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Studies on seasonal activity of white fly (*Bemisia tabaci* genn.) population and its association with weather parameters in Bundelkhand zone of Madhya Pradesh

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ABSTRACT

An experiment was conducted during ten consecutive *kharif* seasons from 1995 to 2004 at Zonal Agricultural Research Station, Tikamgarh to the seasonal activity of white study fly and its association of weather parameters in sesame crop (cv JT-7). The analysis revealed that the activity of the pest started from 30th standard meteorological week and remained up to 39th SMW. The highest population was recorded during 37th SMW. White fly population was correlated with weather data. Correlation coefficient and regression equations were worked out for development of weather based prediction model. White fly to have population was observed to have significantly positive correlation with minimum temperature and rainfall and negative correlation with maximum temperature. The multiple regression technique was used for developing predictive model using white fly population and weather data not only for the corresponding week but also for preceding weeks. The equation explains more than the 98 percent pest population variation.

Key words: White fly, sesame, temperature, rainfall, correlation, regression model

In recent years, white fly has attained the status of key pest of sesame coupled with the ever increasing menace of leaf curl virus transmission. The polyphagous white fly is one of the limiting factors in achieving higher production of sesame. Both nymph and adult of white fly are the damaging stage of the pest. They secrete honeydew on which sooty mould developed affecting photosynthesis and lowers harvest quality. Sesame in India is mostly grown under *rainfed* conditions in marginal and sub marginal lands of poor fertility and the pest is distributed through the northern and western regions of India. It is one of the major pests of cotton and sugarcane and recently it has also become a most damaging insect pest of sesame in Bundelkhand zone of Madhya Pradesh (M.P.). Sesame occupied 12.1 thousand ha area in Tikamgarh district and its average yield is 328 kg ha^{-1}. Indiscriminate use of insecticides for its management leads to irreversible ill effects like resistance, resurgence, residue problems. For development of efficient pest management approach, understanding of association between pest population and weather parameters is prerequisite for any particular location. Many workers (Youngman *et al*.,1986, Berlinger, and Nir, 1989) have reported that weather factor as one amongst the major contributing factor to the outbreak of white fly. Across the country, various workers have described the relationship of ecological factor with the white fly population on the location specific trials (Rote and Puri 1991, Raghupati Rao and Chari 1993, Simawat and Gill, 1992 and Kundu, 1996). Study on the activity of white fly population in Bundelkhand agro-climatic zone was not undertaken so far. Therefore the present study was taken up to understand the population dynamics of white fly and their association with weather parameters.

MATERIALS AND METHODS

The experiment was conducted at Zonal Agricultural Research Station; Tikamgarh (M. P.) of Bundelkhand zone during *Kharif* season of 1995 to 2004. Variety, JT-7 was sown in the first fortnight of July during each *Kharif* season in an isolated area of 200 m^2. Distance between rows and plants were maintained at 30 and 10 cm respectively. The crop was observed for white fly population after two weeks from sowing. The observations on white fly (*Bemisia tabaci* Genn.) population were recorded during each week on 100 plants selected randomly and the mean number of white fly per upper 3 leaves/plant was computed. Meteorological observation of daily rainfall, minimum, maximum temperature and relative humidity were also collected from IMD meteorological observatory (located at Tikamgarh District HQ), and weekly values are computed. The data was processed statistically and correlations and regression between white fly population and weather parameters were established. Regression equations using least square method were workout using most correlated weather parameters. Observation on yield data was also calculated after taking total weight of grain per plot basis and final yield on hectare basis was calculated.

RESULTS AND DISCUSSION

White fly population distribution

Weekly incidence

The white fly population per upper 3 leaves /plant on weekly basis for ten years is presented in Table 1. The pest population varies from season to season; It was started from

Table 1: Seasonal incidence of white fly (*Bemisia tabaci* Genn.) population on sesame crop from 1995 to 2004.

S. No.	SMW	White fly population (three leaves/ plant)										
		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Mean
1.	30	-	-	0.21	1.03	-	-	0.17	-	-	-	0.14
2.	31	-	0.45	0.19	0.77	0.26	0.26	0.26	-	-	-	0.22
3.	32	-	0.21	0.23	0.61	0.40	0.40	1.53	-	0.55	0.36	0.43
4.	33	0.26	0.09	0.54	0.70	0.65	0.65	1.25	-	0.41	0.49	0.50
5.	34	0.27	0.53	1.50	0.83	0.67	0.67	0.73	-	0.94	0.65	0.68
6.	35	0.68	0.78	0.41	0.74	1.01	1.01	0.74	0.86	0.38	0.38	0.70
7.	36	0.71	0.78	0.65	1.24	0.99	0.99	0.22	1.12	0.43	0.25	0.72
8.	37	0.74	1.24	0.40	1.59	0.89	0.89	0.43	1.12	0.48	0.28	0.81
9.	38	0.50	0.86	0.24	1.35	1.16	1.16	-	0.85	0.01	0.01	0.61
10.	39	0.21	0.42	-	-	0.97	0.97	-	0.61	0.10	-	0.32
	Mean	0.33	0.53	0.44	0.89	0.70	0.70	0.53	0.46	0.33	0.24	0.51

30th Standard Meteorological Week (SMW) during 1997, 1998 and 2001 while during three years i.e.1996, 1999 and 2000 it started from 31st SMW and rest of the years it started from 32nd SMW. The insect population remained active up to 39th SMW in all the ten years except during the years 1997, 1998, 2001 and 2004 (Table 1). Weekly population was calculated after pooling the 10 years weekly data and presented in Fig.-1. The data revealed that in general the population was ranging from 0.14 to 0.81 per upper 3 leaves/ plant. The population first appeared in 30th SMW (0.14 per upper 3 leaves/plant). It increased gradually and reached it's peak level between 35th to 37th standard meteorological week and the highest population was recorded in 37th SMW. After that declined trend was observed and there was no population.

Yearly incidence

The yearly mean population of white fly incidence was calculated and presented in Fig. 1 and it is noticed that population started in July/August and reached at its peak in the month of September. However, the peak level of incidence of white fly population was recorded during the month of September.

On the basis of average data on the incidence of whitefly population significantly less population was recorded during the year of 2004 in comparison to the rest of the years except the years 1995 and 2003. Whereas significantly higher whitefly population was observed in the year of 1998 and it was at par with the years of 1999 and 2000.

Weather during study period

The Incidence of white fly varied drastically in the sesame field during the study period of 10 years. The weekly values of the weather data have been calculated and their lowest, highest along with mean value of weekly weather parameters were calculated and presented in Table 2. The seasonal as well weekly variation in weather parameters may be attributed to contribute for year to year variation in the white fly population and level of incidence. Analysis of meteorological weather data showed that there is a high variability in weather parameters under the study period. The variation in maximum temperature ranged between 3.5 to 7.5°C during the study period except during the year 2001.The minimum temperature variation ranged between 2.0 to 3.5°C during the study period except the year 1995. Mean weekly temperature varied by 1.5 to 3.5°C during the study period except during the year 2001.The relative humidity varied by 5 to 10 % during the study period except during the year 2001.The seasonal rainfall was recorded

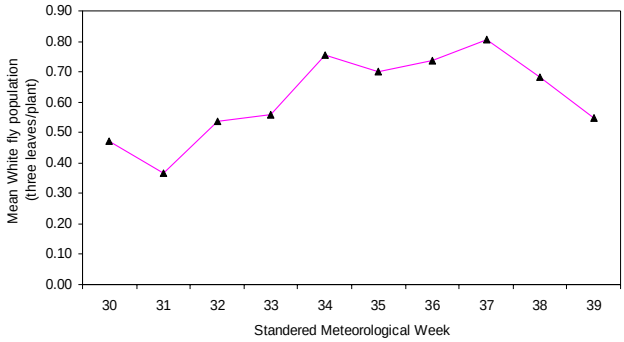

Fig. 1: Weekly distribution of white fly population at Tikamgarh of Bundelkhand zone

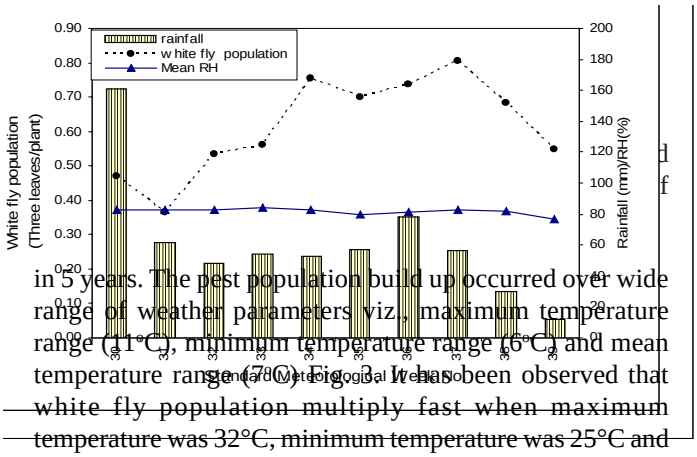

Fig. 2: Weekly mean of weather parameters during *kharif* at Tikamgarh of Bundelkhand zone

Fig. 3: Weekly pattern of white fly population and tempertures at Tikamgarh of Bundelkhand zone

lowest (117.1mm) during 2002 and highest (819.6mm) during 1999. The weekly rainfall was recorded highest (265mm) during year 2004 and lowest (21.0 mm) during 2002. The variability of weather parameters is presented in Fig. 2.

White fly incidence and loss in crop yield

The mean seasonal white fly populations were calculated and corresponding year yield values were also calculated and presented in Table 2. The lowest and highest crop yield was recorded during 2001 and 1999 respectively. There was 76 % loss in yield during 1999 as compared to mean yield. The lowest and highest yield of sesame varied between 84 and 525 kg ha^{-1}. During the years 2001 and 1999 respectively as a consequence of variation in white fly incidence.

Association of pest population with weather conditions

In general, the white fly population was observed low in 5 years. The pest population build up occurred over wide range of weather parameters viz., maximum temperature range (11°C), minimum temperature range (6°C) and mean temperature range (7°C) Fig. 3. It has been observed that white fly population multiply fast when maximum temperature was 32°C, minimum temperature was 25°C and rainfall was ranging from 600-800 mm during the ten years study period (Fig. 4). The temperature and relative humidity are closely related with white fly incidence and association with rainfall is poor. The white fly population is positively related with mean relative humidity and negatively related with temperature values.

Correlation and regression study

The correlation between weekly whitefly population and corresponding week weather parameters was worked out and correlation coefficient values (r) are presented in Table 3. It is found that the population of white fly is negative lycorrelated with maximum temperature for the years

Table 2 : Effect of varying level of population of white fly (*Bemisia tabaci*) on the seed yield of Sesame variety JT-7 from 1995 to 2004 at Tikamgarh

Year	No. of white fly (three leaves/plant)	Yield (kg ha^{-1})	% loss in yi (kg ha^{-1})
1995	0.31	450	27
1996	0.49	210	-41
1997	0.40	260	-27
1998	0.80	300	-15
1999	0.64	525	48
2000	0.64	400	13
2001	0.48	84	-76
2002	0.50	395	12
2003	0.30	437	23
2004	0.22	407	15
Mean	0.47	346.80	--

Table 3 : Correlation coefficient (=r) between white fly population and weather parameters.

Weather parameters	White fly population per upper 3 leaves/plant								Pool data
	1995	1996	1997	2000	2001	2002	2003	2004	
Max. Temp.	0.32	-0.59	-0.47	-0.43	-0.84*	0.19	-0.41	-0.95*	-0.16
Min. Temp.	-0.55	0.26	-0.20	-0.17	-0.75*	-0.02	-0.77*	-0.37	-0.50*
Mean RH	0.99*	-0.80	-0.37	0.53	-0.88	0.76*	0.12	-0.81	0.70*
Rainfall	-0.12	-0.12	+0.32	-0.33	-0.03	+0.64*	-0.42	+0.05	0.04
Difference Temperature	-0.57	-0.04	-0.46	-0.43	+0.37	+0.45	-0.52	+0.34	-0.39

*=Significant at 5 % level

1995,1997,2001,2002 and 2004 with r value of -0.54, -0.17, -0.27, -0.74 and -0.57 respectively. However, it is also positively related in years 1996, 2000 and 2003. Minimum temperature is negatively correlated during 2000 with r value of -0.01 and it was positively correlated with the rest of the years. The correlation with mean relative humidity is significantly positively related with pest population with a maximum correlation value of 0.70 during the year 2004.The correlation between white fly population and rainfall was negative during the years 1995, 1996, 1998, 1999, and 2001 with the r values of – 0.12, -0.12, -0.33, -0.42 respectively (Table 3) . The results indicate that there was significant positive association during some years and non-significant negative association during rest of the years. The favorable condition for multiplication of pest was observed, with the maximum temperature 30-33 °C , minimum temperature above 25 °C , and relative humidity 82-84 % respectively (Table 3). The correlation analysis was performed between weather variables and white fly population and the correlation values are given in Table.3. The correlation with rainfall is weak and non significant. The mean weekly diurnal range of temperature i.e. (weekly maximum temperature - weekly minimum temperature) non significant except the year 2002. Hence, for model development weekly maximum, minimum and mean relative humidity were selected.

Prediction model

Pest population of white fly was significantly influenced by cumulative effect of pervious week's temperature conditions. To get the values of association with previous week's weather parameters the correlation between peak pest population (34-37th SMW) and previous week weather parameters (30-33rd SMW) was also worked out.

The peak infestation was recorded during 34-37 SMW, and highly correlated with maximum and minimum temperatures during 30-33 SMW and mean relative humidity infestation period (30-33 SMW) were taken into consideration for working out the predictive model after pooling the data. The equation for the prediction model formed and given below

$Y=1.67+0.033X_1-0.219X_2+0.038X_3$

R^2 =0.98* Standard Error =0.0

*=Significant at 1% level.

Y= Weekly white fly population

X_1 = Weekly maximum temperature(°C)

X_2 = Weekly minimum temperature(°C)

X3 = Weekly mean relative humidity (%)

The coefficient of determination (R^2) is 0.98 thereby showing a good account of variability by various factors during preceding week and peak period of incidence. Thus the above predictive equation explained more than 98 variability of pest population. It may be concluded that weather parameters during previous week as well as during the peak period, play an important role in pest population build up and also helps in operational management strategies of white fly in Bundelkhand zone

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