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Saurabh DubeyDepartment of Plant Pathology,
DRPCA Pusa, Samastipur,
Bihar, India**Md. Minnatullah**Department of Plant Pathology,
DRPCA Pusa, Samastipur,
Bihar, India**Shivam Maurya**Department of Plant Pathology,
DRPCA Pusa, Samastipur,
Bihar, India**CS Chaudhary**Department of Plant Pathology,
DRPCA Pusa, Samastipur,
Bihar, India**SP Singh**Department of Agricultural
Economics, RPCAU, Pusa,
Samastipur, Bihar, India**Bipin Kumar**Technical Cell,
SRI, RPCAU, Pusa,
Samastipur, Bihar, India**Corresponding Author:****Saurabh Dubey**Department of Plant Pathology,
DRPCA Pusa, Samastipur,
Bihar, India

Effect of weather parameters on incidence of red rot disease in sugarcane

Saurabh Dubey, Md. Minnatullah, Shivam Maurya, CS Chaudhary, SP Singh and Bipin Kumar

Abstract

Agro-climatic conditions influence the crop growth and nutrient use efficiency. A mean temperature of 28 to 32 °C and relative humidity of 70-85 percent is best suited for the growth of sugarcane. Several factors which are responsible for the incidence of the disease in which different weather parameters also play a crucial role in determining the cause and severity of the disease. Thus, the present study was undertaken to find out the effect of weather on incidence of red rot disease caused by *Colletotrichum falcatum* Went in sugarcane at SRI, Pusa farm during cropping season of 2018. The maximum temperature ranged from 22.5 °C to 36.9 °C and minimum temperature ranged from 7.3 °C to 26.6 °C during the crop season. The maximum (25.5 %) disease incidence occurred during second fortnight of August. Weather parameters corresponding to this period were maximum and minimum temperature (33.1 and 26.4 °C), relative humidity at 07 and 14 hours (88.0 and 74.0 %), rainfall (115.8 mm) and sunshine (2.4 hours). Minimum temperature, relative humidity at 14 hours and rainfall showed positive correlation ($r = 0.512, 0.45$ and 0.73) respectively whereas, sunshine showed negative correlation ($r = -0.42$) with disease incidence. Multiple linear regression also revealed that all weather parameters together governed 68.8% towards disease incidence ($R^2 = 0.688$). Thus, the minimum temperature, relative humidity and rainfall showed statically significant positive weather correlation with disease incidence and these weather parameters appeared to be most significant contributing condition for red rot disease development.

Keywords: Weather, incidence, red rot, sugarcane

Introduction

Sugarcane (*Saccharum officinarum*) is one of the major tropical C4 plant crops which is cultivated in the tropical and subtropical regions globally and contributes to 70 per cent of the world's sugar. Agro-climatic conditions influence the crop growth and nutrient use efficiency. A mean temperature of 28 to 32 °C is best suited for the growth of sugarcane. Temperature above 50 °C arrests its growth, whereas temperature below 20 °C may slow down the growth. Relative humidity of 70 to 85 per cent during growth and 55 to 75 per cent during ripening phase is ideal. Relative humidity less than 50 per cent during growing season is not suitable for sugarcane cultivation (Anon, 2011) [2]. India occupies an important place among the sugarcane producing country and has a neck to neck race with Brazil. Sugarcane is cultivated in an area of 4.44 mha in India with the annual production of 306.07 lakh tonnes and cane productivity of around 69.0 t/ha with an average sugar recovery of approximately 10%. In Bihar, it has occupied an area of 0.24 mha with a production of 13.04 t/ha with an average productivity of 54.42 t/ha (ISMA, 2019) [5]. About 10 to 15 per cent of the nation's sugar yield is lost due to diseases of sugarcane (Viswanathan and Rao, 2011) [8]. Red rot disease of sugarcane caused by *Colletotrichum falcatum* Went is widely distributed and has been reported in 68 sugarcane growing countries of the world (Bharti *et al.*, 2012) [3]. Many factors which are responsible for the development of red rot disease in which weather factors also play a crucial role in determining the etiology of the disease. Thus, the present investigation was carried out to study the effect of weather parameters on incidence of red rot disease in sugarcane.

Material and Method

A field experiment was conducted to find out the effect of weather parameters on incidence of red rot disease in sugarcane during the crop season 2018 at Sugarcane research Institute, Pusa farm. Maximum and minimum temperature (°C), relative humidity (%) morning and evening hrs, rainfall (mm) and sunshine (hrs.) corresponding to crop duration on incidence of red rot disease and correlation with environmental factors and data were analyzed by multiple regression to find out the contributing weather parameters on incidence of red rot disease of sugarcane the meteorological data related to the weather conditions prevailing during crop

season regarding temperature ($^{\circ}\text{C}$), relative humidity (%), rainfall (mm) and sunshine (hrs.) were obtained from Agro-meteorological advisory services, Dr. Rajendra Prasad Central Agricultural University, Pusa. The data so obtained was finally merged together to obtain the fortnightly average of weather parameters for the period under investigation. To overcome on the disease, the control measures were followed at peak period of incidence i.e. the second fortnight of August, the affected plants were removed and sprayed with Bavistin @ 0.1% at fortnightly intervals and observations were recorded periodically.

The observation on disease incidence was recorded in randomly selected 100 plants per plot and calculated as number of affected plants out of the total number of plant assessed.

Results and Discussion

The present study was undertaken to establish the relationship among disease incidence and weather parameters. The observations were recorded from the month of June to Dec, 2018 at fortnightly intervals and correlated with the weather factors viz., temperature ($^{\circ}\text{C}$) maximum and minimum, relative humidity (%) at 07 hrs. and 14 hrs. rainfall (mm) and sunshine (hrs.) to find out the effect of weather parameters on red rot disease incidence. It is revealed from data (Table 1) that disease incidence varied from 0.8 to 25.5 per cent during course of investigation. The maximum (25.5) percent of disease incidence was observed during second fortnight of August followed by 18.5 and 12.5 per cent during first fortnight of August and September, respectively. The maximum temperature ranged from 22.5 $^{\circ}\text{C}$ to 36.90 $^{\circ}\text{C}$, minimum temperature ranged from 7.3 $^{\circ}\text{C}$ to 26.6 $^{\circ}\text{C}$, RH at morning hours ranged from 80-90 percent, RH at evening hrs. ranged from 50 to 76 percent, rainfall ranged from 6.3 mm to 115.8 mm and sunshine ranged from 2.4 to 8.4 hrs. during the

observation period. The maximum percentage of disease incidence was recorded during the second fortnight of August, 2018 when corresponding weather parameters viz., maximum and minimum temperature ($^{\circ}\text{C}$), relative humidity (%) at 07 hrs. and 14 hrs. rainfall (mm) and sunshine (hrs.) were 33.1 $^{\circ}\text{C}$, 26.4 $^{\circ}\text{C}$, 88.0%, 74.0%, 115.8 (mm) and 2.4 hrs. respectively. The incidence of disease was more prevalent during rainy season (July to first fortnight of September month). By following proper control measures (removal of affected plants and spraying with Bavistin @ 0.1% %) at fortnightly intervals the data shown in the (Table 1) indicates that there was drastically reduction in disease incidence from 12.5 to 1.8 percent during observations were recorded periodically in the respective months i.e. September second fortnight to second fortnight of December month respectively.

Correlation coefficient

The correlation analysis between weather factors and disease incidence are summarized in (Table 1.a and 1.b) and indicates that minimum temperature and relative humidity at 14 hrs. showed significant positive correlation with disease incidence ($r = 0.51$ and 0.45), while, rainfall showed highly positive correlation ($r = 0.73$) whereas, sunshine showed significant but statistically were negative correlation ($r = -0.42$). The multiple linear regression was worked out by taking disease incidence as dependent variable and climatic factors as independent variables (Table 1.b). The data revealed that all the weather parameters together governed 68.80 per cent towards disease incidence ($R^2 = 0.688$). It is clearly indicated that minimum temperature, relative humidity and rainfall were the congenial weather factors for the development of red rot disease. Many authors have also worked out pertaining to disease weather relationship (Bose *et al.*, 2010, Ashlesha Atri and Harpeet Singh 2019, Paswan *et al.*, 2018; Prateeksha and Sahu, 2015) [4, 1, 6, 7].

Table 1: Impact of Weather parameters on Disease Incidence

Months/2018	Disease Incidence (%)	Temperature ($^{\circ}\text{C}$)		Humidity (%)		Rainfall (mm)	Sunshine (hrs.)	
		Maximum	Minimum	Morning	Evening			
January	I	0.0	13.3	6.6	93	81	0.0	0.3
	II	0.0	17.6	8.4	94	74	0.0	1.2
February	I	0.0	23.3	10.0	91	64	0.0	4.1
	II	0.0	26.2	12.3	91	67	0.0	7.2
March	I	0.0	39.8	15.3	84	68	0.0	8.4
	II	0.0	32.8	15.6	79	53	0.0	8.3
April	I	0.0	32.7	19.6	78	59	15.4	8.2
	II	0.0	35.4	21.3	79	57	0.0	9.0
May	I	0.0	33.6	22.7	81	62	31.2	8.3
	II	0.0	33.9	24.8	84	65	89.2	8.1
June	I	0.8	35.6	26.0	80	61	12.4	7.0
	II	1.8	36.9	26.6	81	57	7.0	8.0
July	I	8.2	33.9	25.9	88	70	31.0	5.8
	II	8.4	34.0	26.4	85	71	31.3	6.5
August	I	18.5	31.9	25.8	90	76	76.1	3.1
	II	25.5	33.1	26.4	88	74	115.8	2.4
September	I	12.5	33.0	25.8	89	76	28.67	5.8
	II	7.2	33.7	24.9	85	68	32.0	4.3
October	I	5.8	32.2	22.1	84	61	6.3	6.5
	II	4.8	31.8	17.0	86	50	0.0	5.8
November	I	3.2	30.8	14.7	83	61	0.0	8.4
	II	3.0	28.2	12.4	80	57	0.0	6.9
December	I	2.8	26.3	10.4	82	53	0.0	7.5
	II	1.8	22.5	7.3	84	56	0.0	6.5

Table 1.a: Correlation matrix of weather parameters on red rot disease in sugarcane

Incidence (%)	No. of observation	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)	Sunshine (hrs.) (X6)
		Maximum (X1)	Minimum (X2)	7 hrs (X3)	14 hrs (X4)	(X5)	
Infection (Y)	24	0.22	0.51*	0.30	0.45*	0.73**	-0.42*

*Significant at 5% probability level.

** Significant at 1% probability level

Table 1.b: Multiple linear regression models for weather parameters and red rot incidence in sugarcane

Incidence (%)	No. of observation	Pure constant	Temperature (°C)		Relative humidity (%)		Rainfall (mm) (X5)	Sunshine (hrs.) (X6)	R2
			Maximum (X1)	Minimum (X2)	Morning (7 hrs)	Evening (14 hrs)			
Infection (Y)	24	- 10.56	0.545	0.007	0.178	- 0.127	0.095	- 1.744	0.688

Multiple linear regression equation

$$Y = -10.56 + 0.545 X1 + 0.007 X2 + 0.178 X3 - 0.127 X4 + 0.095 X5 - 1.744 X6$$

Conclusion

Thus it can be concluded that the different weather parameters i.e. minimum temperature, relative humidity and rainfall play a crucial role in the development and incidence of red rot disease in sugarcane. The present findings would be helpful during planning of suitable management strategies.

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