Epidemiological Study of Chilli Anthracnose

Bharathi B, Hijam Meronbala Devi, Sathiyaseelan K

ABSTRACT

The present research investigation, Epidemiological Study of Chilli Anthracnose, the experiment was conducted in Randomized Block Design (RBD) to know the influence of weather parameters on disease development in the field located at Namakkal district of Tamil Nadu. For the prediction of disease occurrence, the percent disease index (PDI) was correlated with six meteorological parameters statistically. The Correlation matrix showed that the disease severity was positively and significantly correlated with Wind Speed (0.814). Factors like RH $_{max}$ (-0.871) and RH $_{min}$ (– 0.850) were negatively and significantly correlated. T $_{min}$ (–0.48) and DP (–0.381) were also negatively correlated, though they were not significant. T $_{max}$ (0.257) was found to be positively correlated but non-significant.

Keywords Chilli, Anthracnose, Meteorological parameters, Disease severity.

INTRODUCTION

Chilli (*Capsicum annuum* L.) is a fourth dominant significant growing crop in worldwide and one of the members in solanaceous family (Kiran *et al.* 2020). The stability of chill cultivation is endangered by biotic and abiotic factors. Chilli Anthracnose incited by *Colletotrichum capsici* is a destructive and most devasting trouble in India and one of the most important financial problems to chilli cultivation in global, particularly in tropical and subtropical regions (Alberto *et al.* 2022). Epidemiological factors play a significant role in determining the severity and dissemination of disease of Chilli fruit rot. Disease triangle is an interaction between pathogen, host and environment so here favorable environmental condition leads to development of disease. The epidemiological parameters are temperature, relative humidity, wind speed, dew point, rainfall. Warm and wet climate (rainy weather) along with temperature of 27°C, RH ranges from 75 to 80% and soil pH 5 to 6 found favorable to the disease development (Aggarwal *et al.* 2017 and Jehani *et al.* 2024). Thus, prior to proposing the management strategies of the disease a thorough cognizance regarding the epidemiology of the disease should be studied.

Bharathi B[1], Hijam Meronbala Devi[2]*

[2]PhD & Assistant Professor

[1,2]Department of Plant Pathology, School of Agricultural Sciences (SAS), Nagaland University, Medziphema Campus 797106, Nagaland, India

Sathiyaseelan K[3]

PhD Research Scholar
Division of Plant Pathology, ICAR- Indian Agricultural Research Institute, New Delhi 110012, India

Email: meronbaladevi@nagalanduniversity.ac.in
*Corresponding author

MATERIALS AND METHODS

NS 1701 Chilli was studied under field condition and the epidemiological parameters were collected from KVK in Namakkal, Tamil Nadu. The date of the disease's initial appearance was recorded through visual observation and the percent disease severity was calculated at intervals of 7 days before the crop was to be harvested. The standard evaluation scale (0–5) was applied (Jayalakshmi and Seetharaman 1998). For measuring the spread of the disease and evaluations were conducted on randomly chosen plants in each replicated block. The effect of Weather parameters on Disease severity was presented in the Table 1, 2 & 3.

Mathematical modelling of course of epidemic

Regression equation will describe the relationship if this variable (Disease intensity) is thought of as a dependent variable and weather factors as the independent variables. The independent (determining) variable X is considered to be independent of the disease severity, which is known as the dependent (response) variable Y.

Any variable relating to an epidemic, such as the disease increase can be regressed to variables such as temperature, relative humidity, wind speed and other parameters. Correlation, as opposed to regression, assesses the strength of the relationship between variables of comparable importance. There is no requirement for a concept of cause and effect. For calculation of correlation of both variables must be regularly distributed in order to calculate the correlation but only the dependent variables need to be so in order to calculate regression. As a predictive equation, simple regression analysis (SRA) was used

Table 1. Epidemiology Data has been collected as such collected from KVK Tamil Nadu.

Date of obser- vation	Stage of the chilli crop (DAS)	PDI (%)	T_{max} (˚C)	T_{min} (˚C)	RH_{max} (%)	RH_{min} (%)	Ws (m/s)	Dp (˚C Td)
06-12-2021	79	11	31.00	21.40	91.30	67.30	3.00	22.10
13-12-2021	86	15	31.40	20.20	91.30	65.10	3.00	22.06
20-12-2021	93	17	30.56	19.00	88.38	58.38	2.75	19.93
27-12-2021	100	25	30.50	16.29	88.29	52.29	4.57	17.88
03-01-2022	107	32	30.60	18.60	87.40	58.00	3.00	20.54
10-01-2022	114	38	31.50	18.64	88.71	52.29	4.86	20.14
17-01-2022	121	41	33.07	20.36	85.71	49.00	5.14	21.34
24-01-2022	128	42	30.29	16.86	85.86	54.43	6.00	19.36

Note: DAS = Days After Sowing. PDI = Plant Disease Index.
T_{max} = Maximum temperature (˚C) T_{min} = Minimum temperature (˚C)
RH_{max} = Maximum Relative Humidity (%) RH_{min} = Minimum Relative Humidity
(%) WS = Wind speed (Km/hr) Dp = Dew point (˚C) (Td)

Table 2. Correlation matrix of PDI and weather parameters.

Variables	PDI	V_1	V_2	V_3	V_4	V_5	V_6
PDI	1	0.257	–0.48	–0.871**	–0.850**	0.814*	–0.381
T_{max} (V_1)		1	0.56	–0.155	–0.318	0.208	0.505
T_{min} (V_2)			1	0.496	0.554	–0.511	0.946**
RH_{max} (V_3)				1	0.831	–0.684	0.467
RH_{min} (V_4)					1	–0.75	0.602
Ws (V_5)						1	–0.448
Dp (V_6)							1

Note: **Correlation is significant at the 0.01 level.
*Correlation is significant at the 0.05 level.

Table 3. Simple Regression Equation (SRE) between disease severity and weather parameters.

Weather parameter	Regression equation	R^2	Standard error (SE)
T_{max} (V_I)	Y = 30.229 + 0.0283x	0.0655	3.73
T_{min} (V_2)	Y = 22.132 – 0.103x	0.2309	1.88
RH_{max} (V_3)	Y = 95.405 – 0.226x	0.7569	0.93
RH_{min} (V_4)	Y = 77.977 – 0.6703x	0.7216	0.71
WS (V_5)	Y= 0.1594 + 0.1246x	0.6623	1.08
DP (V_6)	Y= 22.495 – 0.0667x	0.1451	2.59

Note: Y = Disease severity
x = Weather parameter

to analyze the multiple impacts on the dependent variables :

$Y = b_0 + b_1 x_1$ (Where, Y= Predicted disease severity).

b_0 = Intercept.

b_1 = Regression co-efficient.

x_1 = Independent variable.

Disease intensity

The percent disease intensity was recorded based on the method described by (Singh *et al.* 1993) on fruits from randomly selected eight tagged plants in each plot at seven days interval. The disease intensity estimated by using following formula,

Percent disease index (PDI) =

$$\frac{\text{(Sum of all individual disease rating)}}{\text{(Total no of plants assessed} \times \text{Max rating)}} \times 100$$

RESULTS AND DISCUSSION

For the Epidemiological study of Chilli Anthracnose, NS 1701 Chilli was studied under field condition (Plate 1). The Colletotrichum pathogen affected stem, leaves and fruits in the name of die back and fruit rot is shown in Plate 2 and the pure culture of the identified pathogen based on morphological characters under the microscopic observation is given in Plate 3. The meteorological data collected from KVK, Namakkal,

Tamil Nadu (Table 1) and the PDI was observed at seven days interval after the onset of disease. The effect of Weather parameters on Disease severity in the form of correlation matrix was determined statistically and presented in the Table 2.

As the onset of Anthracnose disease was recorded in 6th December 2021 i.e., 79 DAS. Having recorded the disease severity as a function of cumulative effects of all factors that may affect their pattern over crop effects of individual factors on disease severity over crop was assessed for six meteorological factors.

V_1 = Maximum temperature (T_{max})

V_2 = Minimum temperature (T_{min})

V_3 = Maximum Relative Humidity (RH_{max})

V_4 = Minimum Relative Humidity (RH_{min})

V_5 = Wind speed (Ws)

V_6 = Dew point (DP)

Impact of temperature on disease severity of chilli anthracnose

The relationship between temperature (max, min) and PDI was analyzed and correlation matrix demonstrated that the disease severity (PDI) was positively correlated with T_{max} (0.257) though their impact was not significant. The PDI was negatively correlated with T_{min} (– 0.48) but not significant (Table 2). Later, an equation for simple regression was created between disease severity and Temperature (max, min) and expressed by equation Y = 30.229 + 0.0283x (R^2= 0.0655) and Y = 22.132 – 0.103x (R^2 = 0.2309) respectively (Table 3 and Fig. 1). According to the coefficient of determination (R^2) and standard error (SE) value it was found that the disease severity was fluctuate from 6.5% to 23% based on changes in T_{max} and T_{min} respectively and to have high SE value of 3.73 and 1.88 respectively.

Table 1 revealed that maximum temperature ranges between 30–33°C is positively correlated but non-significant may be due to Straight up direct

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Plate 1(a): Field Preparation

Plate 1 (b): Fruiting stage

Plate 1 (c): Die – back symptom of Chilli plant

Plate 1. Experimental Field.

Plate 2 (a): Initial stage Symptom.

Plate 2 (b): Lesion on Chiili Fruit.

Plate 2 (c): Coalesced lesion in later stage.

Plate 2. Symptoms of anthracnose of chilli.

sunlight exposure on Chilli fruit may have impact on disease development by shortening the time that free moisture remains on fruit surfaces, thereby creating an environment is less conducive to the development of disease and their severity (Setiawati *et al.* 2016).The minimum temperature results were agreement with Murmu *et al.* (2021) who reported that the effect of minimum temperature negatively and non-signifi-

cantly correlated on disease severity.

Impact of relative humidity on disease severity of chilli anthracnose

The correlation studies between disease severity and Relative humidity showed that both RH $_{max}$ (–0.871) and RH $_{min}$ (–0.850) was found negatively and sig-
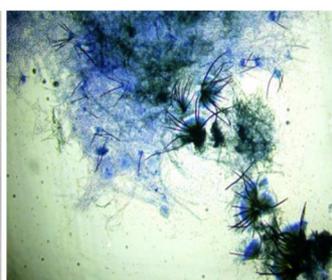

Plate 3(a): Pure culture of *Colletotrichum capsici*

Plate 3(b): Conidiophore (10X).

Plate 3(c): Conidia and Setae (40X).

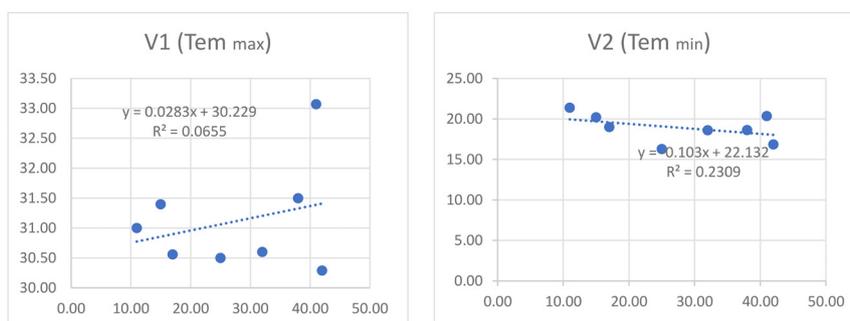**Plate 3.** Morphological characteristics of colletotrichum pathogen.

Fig. 1. Impact of temperature (Max & Min) on disease severity of chilli anthracnose.
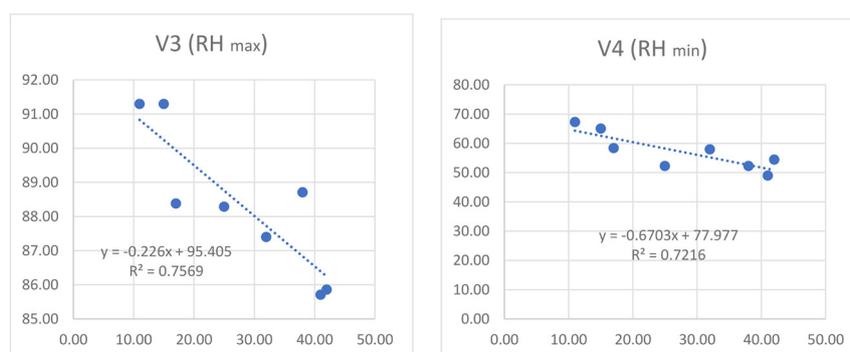

Fig. 2. Impact of relative humidity (Max & Min) on disease severity of chilli anthracnose.

nificantly correlated with disease severity (as given in Table 2). The effect of RH (max, min) expressed by simple regression equation as Y = 95.405 – 0.226x (R^2 = 0.7569) and Y = 77.977 - 0.6703x (R^2 = 0.7216) respectively (Table 3 and Fig. 2). According to the higher value of coefficient of determination (R^2) values which represented that 75.6% of RH $_{max}$ and 72.1% of RH $_{min}$ changes were contributed on disease severity and due to having low SE values, both the equations

were discovered to be the best suited equation for disease prediction.

Impact of wind speed on disease severity of chilli anthracnose

The outcomes of correlation analysis revealed that the relationship between WS and PDI was found to be positively and significantly correlated (0.814) as
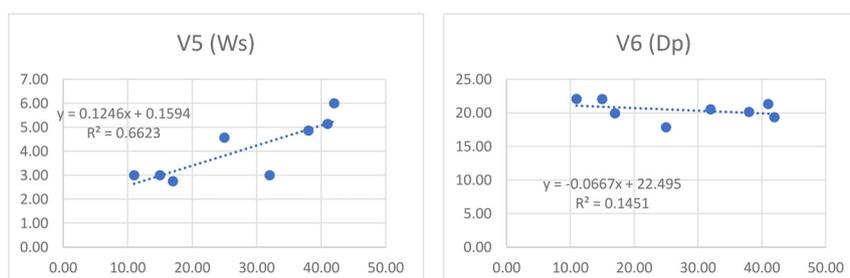

Fig. 3. Impact of wind speed and dew point on disease severity of chilli anthracnose.

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given in Table 2. It's expressed by simple regression equation Y= 0.1594 + 0.1246x (R^2= 0.6623). R^2 values represent 66.2% on disease severity changes was contributed by WS. High R^2 and low SE values revealed that this equation was also found to be the best suited equation for prediction of disease (Table 3).

Impact of dew point on disease severity of chilli anthracnose

The correlation matrix revealed that the disease severity (PDI) was negatively correlated with DP (–0.381) but the relationship was not significant (Table 2). The effect of DP on disease severity was analyzed and expressed by simple regression equation Y= 22.495 – 0.0667× (R^2= 0.1451). R^2 values represent the contribution of DP 14.5% on disease severity. Due to low R^2 and high SE values the equation is not fitted for disease prediction equation (Table 3 and Fig. 3).

All these findings are similar with Begum *et al.* (2017) who reported that disease severity was positively and significantly correlated with RH $_{max}$ (0.681) and RH $_{min}$ (0.669) while other factors like T $_{max}$ (–0.799), T $_{min}$ (–0.781), wind velocity (–0.872) and vapor pressure (–0.717) were negatively and highly correlated with disease severity.

The present results are also found to be similar with the discovering of Rashid *et al.* (2015) who described that relative humidity was found to be favorable for successful establishment of the disease in each area as maximum mycelial growth and highest conidial germination were occurred at 90–95% relative humidity.

This finding also agrees with the observations of Singh *et al.* (2023) in Uttar Pradesh, where during peak anthracnose incidence weeks, average wind speeds of 4.4–4.6 km/hr were recorded, coinciding with PDI values ranging from 55% to 59%. Although their study did not compute correlation coefficients, the co-occurrence of elevated wind speed and increased disease severity clearly supports a positive trend, reinforcing the role of wind in facilitating rapid dispersal of conidia and enhancing the spread of the disease.

CONCLUSION

Based on the above findings, the research experiment can be concluded that All the Data were analyzed Simple Regression Analysis (SRA) and Correlation matrix were work out. The Correlation matrix showed that the disease severity (PDI) was positively and significantly correlated with Wind Speed (0.814). Factors like RH $_{max}$ (–0.871) and RH $_{min}$ (–0.850) were negatively and significantly correlated. Some other factors were also negatively Correlated like T $_{min}$ (–0.48) and DP (–0.381) though they were not significant. T $_{max}$ (0.257) were found to be positively correlated but were found to be not significant.

Though the epidemic nature of the disease has been studied but still need to do more research to predict and prevent the disease occurrence. The weather parameters play a crucial role in Chilli Anthracnose disease. If we can able to predict the disease earlier then we can take precautionary actions and reduce half of the cost of cultivation.

ACKNOWLEDGMENT

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