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Influence of Weather Factors on the Incidence of Yellow Vein Mosaic Disease of Bhendi

By

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ABSTRACT

Fortnightly sowing of bhendi and record of incidence of Yellow Vein Mosaic disease and the vector, *Bemisia tabaci* Genn., were carried out for a period of two years. Using important weather factors, simple correlations and multiple regression analysis were worked out to identify the factors in predicting the disease in 30, 45 and 60 days old crop. Simple correlation studies revealed negative association between disease incidence and relative humidity in all the three periods of crop growth and positive association between maximum, minimum temperature and the disease incidence in 45 and 60 days old crop. Multiple regression analysis led to the conclusion that in 30 days old crop, increase of white fly population by one number brought about 18.5 per cent of the disease, while 1 per cent decrease in relative humidity increased the disease incidence by 1.2 per cent. In 45 days old crop, minimum temperature alone exerted positive influence on disease incidence. During 45-60 days of crop age, increase in minimum temperature by 1°C resulted in 6.3 per cent increase of the disease.

INTRODUCTION

Bhendi (*Abelmoschus esculentus* (L.) Moench) is infected by a few diseases among which, yellow vein mosaic caused by the virus is the most important. Chelliah and Sellammal Murugesan (1975 a) reported that infection by this virus in 30 days old bhendi crop resulted in 88 per cent loss in yield. Studies on the seasonal incidence of this disease revealed that the disease occurred in a more extensive scale in crop sown from March to May, at Coimbatore (Chelliah and Sellammal Murugesan, (1975 b). To investigate further on the possible reasons for the increased incidence of the disease during summer months, a study was carried out at Agricultural College and Research Institute Coimbatore in which the relationship between the incidence of the disease and certain important weather factors *viz.*, maximum temperature, minimum temperature, relative humidity, rainfall and number of rainy days was assessed and the results presented in this paper.

MATERIALS AND METHODS

The field experiment was laid out in a randomised block design with 48 treatments *viz*,, fortnightly sowings for two years from the first fortnight of July, 1972 to second fortnight of June, 1974, replicated thrice. Bhendi variety, H15 was sown on 1st and 16th of every month. Observations on the percentage of diseased plants in

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experimental plots were recorded 30, 45 and 60 days after sowing. The white fly (*Bemisia tabaci* G.) vector population in three leaves selected at random at top, middle and bottom regions of the plants was recorded from ten randomly selected plants in each replication at 10 days interval from 10th to 40th day of sowing.

Data on mean maximum temperature (°C) minimum temperature (°C), relative humidity (%) and total rainfall (mm) prevailing one week prior to each white fly population recording were collected to study the association of these factors individually with the white fly population. The mean incubation period of the virus in the plant under field conditions was observed to be 15 days. The weather influenced by the above four factors, prior to 15 days of the disease recording was considered to study the relationship between these factors individually with the disease incidence. Multiple regression analysis was carried out to find out the important factors that are useful in predicting the yellow vein mosaic incidence in bhendi in 30, 45 and 60 days old crop. The following variables have been used in the regression analysis.

Y1 = Yellow vein mosaic disease per cent (30 DAS)

Y2 = Yellow vein mosaic disease per cent (45 DAS)

Y3 = Yellow vein mosaic disease per cent (60 DAS)

X1 = Mean white fly population (per plant)

For 30 DAS – Mean of 1st and 2nd count (10 DAS and 20 DAS)

For 45 DAS – Mean of 2nd and 3rd count (20 DAS and 30 DAS)

For 60 DAS – Mean of 3rd and 4th count (30 DAS and 40 DAS)

X2 = Mean maximum temperature (°C)
X3 = Mean minmum temperature (°C)
X4 = Mean relative humidity (%)
X5 = Total rainfall (mm)
X6 = Total number of rainy days

} Prevalent 15 days earlier to the disease recording

DAS — Days after sowing

RESULTS AND DISCUSSION

The population of the white fly and the percentage of incidence of yellow vein mosaic at different crop growth stages are persented in Table 1. The results of simple correlation studies of disease with weather factors and white fly population are presented in Table 2. The results revealed that there was a significant negative correlation (−0.342) between the yellow vein mosaic incidence and relative humidity in 30 days old crop.

TABLE 1. Population of *B. tabaci* and percentage of yellow vein mosaic incidence in bhendi in different periods (Pooled data, 1972-74)

Treatment	Mean population of *B. tabaci*/plant				Percentage of disease incidence			
	Days after sowing			Mean	Days after sowing			Mean
	10&20 (Mean)	20&30 (Mean)	30&40 (Mean)		30	45	60	
July 1	0.09	0.03	0.03	0.05	1.66	4.12	8.30	4.69
July 16	0.09	0.05	0.12	0.09	0.55	1.81	3.23	1.86
August 1	0.32	0.05	0.04	0.14	0.18	1.18	1.26	0.87
August 16	0.13	0.11	0.08	0.11	0.51	0.97	3.19	1.56
September 1	0.22	0.12	0.04	0.13	0.83	3.62	9.44	4.63
September 16	0.26	0.15	0.13	0.18	1.94	11.83	23.12	12.30
October 1	0.29	0.06	0.12	0.16	0.80	7.33	16.29	8.14
October 16	0.05	0.05	0.05	0.05	0.00	3.54	9.18	4.24
November 1	0.06	0.07	0.10	0.08	2.30	3.04	9.46	4.93
November 16	0.13	0.17	0.15	0.15	0.00	0.10	5.34	1.81
December 1	0.14	0.10	0.03	0.09	0.00	0.41	1.00	0.47
December 16	0.33	0.07	0.08	0.16	0.00	0.00	1.46	0.49
January 1	0.18	0.17	0.16	0.17	2.74	3.64	3.95	3.44
January 16	0.29	0.11	0.07	0.16	0.00	0.50	0.28	0.26
February 1	0.40	0.12	0.08	0.20	0.00	0.00	0.00	0.00
February 16	0.34	0.09	0.05	0.16	0.00	0.25	0.75	0.33
March 1	0.59	0.55	0.50	0.55	0.52	7.17	30.38	12.69
March 16	0.46	0.43	0.40	0.43	2.34	30.23	55.22	29.26
April 1	0.56	0.36	0.17	0.36	19.78	60.60	78.82	53.07
April 16	0.46	0.71	0.45	0.54	4.80	47.82	74.35	42.32
May 1	0.40	0.44	0.06	0.30	24.12	58.56	81.69	54.79
May 16	0.40	0.18	0.08	0.22	25.25	52.90	68.09	48.75
June 1	0.13	0.13	0.07	0.11	6.05	13.72	24.50	14.76
June 16	0.09	0.11	0.06	0.09	3.90	14.88	19.26	12.68

In 45 days old crop, there existed a highly positive correlation between the disease incidence on one hand and the white fly population, maximum temperature and minimum temperature on the other. However, the incidence of the disease was negatively correlated with the relative humidity. Similar

TABLE 2. Correlation matrix of disease incidence with white fly population and weather factors (n = 48)

	X_1			X_2			X_3			X_4			X_5			X_6		
	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS
Y Disease %	0.232	0.469**	0.241	0.024	0.522**	0.370**	0.009	0.494**	0.578**	−0.342*	−0.374*	−0.390**	0.173	−0.135	−0.045	0.058	−0.128	−0.022
X_1 White fly population				0.469**	0.457**	0.381**	−0.072**	0.225	0.346*	−0.251	−0.324**	0.028	−0.366*	−0.161	0.039	−0.380**	−0.177	0.032
X_2 Max. Temp. (°C)							0.161	0.342*	0.342*	−0.415**	−0.400**	−0.406**	−0.387**	−0.402**	−0.403**	−0.403**	−0.402**	−0.290**
X_3 Min. Temp										−0.063	−0.139	−0.075	0.094	0.360*	0.205	0.134	0.278	0.372**
X_4 Relative humidity													0.563**	0.561**	0.556**	0.548*	0.532**	0.670**
X_5 Rainfall																0.775**	0.783**	0.780**

* Significant at P = 0.05

** Significant at P = 0.01

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association between disease incidence and maximum temperature, minimum temperature and relative humidity was also observed in 60 days old crop.

As simple correlation studies did not throw much light on the incidence of the yellow vein mosaic disease which was influenced by multiple factors, multiple regression analysis was carried out and the prediction equations worked out.

Prediction of bhendi yellow vein mosaic incidence in 30 days old crop: The multiple regression equation fitted with six independent variables to predict the incidence of disease in 30 days old crop (Y_1) was

$Y_1 = 123.239 + 18.476\ X_1 - 0.692\ X_2 - 0.081\ X_3 - 1.210\ X_4 + 0.110\ X_5 + 0.221\ X_6$ with a R^2 value of 0.4231.

The partial regression co-efficients, standard errors, and proportional contribution of each variable to regression of disease per cent in 30 days old crop on weather factors and white fly population are presented in Table 3.

TABLE 3. Partial regression coefficients, standard errors and proportional contribution of each variable to regression of disease per cent (30 DAS) on weather factors and white fly population (n=48)

Variable	Partial regression coefficients	Standard errors	Proportional contribution to R^2 (Per cent)
X_1 White fly population	18.476*	7.422	5.37
X_2 Maximum temperature	— 0.692	0.577	0.92
X_3 Minimum temperature	— 0.081	0.248	0.23
X_4 Relative humidity	— 1.210**	0.328	12.10
X_5 Rainfall	0.110**	0.040	23.58
X_6 No. of rainy days	0.221	0.830	0.10

Constant term 'a' = 123.239

R^2 = 0.423

* Significant at P = 0.05

** Significant at P = 0.01

The partial regression coefficient of disease per cent in 30 days old crop for white fly population was significant, while high negative and positive regression coefficients were recorded with relative humidity and rainfall respectively. The regression function fitted had a R^2 value of 0.4231, which explained that 42.31 per cent variation existed in disease per cent was contributed by six variables considered in the present study.

In the early stage of the crop (30 DAS), white fly population, in addition to relative humidity and rainfall was found to influence the disease. The contribution of white fly population, relative humidity and rainfall to the R^2 were 5.37, 12.10 and 23.58 per cent respectively to the total variation in the disease incidence. It could be inferred that increase of white fly population by one number brought about 18.5 per cent of disease, 1 per cent decrease in relative humidity brought up the disease by 1.2 per cent and addition of 1 mm rainfall brought about 0.11 per cent disease.

Prediction of bhendi yellow vein mosaic in 45 days old crop: The multiple regression equation fitted to predict the incidence of disease on 45 days old crop (y_2) was

$$Y2 = -89.288 + 26.831\ X_1 + 1.873\ X_2 + 3.893\ X_3 - 0.490\ X_4 - 0.0599\ X_5 + 0.507\ X_6$$

with a R^2 value of 0.4616.

The partial regression coefficients, standard errors, proportional contribution to regression of disease incidence in 45 days old crop on weather factors and white fly population are presented in Table 4.

TABLE 4. Partial regression coefficients, standard errors and proportional contribution of each variable to regression of disease per cent (45 DAS) on weather factors and white fly population (n=48)

Variable		Partial regression coefficients	Standard errors	Proportional contribution to R^2 (Per cent)
X_1	White fly population	26.831	15.304	21.973
X_2	Maximum temperature	1.873	1.567	11.934
X_3	Minimum temperature	3.893*	1.758	9.979
X_4	Relative humidity	— 0.490	0.687	1.995
X_5	Rainfall	— 0.059	0.100	0.371
X_6	No. of rainy days	0.507	1.961	0.088

Constant term 'a' = −89.288

R^2 = 0.4616

* Significant at P = 0.05

The partial regression coefficient of minimum temperature alone was found to be significant. The maximum contribution of 9.979 per cent to R^2 by minimum temperature indicates its importance in predicition.

Prediction of bhendi yellow vein mosaic in 60 days old crop: The multiple regression equation to predict the incidence of disease in 60 days old crop (Y3) was

$$Y3 = 36.322 + 10.092\ X_1 + 0.756\ X_2 + 6.319\ X_3 - 2.021\ X_4 + 0.055\ X_5 - 0.155\ X_6$$

with a R^2 value of 0.4641.

The partial regression coefficients, standard errors, proportional contribution of each variable to regression of disease per cent in 60 days old crop on weather factors and white fly population are presented in Table 5.

TABLE 5. Partial regression coefficients, standard errors and proportional contribution of each variable to regression of disease per cent (60 DAS) on weather factors and white fly population (n=48)

Variable		Partial regression coefficients	Standard errors	Proportional contribution to R^2 (Per cent)
X_1	White population	10.092	25.441	5.825
X_2	Maximum temperature	0.756	1.815	9.038
X_3	Minimum temperature	6.319**	2.061	21.897
X_4	Relative humidity	— 2.021*	— 0.979	9.221
X_5	Rainfall	0.055	0.113	0.424
X_6	No. of rainy days	— 0.155	— 3.212	0.003

Constant term 'a' = 36.322

R^2 = 0.4641

* Significant at P = 0.05

** Significant at P = 0.01

In the late stage of the crop (60 DAS) the partial regression coefficient of disease per cent on minimum temperature was highly significant which explained for 22 per cent of the total variation (46.4 per cent) in disease incidence. The partial regression coefficient for relative humidity was significant at 5 per cent level but negative, and it had a low contribution of 9 per cent only to the total variation.

White flies prevalent on 30th and 40th day of the crop did not have any influence on the disease recorded on 60 days old crop. This might probably be due to the significant influence of white fly occurrence during the early stage of the crop *viz.*, 10th and 20th day population which brought up the disease in 30 day old crop.

In simple correlation as well multiple regression analysis, the minimum temperature was observed to have a positive association with the incidence of yellow vein mosaic disease in 45 and 60 days old crop. Simple correlation studies further revealed that maximum temperature also positively correlated with disease incidence at these two stages of crop growth. Higher temperature prevailing during summer was reported to influence the fecundity of *B. tabaci* by Pruthi and Samuel (1942) which might be attributed to increased disease spread. In support of this finding, Trehan (1944) also reported that the rate of development and reproduction of *B. tabaci* was positively correlated with temperature upto 45°C. His studies further revealed that at higher temperatures during summer among the developing adults, the females out numbered the males substantially. As female white flies were more efficient vectors than the males (Varma, 1952; Cohen and Nitzany, 1966 and Nene, 1972), this gave further evidence to increased

disease spread during summer due to higher temperatures. The high negative correlation between relative humidity and disease incidence in 30 and 60 days old crops also emphasised the role of this weather factor in the disease incidence.

The maximum contribution of 22 per cent to R^2 by minimum temperature indicated the importance of this weather parameter in prediction. When the night temperature increased by 1°C during 45-60 days of the crop age, it resulted in a significant increase of disease by 6.3 per cent, in 60 days old crop.

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