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Prediction of White Fly Vector *Bemisia tabaci* (Genn.) and Yellow Mosaic Disease Incidence in Greengram

By

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ABSTRACT

Field experiments on the incidence of *B. tabaci* and yellow mosaic of greengram revealed that more population of white fly and the incidence of the yellow mosaic disease occurred in the crops sown during summer months and maximum was recorded in the crops sown during April. Simple correlation studies of white fly population and yellow mosaic disease incidence with the weather factors revealed that maximum temperature was positively correlated with the white fly population at 20 and 30 days old crop and with the disease incidence when the crop was 45 days old. Multiple regression studies revealed that the partial regression coefficient on maximum temperature alone was the important variable in predicting the white fly population one week ahead of the incidence and the partial regression co-efficients on maximum temperature, rainfall and white fly population were the important variables in predicting the disease.

INTRODUCTION

Greengram (*Phaseolus aureus* Roxb.) is infected by yellow mosaic disease caused by a virus. Nariani (1960) first reported the occurrence of the disease and transmission by *Bemisia tabaci*. Later, Sellammal Murugesan and Chelliah (1976 a) reported the transmission and the relationship of the vector with the disease. Studies on the seasonal incidence of the white fly and the disease revealed that white fly population and yellow mosaic disease incidence occurred in a more extensive scale in crop sown during summer months (March to May) at Coimbatore (Sellammal Murugesan and Chelliah, 1976 b). To investigate the possible weather parameters that influence the increased population of white fly and disease incidence during summer months, a study was carried out at Tamil Nadu Agricultural University, Coimbatore in which the relationship, between the white fly population incidence of yellow mosaic and certain important weather factors was assessed.

MATERIALS AND METHODS

The field experiment was laid out in a randomised block design with 24 treatments *viz*, monthly sowings for two years from February 1973 to January 1975 replicated thrice. Green gram was sown on 1st of every month. Population counts of the white fly adults in three trifoliates selected at random at top, middle and bottom regions of the plants were recorded

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from ten randomly selected plants in each replication at 10 days interval from the 10th to 40th day of sowing. Observations on disease incidence were recorded on 30th and 45th days after sowing.

Data on mean maximum temperature, mean minimum temperature, mean relative humidity and total rainfall prevailing one week prior to each white fly population count, were collected to study the association of these factors individually with the white fly counts. The above weather data prevailing prior to one month of the disease recording were taken to study the relationship between these factors individually with the disease incidence. Simple correlation analyses and multiple regression analyses were carried out to find out the important weather factors such as maximum temperature, minimum temperature relative humidity and rainfall prevalent during different periods of the crop growth on the population of the vector as well as the yellow mosaic disease on green gram.

Variables used in multiple regression analyses to predict the white fly incidence on 10, 20, or 30 days after sowing were as follows :

Y = Number of white flies per plant

X_1 = Mean maximum temperature (°C)	Prevalent one week prior to the white fly population counts
X_2 = Mean minimum temperature (°C)	
X_3 = Mean relative humidity (%)	
X_4 = Total rainfall (mm)	

Variables used in Multiple regression analyses to predict the yellow mosaic disease incidence on 45 DAS were as follows :

Y = Yellow mosaic disease per cent

X_1 = Mean maximum temperature (°C)	Prevalent one month prior to the disease recording
X_2 = Mean minimum temperature (°C)	
X_3 = Mean relative humidity (%)	
X_4 = Total rainfall (mm)	

X_5 = Mean number of white flies recorded on 20th and 30th day of the crop.

RESULTS AND DISCUSSION

The population of white fly at different crop growth stages and the percentage of yellow mosaic at 45 days old crop are presented in Table I. The results of simple correlation studies of white fly population with weather factors are furnished in Table II and those of disease incidence with weather factors and white fly population in Table III.

Highly significant positive correlation existed between the white fly population in 20 days and 30 days old crop with the maximum temperature (Table III).

The disease incidence had highly significant positive correlations with maximum temperature (0.54), minimum temperature (0.56) and white fly population (0.50).

TABLE 1. Mean white fly population and percentage incidence of disease (February 1973 to January 1975)

Month of sowing	Mean white fly population			Mean	Disease per cent 45 DAS
	10 DAS*	20 DAS	30 DAS		
February 1973	0.63	0.70	0.47	0.60	4.82
March ,,	1.57	0.83	0.57	0.99	31.47
April ,,	0.30	1.43	1.77	1.17	68.34
May ,,	0.67	1.83	0.40	0.97	53.85
June ,,	0.03	0.47	0.10	0.20	18.89
July ,,	0.43	0.83	0.0	0.42	7.63
August ,,	0.30	0.10	0.0	0.13	2.67
September ,,	0.0	0.0	0.0	0.0	1.29
October ,,	0.67	1.33	0.67	0.89	0.91
November ,,	0.13	0.10	0.0	0.07	3.28
December ,,	0.07	0.43	0.37	0.28	11.01
January 1974	0.93	0.73	0.27	0.64	17.59
February ,,	0.87	0.97	0.97	0.94	15.53
March ,,	0.17	1.13	1.93	1.08	35.95
April ,,	1.67	1.93	1.63	1.74	18.93
May ,,	1.20	1.23	1.13	1.19	11.76
June ,,	0.93	1.13	1.70	1.25	5.00
July ,,	0.23	0.03	0.0	0.03	1.03
August ,,	0.0	0.07	0.23	0.10	0.0
September ,,	0.0	0.0	0.0	0.0	0.0
October ,,	0.07	0.07	0.0	0.05	0.0
November ,,	2.47	3.80	1.27	2.51	0.0
December ,,	0.07	0.30	0.0	0.12	0.0
January 1975	0.57	0.43	0.83	0.61	1.23

*Days after sowing.

Prediction of white fly population in 10 days old crop

The multiple regression equation fitted with four independent variables to predict the white fly incidence in 10 days old crop was:

$Y = 1.21 + 0.12 X_1 - 0.09 X_2 - 0.03 X_3 + 0.00003 X_4$ with a R^2 value of 0.52

The partial regression co-efficients, standard errors, proportional contribution of each variable to regression of whith fly population 10 days after sowing on weather factors are presented in Table IV.

The partial regression coefficient of the white fly population 10 days after sowing on maximum temperature prevailing one week prior to the white

TABLE II. Correlation matrix of white fly population with weather factors (n=36).

	X_1			X_2			X_3			X_4		
	A	B	C	A	B	C	A	B	C	A	B	C
Y White fly population	0.30	0.44**	0.62**	-0.09	-0.01	0.16	0.25	-0.09	-0.12	-0.18	-0.09	-0.04
X_1 Maximum temperature (C°)				0.52**	0.30	0.36	-0.15	-0.19	-0.21	-0.29	-0.18	-0.34*
X_2 Minimum temperature (C°)							-0.20	-0.03	-0.25	0.27	0.18	0.03
X_3 Relative humidity (%)										-0.34	0.55**	0.46**

A — 10 days after sowing
B — 20 days after sowing
C — 30 days after sowing

* Significant at P=0.05
** Significant at P=0.01

fly population count was significant. The regression function fitted had a very low R^2 value of 0.25, which explained that only 24.61 per cent of variation existed in white fly population was explained by four variables considered in the study and the contribution of maximum temperature was 9.60 per cent to the total variation in white fly population.

Prediction of white fly population in 20 days old crop: The fitted equation to predict the white fly population in 20 days old crop was:

$Y = -2.71 + 0.15\ X_1 - 0.05\ X_2 - 0.005\ X_3 + 0.0_1\ X_4$ with a R^2 value of 0.22

The partial regression coefficient of the white fly population 20 days after sowing for maximum temperature alone was highly significant (Table V). The R^2 value of the equation was very low 0.22 which explained that only 21.88 per cent variation existed in white fly population was contributed by four variables. The proportional contribution of maximum temperature to the total variation in white fly population

TABILE III. Correlation matrix of disease per cent with weather factors and white fly population (n=36)

Variables	X_1	X_2	X_3	X_4	X_5
Y (Disease per cent)	0.54**	0.66**	0.13	-0.03	0.50**
X_1 (Maximum temperature °C)		0.53**	-2.26	-0.29	0.46**
X_2 (Minimum temperature °C)			-0.05	0.09	0.63**
X_3 (Relative humidity %)				0.95**	-0.32
X_4 (Rainfall mm)					-0.28
X_5 (White fly population)					1

** Significant at P=0.01

TABLE IV. Partial regression coefficients, standard errors and proportional contribution of each variable to regression of white fly population (10 days after sowing) on weather factors (n=36)

Variable	Partial regression coefficients	S. E.	Proportional contribution to total variation in Y (in per cent)
X_1 (Maximum temperature)	0.117*	0.054	9.60
X_2 (Minimum temperature)	-0.09	0.050	8.73
X_3 (Relative humidity)	-0.029	0.019	6.28
X_4 (Rainfall)	0.00003	0.009	0

* Significant at P=0.05

TABLE V. Partial regression coefficients, standard errors and proportional contribution of each variable to regression of white fly population (20 days after sowing) on weather factors (n = 30)

Variables	Partial regression coefficients	S. E.	Proportional contribution to total variation in Y (in percent)
X_1 (Maximum temperature)	0.15**	0.05	19.53
X_2 (Minimum temperature)	-0.05	0.05	2.17
X_3 (Relative humidity)	-0.005	0.03	0
X_4 (Rainfall)	0.014	0.05	0.18

** Significant at P = 0.01

was highest (19.53 per cent) than any other variable.

Prediction of white fly population in 30 days old crop: The equation fitted to predict the white fly population in 30 days old crop was : $Y = -2.65 + 0.7 X_1 - 0.04 X_2 - 0.016 X_3 + 0.015 X_4$ with a R^2 value of 0.44.

The partial regression coefficient of white fly population 30 days after sowing for maximum temperature alone was highly significant (Table VI). The R^2 value of the fitted equation increased to 0.44 whereas the R^2 value for the equation fitted to predict white fly population on 10 and 20 days after sowing was very low. The proportional contribution of maximum temperature to the total variation in white fly population was highest (38.20 per cent) than any other variable.

In all the aforesaid regression equations, maximum temperature prevalent during a week prior to the observation was found to be the only important factor in predicting the white fly population in all the three stages of the crop *viz.*, 10, 20 and 30 days after sowing.

TABLE VI. Partial regression coefficients, standard errors and proportional contribution of each variable to regression of white fly population (30 days after sowing) on weather factors (n = 36)

Variable	Partial regression coefficients (in per cent)	S. E.	Proportional contribution to total variation in Y
X_1 (Maximum temperature)	0.17**	0.03	38.20
X_2 (Minimum temperature)	-0.04	0.04	0.45
X_3 (Relative humidity)	-0.016	0.02	0
X_4 (Rainfall)	0.015	0.01	5.11

**Significant at $P = 0.01$

Prediction of disease per cent on weather factors and white fly population: The multiple regression equation fitted with five independent variables to predict the incidence of disease on 45 days old crop was: $Y = -741.86 + 1.78\ X_1 + 1.26\ X_2 - 7.95\ X_3 + 0.55\ X_4 + 9.40\ X_5$ with a R^2 value of 0.70.

It was observed that the partial regression coefficient of disease per cent on maximum temperature, white fly population, relative humidity and total rainfall were found to be significant with a high R^2 value of 0.70 (Table VII). The contribution of maximum temperature and rainfall were 29.10 and 20.52 per cent respectively to the total variation in the disease incidence which meant that maximum temperature and rainfall prevalent during the first fortnight of the crop are important weather factors in predicting the disease incidence which will occur on 45th day of the crop. It could be observed from the results, that 1°C increase in maximum temperature brought about 1.80 per cent of the disease incidence, whereas an addition of 1 mm rainfall brought down the disease incidence by 0.55 per cent. Increase in white fly popula-

TABLE VII. Partial regression coefficients, standard errors and proportional contribution of each variable to regression of disease per cent 45 days after sowing) on weather factors and white fly population (n = 36)

Variable	Partial regression coefficient	S. E.	Proportional contribution to total variation in Y (per cent)
X_1 (Maximum temperature °C)	1.80*	0.38	29.10
X_2 (Minimum temperature °C)	1.26	0.81	10.16
X_3 (Relative Humidity %)	7.95 **	1.50	4.35
X_4 (Rainfall in mm)	−0.55 **	0.12	20.52
X_5 (White fly population)	9.40 *	3.81	6.08

* - Significant at $P = 0.05$ ** - Significant at $P = 0.01$

tion by one number resulted in 9.4 per cent increase in disease incidence and this is in consonance with the findings of Chelliah *et al.* (1976) in the case of yellow vein mosaic disease of bhendi transmitted by *B. tabaci*. Earlier studies by Pruthi and Samuel (1942) revealed that increased incidence of tobacco leaf curl disease in summer was due to increased population of *B. tabaci*. They reported that higher temperatures were condusive for the rapid multiplication of the white fly and hence the increased disease incidence. Nene (1972) also observed that higher temperature was condusive for rapid multiplication and activity of *B. tabaci*. In the light of these findings it could be inferred that increased maximum temperature during summer was mainly responsible for increased vector population *vis-a-vis* disease incidence.

The role of rainfall discussed based on the present finding in constraining disease spread by reducing the population of *B. tabaci* was also in general agreement with the findings of Nene (1972) who reported that the population of *B. tabaci* adults were largely controlled by rains particularly when there were regular and heavy showers and strong winds.

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