded on black gram during 29th standard meteorological weeks (SMW). During this SMW the maximum temperature, minimum temperature, rainfall, wind speed, relative humidity and sunshine hours were 30.08^{0}C, 24.00^{0}C, 93.80mm, 10.93 km/h, 63.07% and 13.25, respectively. A population of 3.19/plant was found on green gram during 38th SMW. For this duration maximum temperature, minimum temperature, rainfall, wind speed, relative humidity and sunshine hours were 31.57^{0}C, 23.08^{0}C, 182.60mm, 4.86 km/h, 65.36% and 12.11 respectively. However, activity of whiteflies during 30th SMW was 1.50/plant on soybean. During this week maximum temperature, minimum temperature, rainfall, wind speed, relative humidity and sunshine hours were 28.93^{0}C, 22.07^{0}C, 68.30mm, 9km/h, 65.57% and 12.32 respectively.

Table1: Mean population of white fly in green gram, black gram and soybean with meteorological parameters

SMW	Whitefly population/plant			Max. Tamp. 0c	Mini. Temp. 0c	Total rain fall (mm)	Wind speed (Km/hrs)	RH (%)	Sunshine hours
	Green Gram	Black Gram	Soybean						
29	3.21	2.69	0	30.08	24.00	93.80	10.93	63.07	13.25
30	6.25	4.37	1.50	28.93	22.07	68.30	9.00	65.57	12.32
31	8.92	5.82	7.37	29.29	22.72	45.30	8.07	65.93	13.10
32	9.29	9.39	9.29	29.07	23.15	71.10	6.50	66.57	13.00
33	4.14	5.24	7.03	29.79	23.14	116.90	6.08	62.72	12.58
34	3.21	4.89	5.33	29.43	23.43	138.00	5.86	68.57	12.48
35	16.47	13.67	17.35	30.15	23.57	31.00	5.86	71.86	12.40
36	21.14	27.89	24.19	30.72	23.22	1.00	6.07	56.36	12.30
37	19.18	16.78	22.98	31.43	23.79	20.40	4.43	58.57	12.21
38	3.19	5.69	4.66	31.57	23.08	182.60	4.86	65.36	12.11
39	0	0	3.62	33.43	21.43	0.00	5.36	54.00	11.87

Thereafter, the activity of whitefly population was gradually increased and reached at peak on 32th SMW when the favorable weather parameters were occurred. In this period maximum population of whiteflies on green gram, black gram and soybean was 9.29, 9.29 and 9.39/plant. During this period maximum temperature, minimum temperature, rainfall, wind speed, relative humidity and sunshine hours were 29.07^{0}C, 23.15^{0}C, 71.10mm, 6.50km/h, 66.57% and 13.00 respectively. Later on the population of whitefly was again little bit declined on 34th SMW (3.21,4.89 and 5.33/plant) on green gram, black gram and soybean, respectively. During this period maximum temperature, minimum temperature, rainfall, wind speed, relative humidity and sunshine hours were 29.43^{0}C , 23.43^{0}C, 138mm, 5.86km/h, 68.57% and 12.48 respectively. The maximum (21.14, 27.89 and 24.19/plant) population of whitefly on green gram, black gram and soybean was recorded on 36th SMW. During the highest peak the maximum temperature, minimum temperature was 30.72^{0}C, 23.22^{0}C while rainfall, wind speed, relative humidity and sunshine hours were 1mm, 6.07km/h, 56.36% and 12.30respectively. After that it was gradually declined as the increased age of crop and remained active up to 38th SMW (3.19 and 5.69 /plant) on green gram and black gram although maximum temperature and relative humidity was increased. During this period maximum temperature, minimum temperature, rainfall, wind speed, relative humidity and sunshine

hours were 31.57^{0}C, 23.08^{0}C, 182.06mm, 4.86km/h, 65.36% and 12.12, respectively while in soybean whitefly remained up to 39th SMW with 3.62/plant. In this period maximum temperature, minimum temperature, rainfall, wind speed, relative humidity and sunshine hours were 33.43^{0}C, 21.43^{0}C, 0 mm, 5.36km/h, 54% and 11.87, respectively.

White fly prefers to suck the phloem sap from the succulent part of the plant and as the plant became older its dry matter accumulation is increased with the age of the plant and thus reduces population of white fly and its infestation as well (Latif and Akhatar, 2013).The present finding of white fly on green gram are agreement with the observation of Nitharwal (2013) who reported that maximum population of white flies was found during 37th SMW. These findings partially corroborate with the results of Kumar *etal.*(2004) who noted that highest population of whitefly in second fortnight of September when the maximum and minimum temperature and relative humidity were 32.5^{0c},20.8^{0c} and 82.00 per cent, respectively. The observations of white fly on black gram are line with work reported by Shrivastava and Prajapati (2012) who found that peak white fly population was recorded in 38th SMW and maximum temperature, mean relative humidity and rainfall play an important role in whitefly population built-up. Marabi *etal*.(2017) observed that the peak whitefly population was found in 37th MSW when maximum temperature, minimum temperature, relative humidity (morning and evening), wind speed, sunshine hours, vapour pressure (morning & evening), evaporation and rainfall were 91% and 55%,3.1km/h, 8.4hrs, 22.3mm,21.2mm,4.0mm and 3.4mm respectively. Selveraj and Ramesh (2012) observed that maximum temperature ranging from 26-35^{0}c, RH 67 – 84% wind velocity 6.3km/h sunshine 9.4 hour and evaporation 52.20 mm were found to be congenial for the built up of white fly population on cotton. Though this result may vary with the findings of other workers because of ecological and different weather conditions, cropping pattern and season, occurrence of natural enemies of the white fly.

Correlation and regression coefficient of white fly

The correlation coefficient was expressed non significant positive between mean population of whitefly and maximum temperature (r=0.39, r=0.57 and r=0.56), minimum temperature (r=0.24, r=0.37 and r=0.20) on green gram, black gram and Soybean. The white fly of green gram also exhibited positive correlation with sunshine hours (r=0.34). The non significant negative correlation was found between mean population of whitefly and wind speed (r=-0.42, r=-0.58 and r=-0.53) and relative humidity (r=-0.40, r=-0.48 and r=-0.59) on green gram, black gram and soybean. The non significant negative correlations were expressed with whitefly on black gram and soybean (r=-0.45 and r=-0.36). The significant negative correlation was exhibited between mean population of whitefly and rainfall (r=-0.85, r=-0.65 and r=-0.76) on green gram, black gram and soybean (Table 2).

Table 2: Correlation coefficient of white fly population on green gram, black gram and soybean with meteorological parameters

Weather factors	Green gram	Black gram	Soybean
Maximum temperature.	0.39	0.57	0.56
Minimum temperature	0.24	0.37	0.20
Total rain fall (mm)	-0.85*	-0.65*	-0.76*
Wind speed (km/hrs)	-0.42	-0.58	-0.53
Relative Humidity (%)	-0.40	-0.48	-0.59
Sunshine hours	0.34	-0.45	-0.36

**significant at 5%*

Regression equation of whitefly population with rainfall was calculated as Y=-6.958x+142.9 (R^2=0.729), Y=-4.724x+122.4 (R^2=0.422), Y=-5.711x+135.0 (R^2=0.584) on green gram, black gram and soybean, respectively. All R^2 values indicated that population of whitefly actively fluctuated due to the contribution of environmental factors. Present findings are contradicted with the results reported by Nitharwal (2013) who found

significant negative correlation of whitefly with maximum temperature (r=-0.56 and r=-0.78) and positive correlation of whitefly with relative humidity (r=0.63 and 0.56) whereas similar findings were observed about minimum temperature (r=-0.67 and 0.56) during 2006 and 2007 on green gram. Shrivastava and Prajapati (2012) reported that maximum temperature (r=0.82) mean RH (r=-0.83) and rainfall (r=-0.57) showed negative influence on whitefly population in black gram whereas temperature (r=0.57) and relative humidity (r=0.77) exhibited positive correlation. Yadav (2013) found that maximum temperature and evaporation exhibited significantly positive correlation while, evening relative humidity and rainfall were expressed negative correlation on influence of whitefly population of soybean. Marabi *et al.* (2017) observed population of adults whitefly were exhibited significantly positive correlation with maximum and minimum temperature (r= 54 and r= 0.58), morning and evening vapour pressure (r= 0.59 and r= 0.58) and evaporation (r= 0.56) whereas, negative correlation was expressed with morning RH% during Rabi season. Similarly during the summer season of soybean the maximum and minimum temperature (r= 0.74 and r= 0.65) and evaporation (r= 0.64) were showed significantly positive correlation with whitefly population while, morning RH% was exhibited negative. On the other hand, in Kharif season maximum temperature (r= 0.56), sunshine (r= 0.59) and evaporation (r= 0.59) were expressed significantly positive correlation whereas, wind speed and rainfall were negative on influence of whitefly population. Overall results revealed that weather parameters like temperature, RH%, sunshine and rainfall were played limiting factors for the buildup of whitefly population in soybean agro-ecosystem.

Seasonal population fluctuations of whitefly on food legume crops are greatly influenced by abiotic factors and peak population levels were observed on grown crops of greengram, blackgram and soybean. The significant correlation values indicated that occurrence of whitefly population on crops were due to the prevailing ecological conditions and impact of climate change. It will support the formulation of insect pest monitoring system and sustainable integrated pest management module.

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