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Epidemiological studies of stem rot of betelvine caused by *Phytophthora parasitica* under closed conservatory condition in West Bengal

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ABSTRACT

Relationship between five meteorological parameters like maximum temperature, minimum temperature, maximum relative humidity, minimum relative humidity and rainfall with disease severity of stem rot of betelvine caused by *Phytophthora parasitica* showed similar type of reactions in different cultivars of betelvine with regards to rate of progress of disease. Multiple regression analysis of meteorological parameters with disease severity showed that except minimum relative humidity all other meteorological factors were negatively correlated with disease severity. These observations were observed in all the tested 3 varieties. Step wise multiple regression analysis of original PDI is highly accurate and viable for disease prediction and it is confirmed by high Co-efficient determination (R^2) value, Adjusted R^2 value and low Residual sum of square and Standard error of estimate. Among the two transformed models Gompertz fit better for disease prediction in stem rot of betelvine.

Key Words: Betelvine, epidemiology, prediction equation, *Phytophthora parasitica*, and stem rot.

In spite of the tremendous potentiality of the crop, cultivation of betel vine is highly risky and returns are uncertain because of its proneness to several diseases, aggravated by the moist and humid conditions of the plantation, that in turn are prerequisites for good harvest. Among the pathogens, *Phytophthora* sp. perhaps ranks first in its destructiveness under both field and storage conditions. The extent of losses may vary from 30-100% due to stem rot, leading to almost total crop failure (Dasgupta and Sen, 1998; Dasgupta, *et al*., 2000). The incidence, pathogenesis and control of stem rot of betel vine caused by *Phytophthora parasitica* have been studied in detail by Roy (2001), Sanyal (2002) and Anon (2004,2006) Mahanty, 2004. Very little information is available about epidemiology of stem rot caused by *Phytophthora parasitica*. Maiti and Sen (1982) reported that the disease occurred between June to October and reached its peak intensity during August and September. It wanes during winter and only to reappear again as temperature becomes higher. The present investigation was undertaken to study the role of epidemiological parameters on the development of stem rot of betel vine caused by *Phytophthora parasitica* under bareja condition.

MATERIALS AND METHODS

The varieties of betel vine used for epidemiological study were Simurali Gol Bangla, Ghanagette and Simurali Deshi. The disease selected for investigation of epidemiological study was stem rot caused by *P.parasitica*. A 'boroj' was selected at Mondouri Farm BCKV, Mondouri, 24 Parganas (N). The epidemiological factors, which were considered, were maximum temperature, minimum temperature, maximum humidity, minimum humidity and total rainfall. The information bout temperature and humidity were collected from Bell's thermohygrograph within the baroj. Rainfall data were collected from Rain gauge situated within the baroj. The experiment was conducted during June to November, 2006 when the incidence of stem rot disease due to *Phytophthora parasitica* appeared. The disease incidence was recorded at 7 days interval starting from 1st week of June to last week of November.

$$\textbf{Percent disease incidence} = \frac{\text{Number of infected plants x 100}}{\text{Total number of plants}}$$

Three varieties Ghanagette, Simurali Deshi and Simurali Gol Bhavna were inoculated with *Phytphthora* sp during end of May. The incidence of diseases and incidence of index were recorded from 1st week of June, 2006 to November 2006 at 7 days interval. The average weekly weather data was also recorded. The results obtained were analysed by multiple regression analysis (MRA) technique where meteorological data are independent variables and the dependent variable percent disease incidence of stem rot of betel vine on above 3 varieties.

RESULTS DISCUSSION

Weather parameter on disease development

The results (Table-1) revealed that the meteorological factors which were considered for disease prediction, only minimum relative humidity played a significant positive role in all the varieties. Similar type of result was also obtained under AICRP on betelvine in B.C.K.V. (Anon., 2004,2006).

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Prediction equation for disease forecasting

Five meteorological parameters like T_{max}, T_{min}, RH_{max}, RH_{min} and total rainfall played a major role within the boroj for the growth of the plant as well as the pathogen, were considered for quantify the disease severity (Table 2). Three popular varieties mentioned earlier showed differential disease reaction within the same environmental condition.

The results (Table 3) of the prediction equation showed that the step wise multiple regression analysis of original PDI is highly accurate and viable for disease prediction and it is confirmed by high Co-efficient determination (R^2) value, Adjusted R^2 value and low Residual sum of square and Standard error of estimate. Among the two transformed models Gompertz fit better for disease prediction in foot rot of betelvine. So the prediction equation of *Phytophthora* foot rot is Y= -0.26+0.0048 RH min. It means that with increase in RH min, the disease severity will be increased.

Epidemic development of stem rot disease of betel vine has been investigated by correlation and MRA using angular transformed disease data for assessment of best fitting of predicted equation of the different varieties and the results are predicted. In the present investigation, among the five selected independent variable except minimum Relative humidity all were negatively. For more accurate prediction other meteorological and biological variables of host and pathogen may be considered. The equations that are presented here can be considered to be prototype model that provide solid groundwork for future improvement of these model for disease forecasting.

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Table 1: Role of weather parameters on disease development.

Sl.No.	Variety	Temperature		Relative humidity		Rainfall	Significance
		Max.	Min.	Max.	Min.		
1.	**Ghanagette**	-	-	-	+	-	*
2.	**Simurali Gol Bhavna**	-	-	-	+	-	*
3.	**Simurali Deshi**	-	-	-	+	-	*

'+' positively correlated, '-' negatively correlated * significant at 5% level of significance

Table 2: Effect of meteorological paramters on stem rot of betelvine caused by *Phytophthora* sp.

Weeks	Temperature (^{0}C)		Relative humidity(%)		Rainfall (mm)	Disease incidence (%)		
	Max	Min	Max	Min		Ghanagette	Simurali Gol Bhavna	Simurali Deshi
1.	33.72	25.65	94.87	71.75	4.14	1.15*	0.53	1.05
2.	35.93	26.76	93.87	69.87	3.36	3.49	0.50	2.65
3.	35.87	25.73	97.14	68.00	2.47	4.19	1.92	8.24
4.	35.78	26.44	97.00	72.14	1.40	6.02	2.35	10.79
5.	34.72	26.94	93.14	73.85	25.9	7.28	4.42	13.25
6.	32.64	26.05	97.88	87.63	118.64	8.38	5.62	14.67
7.	32.34	25.85	98.25	81.88	195.68	9.12	6.00	15.74
8.	32.93	25.94	98.13	82.63	69.60	9.77	7.70	19.22
9.	32.42	25.39	96.71	81.71	24.70	11.41	8.67	20.31
10.	33.43	25.95	95.63	75.63	31.70	12.75	10.07	22.17
11.	32.05	25.65	99.38	87.13	80.40	13.91	10.47	22.68
12.	31.78	25.84	98.75	85.13	122.40	16.22	11.21	23.97
13.	33.81	25.37	96.28	73.71	6.50	16.77	12.41	26.09
14.	34.07	25.84	97.28	74.85	72.00	17.94	12.08	22.23
15.	32.24	25.05	99.00	79.00	241.61	20.01	10.93	20.55
16.	32.63	25.30	99.38	82.50	101.70	20.95	9.68	17.06
17.	34.34	24.99	98.71	76.86	49.90	18.27	7.12	14.47
18.	34.49	24.83	98.37	72.13	16.70	15.71	5.18	10.84
19.	32.58	22.04	98.75	74.50	31.30	13.26	3.50	8.88
20.	31.66	20.90	97.75	64.50	0.00	9.88	2.84	6.89
21.	31.64	20.70	97.00	57.68	0.20	6.77	1.59	4.12
22.	28.91	19.89	97.71	57.55	1.60	6.09	0.90	2.79
23.	31.55	16.43	97.88	63.40	0.00	3.33	0.35	1.92
24.	29.84	15.76	95.75	63.42	0.00	1.77	0.00	0.48

Table 3: Results of stepwise multiple regression analysis of epidemiological studies in fruit rot.

Transformation	Fitted regression equation	R^2	Adjusted R^2	Residua l S.S	S.E
Disease severity	Y= -0.26+0.0048 min.RH**	0.50	0.48	0.039	0.042
Logit transformation	Y= -8.26+0.078 min.RH**	0.45	0.43	12.53	0.75
Gompertz transformation	Y= -2.85+0.026 min.RH**	0.49	0.46	1.226	0.24

*Significant at P=0.01 level of significance