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Influence of Weather Parameters on Development of Maydis Leaf Blight of Maize Caused by *Bipolaris maydis* (Nisikado Shoemaker)

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A B S T R A C T

A field experiment was conducted at Main Agriculture Research Station, University of Agriculture Sciences, Dharwad, to study the disease development in relation to weather parameters, which clearly depicts the relationship between the weather factors like temperature, relative humidity, rainfall and number of rainy days with the development of the maydis leaf blight of maize. Observations were taken from 31st standard week to 39th standard weeks at weekly interval. The PDI was lowest during 31st standard week (8.34 %) and increased throughout the cropping period. It was peak during last stage that is 39th standard week (80.07 %). During cropping period maximum temperature ranged from 25^0C (31st standard week) to 29.4^0C (35th standard week), minimum temperature from 19.3^0C (35th standard week) to 21^0C (37th standard week), relative humidity (morning) from 91 per cent (35th standard week) to 95 per cent (38th standard week) and relative humidity (evening) from 63 per cent (35th standard week) to 85 per cent (31st standard week). Cumulative weekly rainfall ranged from 59.60 mm (31st standard week) to 237.80 mm (39th standard week). No of rainy days ranged from 1 (32nd standard week) to 6 (37th standard week). With respect to weather studies the per cent disease index at weekly intervals were calculated. This was progressing at linear rate as the age of the plant was increasing. Maximum temperature (r = 0.40), minimum temperature (r = 0.03) were not significantly positively correlated with PDI. Morning relative humidity (r = -0.03), evening relative humidity (r = -0.45) and number of rainy days (r = -0.12) were not significantly negatively correlated with PDI. While, the rainfall showed a highly significant positive correlation with PDI.

Introduction

Maize is grown throughout the world under a wide range of climatic conditions. In India, maize is an important cereal crop next to rice, wheat and sorghum. It is mainly grown in Karnataka, Andhra Pradesh, Maharashtra, Uttar Pradesh, Bihar, Rajasthan, Madhya Pradesh and Punjab. Maydis leaf blight of maize (*Zea mays* L.) caused by *Bipolaris maydis* (Nisikado) Shoemaker (Teliomorph: *Cochliobolus heterostrophus*) covers the widest geographical area and it is considered as a major foliar pathogen (Ullstrup, 1972 and

Tatum 1971). In India, the disease was first reported by Munjal and Kapoor (1960) from Malda (West Bengal). The maydis leaf blight injures or kills the leaf tissues and thereby reduces the area of chlorophyll which involved in photosynthesis. If considerable leaf area is killed, then vigour and yields are reduced drastically. If much of the green area is killed starch formation is restricted and the kernels become chaffy. The blighted leaves are not suitable for fodder because of the lowered nutrition value. In northern Karnataka, the disease is becoming important in recent years and there is no systematic information available with respect to maydis leaf blight.

Materials and Methods

The influence of weather factors like temperature (maximum and minimum), relative humidity (morning and evening), rain fall and number of rainy days on the development of maydis leaf blight was studied at Main Agriculture Research Station, University of Agriculture Sciences, Dharwad. This study was undertaken. Highly susceptible hybrid 900 M was sown in 10 × 10 m block with 60 × 20 cm spacing and the crop was raised with the recommended agronomic practices. The observations were made on disease incidence and severity starting from first day of its appearance and till the physiological maturity of crop. It was correlated with weather parameters by simple correlation. The meteorological observations at Main Agriculture Research Station, UAS, Dharwad were used for this experiment.

The present investigation of maydis leaf blight of maize was undertaken at Main Agriculture Research Station, UAS Dharwad. The mean weekly rainfall at Dharwad was 26.43 mm during the experimental period. The mean minimum and maximum temperature during this cropping period

ranged from 20.05^0 C to 27.16^0 C respectively. The mean relative humidity ranged from 75.78 to 93.89 per cent was favourable for the disease development. In general the environmental conditions were favourable for the outbreak of the disease in 2013. Hence maydis blight was severe.

Results and Discussion

Disease development

In the present investigation, disease development in relation to weather parameters were studied as described in materials and methods. This study clearly depicts the relationship between the weather factors like temperature, relative humidity, rainfall and number of rainy days with the development of the maydis leaf blight of maize. Observations were taken from 31st standard week to 39th standard weeks at weekly interval. The data presented in Table 3. The PDI was lowest during 31st standard week (8.34 %) and increased throughout the cropping period. It was peak during last stage that is 39th standard week (80.07 %). During cropping period maximum temperature ranged from 25ºC (31st standard week) to 29.4ºC (35th standard week), minimum temperature from 19.3ºC (35th standard week) to 21ºC (37th standard week), relative humidity (morning) from91 per cent (35th standard week) to 95 per cent (38th standard week) and relative humidity (evening) from 63 per cent (35th standard week) to 85 per cent (31st standard week). Cumulative weekly rainfall ranged from 59.60 mm (31st standard week) to 237.80 mm (39th standard week). No of rainy days ranged from 1 (32nd standard week) to6 (37th standard week) (Table 1).

With respect to weather studies the per cent disease index at weekly intervals were calculated. This was progressing at linear rate as the age of the plant was increasing.

Table.1 Influence of weather parameters on the development of maydis leaf blight

Standard week No.	Month and date	Age of the crop (Days)	Per cent disease index	Temperature (^{0}C)		Relative humidity (%)		Cumulative Rainfall (mm)	No. of rainy days
				Maximum	Minimum	Morning	Evening		
31	August 1 – 8	36	8.90 (17.33)*	25.0	20.1	95	85	59.6	6
32	August 9 – 16	44	17.11 (24.33)	27.2	20.0	94	78	78.0	1
33	August 17 – 24	52	21.73 (27.77)	26.3	20.5	95	79	90.0	1
34	August 25 – September 1	60	36.37 (37.11)	26.3	19.5	92	79	101.6	3
35	September 2 – 9	68	43.91 (41.52)	29.4	19.3	91	63	109.6	1
36	September 10 – 17	76	51.21 (45.72)	28.6	20.0	94	73	119.0	2
37	September 18 – 25	84	61.56 (51.72)	28.0	21.0	95	73	216.0	6
38	September 26 – October 3	92	68.44 (55.87)	27.2	20.4	95	75	231.4	3
39	October 4 – 11	100	80.65 (63.97)	26.5	19.7	94	77	237.8	1

* Figures in parenthesis are arcsine values

Table.2 Correlation between per cent disease index of maydis leaf blight of maize in relation to weather parameters

Parameters	Y	X_1	X_2	X_3	X_4	X_5	X_6
Y PDI	1.000	0.406	0.035	-0.035	-0.459	0.926*	-0.123
X_1 Maximum temperature (^{0}C)	0.406	1.000	-0.127	-0.457	-0.946*	0.201	-0.310
X_2 Minimum temperature (^{0}C)	0.035	-0.127	1.000	0.845*	0.258	0.310	0.518
X_3 Relative humidity (morning) (%)	-0.035	-0.457	0.845	1.000	0.581	0.244	0.404
X_4 Relative humidity (evening) (%)	-0.459	-0.946	0.258	0.581	1.000	-0.258	0.348
X_5 Rainfall (mm)	0.926	0.201	0.310	0.244	-0.258	1.000	0.076
X_6 No. of rainy days	-0.123	-0.310	0.518	0.404	0.348	0.076	1.000

*Significant at P=0.05

Table.2a Correlation coefficient (r) for maydis leaf blight severity with weather variables

Weather parameters	Correlation Coefficient (r)
Maximum temperature (^{0}C)	0.40
Minimum temperature (^{0}C)	0.03
Relative humidity (morning) (%)	-0.03
Relative humidity (evening) (%)	-0.45
Rainfall (mm)	0.92*
No. of rainy days	-0.12

*Significant at P=0.05

Table.3 Multiple linear regression between per cent disease index of maydis leaf blight of maize in relation to weather parameters

Parameter	X_1 Maximum temperature (^{0}C)	X_2 Minimum temperature (^{0}C)	X_3 Relative humidity (morning) (%)	X_4 Relative humidity (evening) (%)	X_5 Rainfall (mm)	X_6 No. of rainy days
β - Value (RC)	5.199	-6.289	-0.861	0.886	0.222	-0.309
SE of β (r)	5.218	9.861	4.224	1.399	1.032	1.262
Intercept	9.825					
R^2 value	0.96					
Multiple linear regression equation	$Y=a+\beta1X_1 +\beta2X_2 +\beta3X_3 +\beta4X_4 + \beta5X_5+ \beta6X_6$					
	$Y= 9.825 +5.199 X_1 - 6.289 X_2 -0.861 X_3 + 0.886 X_4 + 0.222 X_5 -0.309 X_6$					

Susceptibility of maize plants increased with age so that older leaves were more susceptible than younger leaves. Maximum temperature (r = 0.40), minimum temperature (r = 0.03) were not significantly positively correlated with PDI. Morning relative humidity (r = -0.03), evening relative humidity (r = -0.45) and number of rainy days (r = -0.12) were not significantly negatively correlated with PDI (Table 2 and 2a). Similarly Wallin and Loonan (1977) reported longer dew period up to 48 hour at higher temperatures of 28^0C resulted in greatest spore production.

While, the rainfall showed a highly significant positive correlation with PDI. These results were in accordance with Sharma and Mishra (1988). Similarly, Harlapur *et al.,* (2000) reported that high rainfall coupled with low temperature during September increased the incidence of TLB and caused significant yield loss. Pandurangegowda *et al.,* (1994) also observed that the incidence of TLB of maize increased from June to October. Meteorological factors like temperature (22-38°C), relative humidity (72-98%) and rainfall (134-165 mm) have shown highly significant correlation with disease intensity. The multiple regression equation developed for 2013 was Y = 9.825 +5.199 X1 - 6.289 X2 -0.861 X3 + 0.886 X4 + 0.222 X5 -0.309 X6 with R^2 =0.96 *i.e.*, the weather parameters put together influence PDI to the extent of 80.65 per cent (Table 3). Pandurangegowda *et al.,* (1989) studied the incidence of *E. turcicum* on the susceptible cv. CM-202 sown at fortnightly intervals and reported that meteorological factors like temperature 22 to 38°C, relative humidity 72 to 98 per cent and rainfall 134 to 165 mm were correlated with increased disease intensity. In Georgia, Russia, the most favourable conditions for development of maize leaf blight were 22 to 25°C temperature and 75 to 90 per cent relative humidity (Khatri, 1993).

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