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Epidemic development of Leaf spot of betelvine (*Piper betle* Linn.) caused by *Colletotrichum capsici* (Syd.) Butler and Bisby under closed conservatory condition in West Bengal

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Relationship between five meteorological parameters viz. maximum temperature, minimum temperature, maximum relative humidity, minimum relative humidity and rainfall with disease severity of leaf spot of betelvine caused by *Colletotrichum capsici* showed different 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 maximum temperature and maximum relative humidity were positively and negatively correlated with disease severity respectively. These observations were observed in all the tested 18 varieties. The other three factors showed differential relations in different varieties. Among the 18 varieties, 10 varieties showed significant relation with meteorological factors and this was confirmed by high R^2 value. The prediction equation of disease severity of 10 varieties were (1) CARI-2(AN) - $Y= 0.10 + 0.08X_1 - 0.003X_2 - 0.004X_3 + 0.002X_4 + 0.001X_5$ (2) CARI-6(AN) - $Y= 0.43 + 0.014X_1 - 0.019X_2 - 0.006X_3 + 0.021X_5$ (3) Ramtek Bangla - $Y= 0.07 + 0.008X_1 - 0.003X_2 - 0.004X_3 + 0.001X_4$ (4) Godi Bangla - $Y= 0.32 + 0.007X_1 + 0.001X_2 + 0.001X_4 + 0.001X_5$ (5) Kotki Bangla - $Y= 0.03 + 0.001X_1 + 0.002X_2 - 0.001X_3 + 0.001X_5$ (6) Bankura Bangla - $Y= 0.09 + 0.002X_1 + 0.003X_2 - 0.003X_3$ (7) Bagerhat Bangla -$Y= 0.04 + 0.004X_1 - 0.002X_3 - 0.001X_4 + 0.001X_5$ (8) Jabalpur Bangla - $Y= 0.08 + 0.001X_1 + 0.006X_2 - 0.003X_3 + 0.001X_4$ (9) Simurali Bangla - $Y= 0.08 + 0.009X_1 - 0.005X_2 - 0.003X_3 + 0.001X_4 - 0.004X_5$ (10) Chamundali Bhavna - $Y= 0.07 + 0.004X_1 - 0.002X_3 + 0.001X_4 + 0.001X_5$.

Key words: Epidemic, Prediction equation, Leaf spot, *Colletotrichum capsici*, betelvine, West Bengal

INTRODUCTION

The major constraint for cultivation of betelvine is its diseases that severely damage foot, stem, root and foliage. Among the pathogens, *Colletotrichum capsici* causes extensive damage under both field and storage conditions. The extent of losses may vary from 10-20% in case of leaf spot, leading to almost total crop failure (Singh and Shankar, 1997; Maity and Sen, 1982; Dasgupta and Sen, 1999). The incidence, pathogenesis and control of leaf spot of betel vine caused by *Colletotrichum capsici* have been studied in detail by Dasgupta (1982), Roy (2001), Sanyal (2002), and under AICRP on betel vine (Anonymous, 1995-2003). Very little information have been received about epidemiology of leaf spot caused by *Colletotrichum capsici.* 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. Observations made under AICRP on betelvine revealed that all the meteorological parameters like maximum and minimum temperature, maximum and minimum relative humidity and rainfall play an important role on leaf spot of betelvine caused by *Colletotrichum capsici* (Annonymous, 2002-03 and 2005-06). The present investigation was undertaken to study the role of epidemiological parameters on the development of leaf spot of betelvine caused by *Colletotrichum capsici* under bareja condition.

MATERIALS AND METHODS

The varieties of betel vine used for epidemiological study were CARI-2 (AN), CARI-6 (AN), Ramtek

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Bangla, Godi Bangla, Kotki Bangla, Bankura Bangla, Bagerhat Bangla, Jabalpur Bangla, Simurali Bangla, Chamundali Bhabna.

The disease selected for investigation of epidemiological study was leaf spot disease of betel vine (*Piper betle* L.) caused by *C. capsici* (Syd.) Butler and Bisby.

A 'boroj' was selected at Mondouri Farm, Mondouri, N-24 Parganas. The size of the 'boroj' was 500 sq. ft. The length of the 'boroj' was 25 ft. and the width was 20 ft. The epidemiological factors, which were considered, were maximum temperature, minimum temperature, maximum humidity, minimum humidity and total rainfall. The data of maximum and minimum temperature, maximum and minimum relative humidity were collected from Bell's thermohygrograph situated within the baroj. Rainfall data were collected from Rain gauge situated within the baroj. All the data were collected daily except the rainfall data, which was collected when rain occurs. The experiment was conducted during June to November when the incidence of leaf spot disease due to *Colletotrichum capsici* appeared. The disease incidence was recorded at 10 days interval starting from 1st week of June to last week of November.

The intensity of disease was rated at 10 days interval on a 0-4 scale where 0 = no infection; 1 = 1-25% leaf area infection; 2 = 26-50% leaf area infection; 3 = 51-75% leaf area infection; 4 = 75-100% leaf area infection (Roy *et al.*, 2002) by random sampling of 100 leaves at waist height. The test was conducted for all the varieties of betel vine. The Per cent Disease Index (PDI) was calculated as:

$$PDI = \frac{\text{Sum of all numerical rating}}{\text{Total number of leaf} \times \text{Maximum score}} \times 100$$

(Townsend and Heuberger, 1943)

The results obtained were analysed by multiple regression analysis (MRA) technique where maximum temperature, minimum temperature, maximum relative humidity, minimum relative humidity and rainfall as explanatory variables (independent) and the dependent variable per cent disease index of leaf spot of betelvine caused by *C. capsici* on 18 varieties. The results obtained are discussed here in.

RESULTS AND DISCUSSION

Role of weather parameter on disease development of different varieties of betelvine

The results (Table 1) revealed that the meteorological factors which were considered for disease prediction showed insignificant in case of varieties Simurali Goal Bhabna, Simurali Sanchi, Boinchi Godi, Harishpur Bangla, Kadwa, Kalipatti, Ghanagette as confirmed by low coefficient of determination (R^2) value. Maximum temperature played a significant positive role on disease development in case of variety CARI-6 (AN), Godi Bangla, Kotki Bangla, Bankura, Bangla, Jabalpur Bangla and Awani Pan.

Table. 1: Role of weather parameters on disease development.

Name of the variety	Max. Temp.	Min. Temp.	Max RH	Min RH	Rain fall	Signifi-cance
Simurali Goal Bhabna	+	-	-	+	-	
Simurali Sanchi	+				+	
CARI-2(AN)	+	-	-	+	+	*
CARI-6(AN)	+	+	-		+	*
Boinchi Godi	+	+	-	+	+	
Ramtek Bangla	+	-	-	+		*
Godi Bangla	+	+		+	+	*
Kotki Bangla	+	+	-		+	*
Bankura Bangla	+	+	-			*
Harishpur Bangla	+	-	-	+	+	
Bagerhat Bangla	+		-	+	+	*
Kadwa	+	-	-	+		
Kalipatti	+	-	-	+		
Jabalpur Bangla	+	+	-	+		*
Awani Pan	+	+	-		+	*
Ghanagette	+	-	-	+	-	
Simurali Bangla	+	-	-	+	+	*
Chamundali Bhabna	+		-	+	+	*

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

Table. 2: Effects of weather parameters on leaf spot of betelvine caused by C. capsici

Name of the variety	Multiple Regression Equation	Multiple R^2	F value for R
CARI-2(AN)	$Y = 0.10 + 0.008\ x_1 - 0.003\ x_2 - 0.004\ x_3 + 0.002\ x_4 + 0.001\ x_5$	0.5234	4.17*
CARI-6(AN)	$Y = -0.43 + 0.014\ x_1 + 0.019\ x_2 - 0.006\ x_3 + 0.021\ x_5$	0.4427	3.02*
Ramtek Bangla	$Y = 0.07 + 0.008\ x_1 - 0.003\ x_2 - 0.004\ x_3 + 0.001\ x_4$	0.5029	3.84*
Godi Bangla	$Y = -0.32 + 0.007\ x_1 + 0.001\ x_2 + 0.001\ x_4 + 0.001\ x_5$	0.4929	3.69*
Kotki Bangla	$Y = 0.03 + 0.001\ x_1 + 0.002\ x_2 - 0.001\ x_3 + 0.001\ x_5$	0.4841	3.57*
Bankura Bangla	$Y = 0.09 + 0.002\ x_1 + 0.003\ x_2 - 0.003\ x_3$	0.6104	5.95*
Bagerhat Bangla	$Y = 0.04 + 0.004\ x_1 - 0.002\ x_3 - 0.001\ x_4 + 0.001\ x_5$	0.4258	2.82*
Jabalpur Bangla	$Y = 0.08 + 0.001\ x_1 + 0.006\ x_2 - 0.003\ x_3 + 0.001\ x_4$	0.6962	8.71*
Simurali Bangla	$Y = 0.08 + 0.009\ x_1 - 0.005\ x_2 - 0.003\ x_3 + 0.001\ x_4 - 0.004\ x_5$	0.5139	4.02*
Chamundali Bhabna	$Y = 0.07 + 0.004\ x_1 - 0.002\ x_3 + 0.001\ x_4 + 0.001\ x_5$	0.5182	4.09*

The highest co-efficient of determination (R^2) values confirmed the validity of these prediction equations
x_1= Maximum temperature; x_2= Minimum temperature; x_3 = Maximum Relative humidity; x_4 = Minimum Relative humidity; x_5 = Rainfall

Minimum temperature played a significant negative role on disease development in CARI-2(AN), Ramtek Bangla and Simurali Bangla where as in Bagerhat Bangla and Chamundali Bhabna, it played no role on disease development. Maximum relative humidity played a significant negative role in all the varieties except in Godi Bangla where maximum relative humidity played no role in disease development. Minimum relative humidity played a significant positive role in all the varieties except CARI-6(AN), Kotki Bangla, Bankura Bangla and Awani Pan. Rainfall played a significant positive role in all the varieties except Ramtek Bangla, and Jabalpur Bangla where it had no role on disease development. Similar type of result was also obtained under AICRP on betelvine in B.C.K.V. where the experiment was conducted taking one variety (Anonymous, 2002-03) and two varieties (Anonymous, 2005-06).

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). Ten popular varieties mentioned earlier showed differential disease reaction within the same environmental condition. Five meteorological factors showed no significant relation with disease severity when combinedly considered in 7 varieties like Simurali Goal Bhabna, Simuraly Sanchi, Boinchi Godi, Harishpur Bangla, Ganagette, Kalipatti and Kadwa among the 18 varieties tested. This was confirmed by low R^2 value. Four meteorological parameters like T_{max}, T_{min}, RH_{max}, RH_{min} were positively correlated with disease progress on Boinchi Godi, Godi Bangla. When five meteorological parameters are individually considered, all the varieties were positively correlated with T_{max} and RH_{max} except Simurali Sanchi, CARI-6 (AN), Kotki Bangla, Bankura Bangla and Awani pan. RH_{max}, was negatively correlated with disease severity observed in 10 varieties. Which was confirmed by high R^2 value in combined meteorological interaction. Total rainfall was positively correlated with disease severity except Simuraly Goal Bhabna Ghanagette which was negatively correlated (Table 2).

Epidemic development of leaf spot disease of betelvine 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, five selected independent variable were positively, negatively or partially correlated with disease severity. The prediction equation is different in different varieties due to different disease reaction in different cultivars as the disease reaction is genetically controlled. 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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