

Role of Weather Parameters on Development of Target Spot of Cotton caused by *Corynespora cassiicola*

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ABSTRACT: The corynespora target spot caused by *Corynespora cassiicola* is a severe constraint in cotton production and the disease intensity has been increasing day by day for the last few years in India due to changes in the environment. The field experiment was carried out to understand the development of target spot on cotton with respect to weather conditions during Kharif 2023 at Cotton Research Station, JAU, Junagadh and Oilseeds Research Scheme JAU, Manavadar. Correlation with weather factor indicated that significantly positive correlated with minimum temperature (0.61*) and significant negative correlated with evaporation ($r=-0.58^*$). Results showed that multiple regression equation was fitted to the data and the equation arrived for the weather parameters indicated that increase in one unit of minimum temperature, evening relative humidity and sunshine hour, the per cent disease intensity increased by 2.09, 0.80 and 4.00 units, respectively. While when there was increased in one unit of maximum temperature, evening relative humidity, rainfall, evaporation and rainy days, the per cent disease intensity decreased by 0.17, 1.43, 0.03, 7.51 and 7.51 units respectively. The R^2 values indicated the combination of eight weather factors accounted for variation in disease development. R^2 value close to 1 proved the goodness and feasibility of model at Junagadh and when there was increased one unit maximum temperature, morning relative humidity, evening relative humidity, rainfall, sunshine hour and evaporation, the per cent disease intensity increased by 1.70, 0.14, 1.22, 0.007, 4.08 and 6.56, respectively. While when increased in one unit of minimum temperature and rainy days, the per cent disease intensity decreased by 1.20 and 1.31 units respectively at Manavadar. Using these variables, the regression models were developed to foretell the relationship between disease severity and weather variables. Stepwise regression equation obtained $Y = -41.22 + 3.56 T_{\min}$ $R^2=0.4670$ and $Y = -107.52 + 1.07 RH_{II} + 4.95 SSH + 7.56 Evap.$ $R^2=0.8590$ at Junagadh and Manavadar, respectively.

Highlights: Minimum temperature, evening relative humidity, sunshine and evaporation were positive correlated with corynespora target spot in cotton.

Keywords: *Corynespora cassiicola*, cotton, weather parameters, correlation and regression.

INTRODUCTION

Cotton known as “White Gold” in world and it is one of the most commercially important natural textile fiber crops with significant contributor of oilseeds. It is one of the most ancient and important cash crops next only to food grains and is the principle raw material for a flourishing textile industry. Cotton, although under pressure from synthetic fibers has made resurgence worldwide and remains as the most improved crop species producing lint plus oil and meal from seed (Nosberger *et al.*, 2001). Biotic stress on cotton caused by pests and diseases contribute to 10-30% of annual yield loss worldwide (Hagan *et al.*, 2015; Bowen *et al.*, 2018). Cotton crop is affected by fungal, bacterial and viral diseases. In India, foliar diseases (fungal, bacterial, viral and boll rot) have been estimated to cause yield losses up to 20 to 30 per cent (Mayee and Mukewar 2007). In case of foliar diseases of cotton crop is affected by throughout the season. Among the fungal diseases, alternaria leaf spot/blight, grey mildew and

rust cause economic losses under congenial conditions (Monga *et al.*, 2013).

A fungal foliar diseases, corynespora target spot caused by *Corynespora cassiicola* has been increasing its prevalence and severity in cotton growing areas of south central United States and Central India (Butler *et al.*, 2016 ; Salunkhe *et al.*, 2019). Recently, *Corynespora cassiicola* (Berk & M.A. Curtis) C. T. Wei the cause of target spot, an emerging disease on cotton in India. Earlier, *Corynespora cassiicola* was minor in cotton and first reported by (Parakhia *et al.*, 1989) in Gujarat.

Meteorological parameters are the critical components of disease development. Corynespora target spot is occurred frequently and in severely in regions with prevailing moderate temperature of 25-30°C, high relative humidity (>90%) with intermittent rainfall were essential for disease establishment. Considering the importance of the target spot in cotton an attempt was made to know the influence of weather factors on disease development.

MATERIALS AND METHODS

A field experiment was conducted during *Kharif*-2023 at Cotton Research Station, JAU, Junagadh and Oilseeds Research Scheme, JAU, Manavadar using G. Cot.-38 variety with bulk plot an area of 226 m². Fifty plants in the middle rows at random was tagged. All other agronomical practices was followed as per the scientific recommendations. The crop under the experiment was kept free from any fungicidal sprays throughout the crop season. The data on corynespora target spot was weekly examined from true leaf stage to end of December on leaves using 0-4 grade scale (Sheo Raj, 1988). The per cent disease intensity (PDI) was calculated by using the following formula (Wheeler, 1969).

$$\text{Disease Intensity (\%)} = \frac{\text{Summation of numerical ratings observed}}{\text{No. of leaves examined} \times \text{Maximum grade/rating}} \times 100$$

Score	PDI	Reaction	Description
0	0-0	Immune	No infection
1	1.0-25	R	Few < 2mm, scattered, brown spots < 5% leaf area covered.
2	26-50	MR	Spots bigger, 3 mm, not coalescing, brown and 6-20 % leaf area covered.
3	51-75	MS	Spots 3-5 mm, irregular in shape coalescing, 21-40 % leaf area covered.
4	>75	S	Spots coalescing to form bigger lesions, irregular > 40 % leaf area covered.

Meteorological data such as rainfall, rainy day, maximum temperature and minimum temperature, relative humidity at morning and evening hours, sunshine hour and evaporation was collected from the Meteorological Weather Station, JAU, Junagadh and Manavadar. Correlation and regression analysis was conducted to determine the influence of weather conditions on the severity of corynespora target spot disease in cotton. The weather parameters were correlated to weekly disease intensity by calculating the Karl Pearson's correlation coefficient (r). Correlation coefficient values were tested individually for their significance at 5 per cent and 1 per cent probability level using following formula

$$t = \frac{r \sqrt{n-2}}{\sqrt{1-r^2}} \times 100$$

where,

t = Test of significance

r = Correlation coefficient

n = Number of observations

RESULTS AND DISCUSSION

Disease development under natural conditions was found to be influenced by environmental factors. The data from crop season revealed that sowing on the 27th standard meteorological week (SMW) during *Kharif* 2023. Observations were recorded from 35th and 32nd SMW in weekly interval at Junagadh and Manavadar, respectively. The first appearance of target spot was noticed at Junagadh and Manavadar 63 and 42 days after sowing, respectively which progressed thereafter

(Table 1). The development of the disease was initially slow but it reached to the maximum (70.5%) during the 39th SMW of 2023. The previous week had maximum temperature (30.4°C), minimum temperature (25.5°C), morning relative humidity (94%), evening relative humidity (77%), sunshine (2.5 hrs), evaporation rate (2.5 mm), rainfall (55.70 mm) and four rainy days (Table 2). In case of Manavadar, disease was reached maximum (22.5%) 38th SMW and the previous week had maximum temperature (32.4°C), minimum temperature (23.5°C), morning relative humidity (91%), evening relative humidity (77%), sunshine (3 hrs), evaporation rate (3.1 mm), rainfall (100.7 mm) and five rainy days (Table 3).

Correlation studies. The data from the table revealed that the Junagadh centre, there was non-significant positive correlation of morning humidity (r=0.46), evening humidity (r=0.44), rainy day (r=0.46) and rain fall (r=0.36) and significantly positive correlation with minimum temperature (0.61*). There was significant negative correlation evaporation (r=-0.58*) and non-significant negative correlation with maximum temperature (r=-0.02) and sunshine hour (r=-0.51) and the data from the table revealed that the Manavadar centre, significantly positive correlation were found minimum temperature (r=0.54*). Non-significant positive correlation was recorded in morning humidity (r=0.44), evening humidity (r=0.34). Non-significantly negative correlation was observed in maximum temperature (r=0.03), rainfall (r=-0.15), sunshine hour (r=-0.02), evaporation (r=-0.15) and rainy days (r=-0.13) (Table 1).

Regression studies. Multiple linear regression statistics of corynespora target spot (PDI) with weather variables during *Kharif*-2023 at Junagadh location, multiple linear regression equation was fitted to the data and the equation arrived for the weather parameters were $Y = 56.66 - 0.17 T_{\max} + 2.09 T_{\min} - 1.43 RH I + 0.80 RH II - 0.03 RF - 1.36 RD + 4.00 SSH - 7.51 Evap$. $R^2 = 0.9699$. (Table 4) Equation showed that when there was increase in one unit of minimum temperature, evening relative humidity and sunshine hour, the per cent disease intensity increased by 2.09, 0.80 and 4.00 units, respectively. While when there was increased in one unit of maximum temperature, evening relative humidity, rainfall, evaporation and rainy days, the per cent disease intensity decreased by 0.17, 1.43, 0.03, 7.51 and 7.51 units respectively. The R^2 values indicated the combination of eight weather factors accounted for variation in disease development. R^2 value close to 1 proved the goodness and feasibility of model. The stepwise regression was used for identify the best subset of weather variables that play crucial role in development of disease. Using these variables, the regression models were developed to foretell the relationship between disease severity and weather variables. Stepwise regression equation obtained $Y = -41.22 + 3.56 T_{\min}$ $R^2 = 0.4670$ (Table 5).

Multiple linear regression statistics of corynespora target spot (PDI) with weather variables during *Kharif*-2023 at manavadar location, multiple linear regression equation was fitted to the data and the equation arrived for the weather parameters were $Y = -146.04 + 1.70$

$T_{\max} - 1.20 T_{\min} + 0.14 RH I + 1.22 RH II + 0.007 RF - 1.31 RD + 4.08 SSH + 6.56 \text{ Evap.}$ $R^2=0.9015$ (Table 4). Equation showed that when there was increased one unit maximum temperature, morning relatively humidity, evening relatively humidity, rainfall, sunshine hour and evaporation, the per cent disease intensity increased by 1.70, 0.14, 1.22, 0.007, 4.08 and 6.56, respectively. While when increased in one unit of minimum temperature and rainy days, the per cent disease intensity decreased by 1.20 and 1.31 units respectively. The stepwise regression was used for identify the best subset of weather variables that play

crucial role in development of disease. Using these variables, the regression models were developed to foretell the relationship between disease severity and weather variables. Stepwise regression equation obtained $Y = -107.52 + 1.07 RH II + 4.95 SSH + 7.56 \text{ Evap.}$ $R^2=0.8590$ (Table 5).

The present investigation are in more or less similar with the finding of Roshan (2020); Acosta *et al.* (2020); Yamuna *et al.* (2021); Bandi (2022) on corynespora target spot of cotton, where influence of weather parameter on disease incidence was 74 to 96.99 per cent.

Table 1: Correlation between per cent disease intensity of corynespora target spot and weather factors.

Weather parameters	Correlation coefficient (r)	
	Junagadh 2023	Manavadar 2023
X1-Maximum temperature (°C)	-0.02	-0.03
X2-Minimum temperature (°C)	0.61*	0.54*
X3-Morning relative humidity (%)	0.46	0.44
X4-Evening relative humidity (%)	0.44	0.34
X5-Rainfall (mm)	0.36	-0.15
X6-Sunshine hours (h day ⁻¹)	-0.51	-0.02
X7-Evaporation (mm)	-0.58*	-0.15
X8-Rainy day	0.46	-0.13

* Significant at (P=0.05) level (R value 0.514) at Junagadh, n=15

* Significant at (P=0.05) level (R value 0.497) at Manavadar, n=16

Table 2: Weather data of Junagadh centre with disease intensity.

SMW	Disease intensity (%)	Maxi. Temp.	Mini. Temp.	Morning RH I %	Evening RHII %	Rainfall (mm)	Rainy day	Sun-shine hours	Evaporation
35	6.0	32.3	23.4	89	69	69.2	3.0	3.4	3.9
36	25.0	30.1	23.7	94	83	179.3	6.0	1.4	2.1
37	49.5	29.3	24.5	96	88	393.4	4.0	0.9	2.0
38	64.0	30.4	25.5	94	77	55.7	4.0	2.3	2.5
39	70.5	30.6	24.2	92	80	156.6	5.0	3.5	1.7
40	54.5	33.1	25.1	86	61	16.7	1.0	8.3	3.8
41	43.0	34.1	24.3	81	68	60	4.0	6.1	3.3
42	36.0	34.5	20.2	72	35	0.0	0.0	9.5	4.4
43	27.5	33.1	20.2	78	39	0.0	0.0	9.8	4.1
44	32.0	33.9	16.2	69	32	0.0	0.0	9.5	4.3
45	33.5	33.7	17.4	63	28	0.0	0.0	5.5	3.7
46	25.5	32.8	15.9	68	35	0.0	0.0	6.9	4.8
47	25.0	32.7	20.8	73	49	0.0	0.0	4.1	4.5
48	11.5	32.1	16.2	77	49	0.0	0.0	6	4.0
49	5.0	28.6	16.8	70	45	0.0	0.0	2.8	3.8

Table 3: Weather data Manavadar centre with disease intensity.

SMW	Disease intensity (%)	Maxi. Temp.	Mini. Temp.	Morning RH I %	Evening RHII %	Rainfall (mm)	Rainy day	Sunshine hours	Evaporation
32	1.0	31.6	24.4	92	83	108.6	7.0	1.8	1.9
33	2.0	29.6	23.6	94	88	203.9	7.0	0.7	1.6
34	3.5	30.2	23.8	90	73	3.3	1.0	2.3	3.2
35	16.5	32.2	23.3	85	64	7.3	1.0	5.1	3.4
36	18.5	33.6	24.4	86	59	14	1.0	5.5	3.8
37	15.5	32.4	23.5	91	77	100.7	5.0	3.0	3.1
38	22.5	34.4	23.0	84	57	0.0	0.0	9.0	3.4
39	20.5	32.9	22.5	83	58	2.4	0.0	8.2	3.5
40	11.5	33.8	23.4	81	49	0.0	0.0	8.3	3.1
41	6.5	35.0	23.4	85	47	51.2	1.0	6.9	4.2
42	4.0	35.9	20.2	62	25	0.0	0.0	10.1	5.1
43	2.0	35.6	19.7	67	27	0.0	0.0	9.5	4.8
44	1.0	35.8	17.8	65	26	0.0	0.0	9.3	4.6
45	1.0	35.4	18.2	61	28	0.0	0.0	9.0	4.3
46	1.0	33.9	16.9	72	27	0.0	0.0	9.1	4.3
47	1.0	32.3	13.8	67	26	0.0	0.0	9.5	4.2

Table 4: Multiple linear regression of weather parameters with corynespora target spot disease intensity of cotton.

Sr. No.	Location	Constant	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	R ²
1.	Junagadh	56.66	- 0.17	2.09	- 1.43	0.80	-0.03	-1.36	4.00	-7.51	0.9699
2.	Manavadar	-146.04	1.70	-1.20	0.14	1.22	0.007	-1.31	4.08	6.56	0.9015

Table 5: Stepwise multiple regression of weather parameters with corynespora target spot disease intensity of cotton.

Sr. No.	Location	Constant	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	R ²
1.	Junagadh	-41.22	-	3.56	-	-	-	-	-	-	0.4670*
2.	Manavadar	-107.52	-	-	-	1.07	-	-	4.95	7.56	0.8590*

* Significant at (p=0.05) level

X₁ = Maximum temperature (C°); X₂ = Minimum temperature (C°); X₃ = Morning relative humidity (%); X₄ = Evening relative humidity (%); X₅ = Rainfall (mm); X₆ = Rainy days; X₇ = Sunshine (hrs); X₈ = Evaporation (mm); R² = Coefficient of determination

CONCLUSIONS

The effect of weather parameters on disease development was studied two location *Kharif* 2023. Prevailing moderate temperature of 25-30°C, high relative humidity (>90%) with intermittent rainfall were essential for disease establishment observed in two location. Disease initiation was observed in 35 and 32 standard meteorological week which required weather parameters for disease development at Junagadh and Manavadar, respectively.

FUTURE SCOPE

Plant diseases are more common and severe in humid area with warm temperature. During pathological investigations, the interaction between pathogen populations with host population was studied under the influence of environmental factors. The knowledge of weather conditions predisposing for development and spread of the disease is important and it will helpful to farmers to take up timely management practices and data will used to develop predication model.

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