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Spore Trap based Prediction Model for Leaf Blight of Maize Caused by *Exerohilum turcicum* (Pass.) Leonard and Suggs

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Abstract

A field experiment was conducted at Maize Research Station, Vagarai, Tamil Nadu, India to study the disease development in relation to weather parameters, like temperature, relative humidity, rainfall with the development of the *turcicum* leaf blight of maize. Observations on the spore load and PDI were taken from 33rd standard week to 44th standard weeks at weekly interval. This was progressing at linear rate as the age of the plant was increasing (15% to 50%). Maximum temperature, minimum temperature was not significantly positively correlated with PDI. Relative humidity and number of rainy days were not significantly negatively correlated with PDI. While, the rainfall showed a highly significant positive correlation with PDI. Spore load of 8.25/microscopic field, Temperature -ve correlation with the increase of the disease (23.44°C to 30.66°C), wind speed -ve correlation with the increase of the disease (21.11 kmph), relative humidity +ve correlation with the increase of the disease (56.22%), dew +ve correlation with the increase of the disease (19.33°C) and scattered showers will play vital role for the incitement of *turcicum* leaf blight. To validate the prediction model, Chi square value was calculated and the value (30.42) is lesser than the critical value (41), the hypothesis is accepted. The proposed prediction may be considered for forewarning of *turcicum* leaf blight incidences.

Keywords: Temperature; Relative humidity; Rainfall; Number of rainy days; PDI; *Turcicum* leaf blight

Introduction

Maize is an important food and feed crop. Its plant area and total output are the largest in the world except for rice and wheat. In India it is grown over an area of 9.56 mha with production of 28.7 m tons with an average productivity of 3006 kg per ha [1]. In recent years, maize crop is affected by much number of diseases with increasing degree of harm due to changes in the cultivation system, variation of pathogens and improper plant protection measures. There are eight types of leaf diseases including curvularia leaf spot, dwarf mosaic, gray leaf spot, northern leaf blight, and brown spot, round spot, rust and southern leaf blight. Leaf blight caused by *E.turcicum* is commonly or generally found on maize in the sub-tropics and tropical low lands during summer [2]. *Turcicum* leaf blight is also called as Northern leaf blight of maize caused by *Exserohilum turcicum* (Pass) Leonard and Suggs (Syn: *Helminthosporium turcicum* Pass.) is of global importance [3]. In India, the disease is prevalent in almost all the maize growing areas. Severe losses in grain yield due to epiphytotics have been noticed in various parts of India and these loses vary from 25 to 90 percent depending upon the severity of the disease [4]. The pathogen is easily wind disseminated and apparently most consistent in their occurrence and severity across the diverse maize growing environments. Keeping this in view, epidemiological study was undertaken to find out how the different weather parameters are influencing the disease and spore load for the incitement of disease by installing “T” shape spore trap inside the field.

Correlation of disease with weather parameters

Experiment was conducted during Kharif 2021 at Maize Research Station, Vagarai to study correlation of the disease with, weather parameters. Observations on leaf blight severity was taken at weekly interval starting from the onset of disease till harvesting of the crop following 0-9 scale of further Percent Disease Index (PDI) was calculated using the formula and it was calculated with weather parameters [5,6].

Testing of Chi square goodness of fit

Hypothesis to be tested: To test the maximum occurrence of the TLB in the predicted weather model, Null Hypothesis: Ho=Equal frequencies for the occurrence of the initial symptom of grade 1 of TLB, Research Hypothesis H1=H0 is false.

Chi-square test for validation of the model

In order to test whether the developed model is suitable for the disease progress or not, the chi-square goodness of fit was studied. To validate the proposed model, maize hybrid CoHM 6 was sowing on 13-08-2021 with 500 m^2 area with three replications and designed "T" shape spore trap was fixed. The periodical occurrence of the spores and incipient of the spot was recorded and correlated with weekly mean of daily weather parameters. The interaction between the observed values and expected values were used to study the goodness of fit and it was calculated by the following formula [7].

$$X^2 = \frac{(O-E)}{E}$$

Where, O-Observed value, E-Expected value the degrees of freedom associated with this x^2 was k^{-1}, where k is the number of groups.

Results and Discussion

The effect of weather parameters on the severity of leaf blight development was assessed using the CoHM 6 during Kharif 2021 at Maize Research Station, Vagarai. The intensity of disease was recorded at weekly interval as described in "Materials and Methods" and the data were analyzed by simple correlation and regression analysis and presented in Table 1. The data reveals that, the first appearance of leaf blight disease was observed between 35th and 45th days after sowing with PDI of 15% (34^{th} meteorological standard week). The PDI was increased from 15% to 50% as the age of the crop increases. There was a sudden increase in PDI from 26% to 50% because of increased scattered showers and increased relative Humidity (44^{th} meteorological standard week). Temperature has not much influenced the disease development, since it was almost uniform throughout the cropping season (Table 2 and 3).

Date	*Turcicum* leaf blight spores	Percent Disease Index (PDI)	Temp. max °C	Temp. min °C	Relative humidity %	Dew°	Rainfall mm	Wind Speed Km/h
13-08-2021	2	0	32	25	42	17	0	45
08-09-2021	5	0	34	25	48	18	0	43
20-09-2021	8	15	34	25	41	18	10	24
23-09-2021	10	15	34	25	41	18	0	24
05-10-2021	15	25	31	24	56	21	0	19
25-10-2021	25	26	30	23	65	21	3	9
29-10-2021	25	50	25	22	81	21	2.6	6

Table 1: Spore load of *turcicum* leaf blight and weather parameters

Parameters	Correlation coefficient (r)	Regression (Y)
Relative Humidity	0.9564	0.6X-16.11
Temperature (Max.)	-0.9904	-2.57X+96.54
Temperature (Min.)	-0.9354	-8.11X+211.73
Dew	0.7146	6.16X-102.05
Wind Speed	-0.8679	-0.79X+35.05

Table 2: Correlation coefficient (r) and Regression (Y) for leaf blight severity with weather variables.

Date of observation	No of spot occurred based on	Expected value	O-E	(O-E)^2	(O-E)^2/E
	the thumb rule (50 leaves) Observed value (O)				
13-08-2021	0	0	0	0	0
08-09-2021	0	0	0	0	0
20-09-2021	5	10	-5	25	2.5
23-09-2021	6	8.33333	-2.33333	5.444444	0.653333
05-09-2021	8	6.25	1.75	3.0625	0.49
25-10-2021	10	5	5	25	5
29-10-2021	13	3.84615	9.15385	83.7929	21.78615
	0	0	0	0	0
	42				30.42949
	Degrees of freedom=n-1				
		42-1=41			
		The Chi square value (30.42) is lesser than the critical value (41), the hypothesis is accepted		30.42	

Table 3: Chi square calculation of the occurrence of the *turcicum* leaf blight.

The calculated Chi square value=30.42, Degrees of freedom=n-1 *i.e.* 42-1=41, critical table value at 5% Level, table value 66.21.

The calculated Chi square value is lesser than the table value; it concludes the prediction model good ness of fit at 5% level was accepted for the cause of the disease. The results of the experiments were highlighted given in the Table 4.

Particulars	*Turcicum* leaf blight
Spore load trapped	8.25/microscopic field
DOS	13.08.2021
Max disease incidence	37.50%
First occurrence of the disease	35 DAS
Correlation analysis	Temperature -ve correlation with the increase of the disease (23.44°C to 30.66°C), wind Speed -ve correlation with the increase of the disease (21.11 kmph), relative humidity +ve correlation with the increase of the disease (56.22%), dew +ve correlation with the increase of the disease (19.33°C)
Prediction model for the occurrence of *turcicum* leaf blight	a. Occurrence of the spore–4.0 to 8.0/microscopic field b. Relative humidity–42% to 81%, c. Minimum temperature–25 °C to 34°C d. Dew fall–17 to 21 e. Rain fall-scattered showers

Table 4: Prediction model for *turcicum* leaf blight incitement

Based on the spore load and weather parameters observed, *turcicum* spore load of 8.25/microscopic field, temperature -ve correlation with the increase of the disease (23.44˚C to 30.66˚C), wind speed -ve correlation with the increase of the disease (21.11 kmph), relative humidity +ve correlation with the increase of the disease (56.22%), dew +ve correlation with the increase of the disease (19.33˚C) and scattered showers will play vital role for the incitement of *turcicum* leaf blight (Table 1). To validate the prediction model, Chi square value was calculated and the value (30.42) is lesser than the critical value (41), the hypothesis is accepted. The proposed prediction may be considered for forewarning of *turcicum* leaf blight incidence. These results are in accordance with from Tanzania reported that, severity of *turcicum* leaf blight of maize was significantly positively correlated with the relative humidity, whereas negative correlation was observed with the minimum temperature [8]. Similarly reported longer dew period up to 48 hours at higher temperatures of 28°C resulted in greatest spore production [9]. Reported that high rainfall coupled with low temperature during September increased the incidence of TLB and caused significant yield loss [10]. Study indicated that, significantly positive correlation was observed with morning and evening relative humidity, rainfall and number of rainy days without any association with maximum and minimum temperature at 0.01 levels [11]. Also observed that the incidence of TLB of maize increased from June to October [12]. Studied the incidence of *E.turcicum* on the susceptible cv. CM-201 sown at fortnightly intervals and reported that meteorological factors like temperature 22°C to 38°C, relative humidity 72 to 98 percent and rainfall 134 to 165 mm were correlated with increased disease intensity [13].

Conclusion

The intensity of disease was recorded at weekly interval as described in “Materials and Methods” and the data were analyzed by simple correlation and regression analysis. The proposed prediction may be considered for forewarning of *turcicum* leaf blight incidences.

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