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Role of Meteorological Factors on Development of *Cercospora* Leaf Spot Disease of Sesame

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ABSTRACT
Sesame (Sesamum indicum L.) is one of the important and ancient oilseed crop cultivated both in tropical and sub tropical regions. It is also named as gingelly, til or tila and used by us because of its considerable economic importance. It is called as "Queen of oil seed crops" by virtue of the excellent quality of its sweet oil. The Cercospora leaf spot, caused by the fungus, Cercospora sesame Zimm, is one of the important disease of this crop which infects all above ground parts of the plant, resulting in complete defoliation and leads to severe economic losses that varies from 20 to 50 %. The disease appeared during 1st week of July in the field and its intensity increased gradually till harvest of the crop during the crop seasons. Maximum apparent infection rate was calculated at July 15, during both years of experimentations. The temperature, 23.93 to 31.75^{0}C and 23.41 to 30.45^{0}C, relative humidity 66.9 to 89.15% and 67.2 to 86.6%, rainfall 5.66 mm and 11.05 mm and 7 and 11 number of rainy days were favourable for maximum disease development during June 25 to July 15. Multiple regression equation between disease index and weather variables exhibited strong relationship among the different components of the epiphytotics during both the years (R^2 =0.989 and 0.964) respectively.
Keywords: *Sesame, meteorological factors, leaf spot, Cercospora sesame.*

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INTRODUCTION

Sesame (*Sesamum indicum* L.) is one of the important and ancient oilseed crops cultivated both in tropical and sub tropical regions. It is variously named as gingelly, til or tila and used by man because of its considerable economic importance. It is called as "Queen of oil seed crops" by virtue of the excellent quality of its sweet oil. The oil content varies from 46 to 52 per cent. It is mainly used for edible purpose and also in pharmaceutical industry for manufacturing perfumed oils, soap, cosmetics and for medicinal purposes. Oil components such as sesamin and sesamolin are used as effective synergists for Pyrethrin. Sesame-cake is a rich source of protein, carbohydrates and mineral nutrients, viz. calcium and phosphorus which makes it a valuable and nutritious feed for milch cattle. The area under sesame in the world is 7.73 million hectares with production of 6.11 million tonnes. Among the sesame growing countries, India ranks first in area with 17.5 lakh hectares and production of 7.39 lakh tonnes, however the productivity is 363 kg/ha [1]. India's contribution to the production of sesame seeds in the world is 18.8 per cent and is the largest exporter of sesame, exporting about 5.4 lakh metric tonnes of sesame annually. About 25 per cent of the total production is exported to various importing nations worldwide. In India, Gujarat is the leading sesame producing state followed by West Bengal, Karnataka, Rajasthan, Madhya Pradesh, Tamil Nadu, Andhra Pradesh, Maharashtra and Bihar. Among the several limiting factors for successful sesame production, yield loss due to diseases is one of the major constraints. Sesame suffers from many fungal foliar diseases, viz. Cercospora leaf spot, Powdery mildew, Alternaria leaf spot, bacterial leaf spots etc.. Kumar and Mishra [6] recorded twelve diseases occurring on sesame.

Among these diseases, leaf spot caused by *Cercospora sesame* Zimm. is a major constraint in sesame production and caused a yield loss of 11 to 18 per cent. Systematic studies on estimation of losses in yield have not been worked out but its considerable damage to the crop is reported to occur in India [3].Extensive infection leads to defoliation and damage of capsules before the plant reaches maturity which can result in yield losses of 20 to 50%. Regular occurrence of *Cercospora* leaf spot disease has been recorded from different districts of Jharkhand State with varying incidence per cent of 14.00 to 23.6 per cent and 13.60 to 22.60 per cent during *Kharif,* 2002-03 and *Kharif,* 2003-04 crop seasons, respectively. Prasad and Reddy [8] carried out an intensive survey on sesame diseases during *Kharif* and *Rabi* and reported that the incidence of *Cercospora sesami (Mycosphaerella sesamicola*) was 30.8%. Bhowmick [2] also reported that the sesame crop was affected by *Cercospora* leaf spot caused by *Cercospora sesame* Zimm. at all stage of the crop growth and caused heavy economic losses. Cercospora leaf spot infects all above ground parts of the plant, resulting in complete defoliation which leads to severe economic losses. The disease, which affects leaves as early as 4 weeks after planting, starts as small pinhead-sized cottony spots on the infected leaves. These spots gradually spread on the lamina and can extend up to 4 mm in diameter. The fungal spores are spread to healthy plants through rain, irrigation water and wind. Germination occurs in humid conditions, usually during late spring and summer, and fungus growth is encouraged when leaves are frequently damp. Field trials were therefore conducted to determine the role of meteorological factors on development of the disease and the results are presented in this paper.

MATERIAL AND METHODS

To determine the role of weather variables on Cercospora leaf spot disease development, field trials were conducted in Randomized Block Design (RBD) with three replications. Seeds of sesame variety, Kanke safed were sown in 6 m^2 plots, 30 cm x 10 cm spacings on 25th June during both the years. PDI was recorded at 10 days intervals beginning from initial appearance of disease. Progress of disease in terms of intensity was recorded on the basis of 100 leaves selected randomly from each replication using 0-5 rating scale (Anon., 1998). Weather parameters like temperature, relative humidity, rainfall and number of rainy days upto 60 days were recorded from Meteorological Observatory of the University and correlated with disease development. Stepwise Multiple Regression Analysis (MRA) was calculated to determine the effect of individual as well as combined weather variables. Disease prediction analysis equation viz., $Y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6$ was derived. Significance of coefficient of multiple determination (R^2) and partial regression coefficient (b) value was followed at 5 per cent level of probability

Disease development in term of apparent infection rate (unit/day) was calculated with the help of formula given by Vander plank (1963) as detailed below:

$$r = \frac{2.3}{t_2 - t_1} \log \left\{ \frac{x_2}{1 - x_2} - \log \frac{x_1}{1 - x_1} \right\}$$

where, r = Apparent infection rate
t_1 and t_2 = time intervals
x_1 and x_2 = disease intensities

RESULTS

The results obtained for the influence of dates of sowing on the development of *Cercospora* leaf spot of sesame and the seed yield is summarized in Table 1.

Table 1: Influence of dates of sowing on the development of *Cercospora* leaf spot of sesame and seed yield

Date of sowing	*Disease intensity (%)	*Yield (Kg/ha)	**Mean temperature (^oC)		**Mean Relative Humidity (%)		**Mean Rainfall (mm)	**No. of rainy days
			Max^m	Min^m	Max^m	Min^m		
2002-03								
5th June	12.75 (20.92)	424.0	32.89	24.13	87.38	63.12	7.38	27
15th June	16.90 (24.29)	418.0	31.25	23.14	89.20	67.15	7.05	29
25th June	20.25 (26.74)	415.0	30.11	22.54	89.92	71.60	8.94	29
5th July	22.15 (28.08)	401.0	30.00	22.15	90.05	84.30	8.42	29
15th July	23.60	380.5	29.60	22.09	91.02	75.78	11.96	37

	(29.05)							
25th July	25.50 (30.32)	365.0	29.30	22.00	91.23	75.05	11.62	34
4th August	27.00 (31.30)	342.0	28.63	21.94	90.63	74.35	12.33	38
2003-04								
5th June	13.95 (21.91)	422.0	31.93	23.42	84.53	62.66	9.96	30
15th June	16.50 (23.95)	418.0	29.99	23.26	86.92	67.37	10.05	31
25th June	19.25 (26.02)	402.0	29.28	23.23	88.43	72.17	11.75	34
5th July	20.50 (26.91)	395.0	29.53	23.12	87.57	73.50	12.12	37
15th July	22.00 (27.95)	382.0	28.99	23.03	89.88	75.22	12.46	40
25th July	24.25 (29.50)	361.0	28.87	22.97	91.75	76.20	10.52	43
4th August	25.00 (30.01)	355.0	29.14	22.83	90.33	75.08	7.81	40

	Disease Incidence (%)		Yield (kg/ha)	
	2002-03	2003-04	2002-03	2003-04
SEm ±	0.14	0.13	2.46	3.29
CD at 5%	0.41	0.42	7.54	11.860

* Average of three replications, ** Average of 60 days; Figures in parentheses are transformed angular values

The results obtained for Correlation coefficient and regression equation between *Cercospora* disease index and weather parameters summarized in Table 2.

Table 2: Correlation coefficient and regression equation between *Cercospora* disease index and weather parameters

Independent variable	Correlation coefficient (r)	Coefficient of multiple Determination (R^2)	Regression equation
2002-03			
Maximum temperature	-0.985**	0.971**	$Y = 126.422-3.479X_1$
Minimum temperature	-0.964**	0.930**	$Y = 156.192-5.982X_2$
Maximum relative humidity	0.939*	0.882*	$Y = -298.845+3.559X_3$
Minimum relative humidity	0.709^{NS}	0.504^{NS}	$Y = -17.066+0.523X_4$
Mean rainfall	0.882*	0.779*	$Y = 2.211+1.959X_5$
No. of rainy days	0.836^{NS}	0.699^{NS}	$Y = -8.963+0.945X_6$
Yield	0.900*	0.810*	-
2003-2004			
Maximum temperature	-0.861^{NS}	0.741*	$Y = 116.668-3.250X_1$
Minimum temperature	-0.976**	0.953**	$Y = 476.039-17.713X_2$
Maximum relative humidity	0.945*	0.894**	$Y = 118.765+1.570X_3$
Minimum relative humidity	0.949*	0.901**	$Y \backslash = -34.768+0.766X_4$
Mean rainfall	-0.128^{NS}	0.016^{NS}	$Y = 23.616-0.319X_5$
No. of rainy days	0.953**	0.908**	$Y = -8.025+ 0.775X_6$
Yield	-0.975**	0.951**	-

The results obtained for Multiple regression between weather parameters and *Cercospora* disease index is summarized in Table 3.

Table3: Multiple regression between weather parameters and *Cercospora* disease index during the year, 2002-03 and 2003-04

Disease Index	Correlation coefficient (r)	Coefficient of multiple Determination (R^2)	Regression equation
2002-03	0.998**	0.996**	$Y = -1585.607-17.366X_1 +49.219\ X_2+10.247\ X_3 +1.392X_4 -0.185X_5$
2003-04	0.999**	0.999**	$Y =-27.299+1.202X_1 - 2.839X_2 + 0.275X_3 + 0.812X_4 - 0.483X_5$

* Significant at 5% level of significance, ** Significant at 1% level of significance ,NS = Non-significant, Y = Disease index, X_1 = Max. temp, X_2 = Min. temp, X_3= Max. RH,X_4 = Min. RH, X_5 = Mean Rainfall, X_6 = No. of rainy days.

DISCUSSION

The crop sown on June 5, recorded lowest PDI of 12.75 and 13.95 per cent *Cercospora* leaf spot during above mentioned crop seasons, respectively. The crop sown on June 15, which recorded 16.90 and 16.50 per cent disease intensity, followed the above treatment. A relatively higher PDI was recorded with the advancement of date of sowing. As evident from the data, late sowing favoured disease development. The mean temperature (21.94 to 28.63^{0}C and 22.83 to 29.14^{0}C), mean relative humidity (74.35 to 90.63 and 75.08 to 90.33%), mean rainfall (12.33 and 7.81 mm) and 38 and 40 number of rainy days during above-mentioned seasons, respectively, favoured disease development. Maximum seed yield of 424.0 kg/ha and 422.0 kg/ha were recorded when crop was sown on June 5, during above mentioned seasons crop seasons, respectively (Table 1). PDI were significantly positively correlated with maximum relative humidity and mean rainfall, non significantly positively correlated with minimum relative humidity and rainy days and significantly negatively correlated with maximum temperature, minimum temperature and yield of sesame during 2002-03. Whereas maximum relative humidity, minimum relative humidity and rainy days were significantly positively correlated, significantly negatively correlated with minimum temperature and yield and non significantly negatively correlated with maximum temperature and mean rainfall during 2003-04 (Table 2). Multiple regression equation between disease index and weather variables exhibited strong relationship among the different components of epiphytotics during both the years of study (Table 3) Shrinivasalu *et al*. [9] reported that early sowing (early August) of rain fed sesame reduced incidence of *Cercospora* leaf spot and increase the seed yield. Lewin *et al*. [7] observed that groundnut disease incidence was positively correlated with rainfall and negatively correlated with temperature Tripathi *et al.* [10] conducted field trials to manage *Cercospora* leaf spot of sesame by manipulation of dates of planting. Significant reduction in disease severity was recorded in earlier sowing of 18th and 25th June than delayed planting of 10th August. Highest seed yield (4.43 q/ha) was recorded in early sown crop of 18th June followed by 25th June (3.75 q/ha), whereas it was minimum (1.45 q/ha) in late planting of 10th August. Enikuomehin *et al.* [4] assessed *Cercospora* leaf spot disease of sesame on different planting dates and concluded that planting dates significantly affected the incidence and severity of the disease. Disease incidence and severity were lowest in plants sown in early July, while the disease adversely affected those sown from mid August to early September. Jenson and Boyle [5] reported that excessive increase of leaf spot due to *Cercospora* sp. with period of high relative humidity and temperature more than 70^0 F. Although rains were frequent and probably helpful in spore dispersal and in producing suitable leaf wetness. Relative humidity appeared to be a better measure of the moisture factors involved.

CONCLUSION

Early sowing reduced the incidence of *Cercospora* leaf spot disease. *Cercospora* leaf spot disease appeared during 1st week of July in the field. Maximum apparent infection rate of 0.104 and 0.107 unit/day were calculated at July 15, during both the crop seasons, respectively. Correlation regression analysis studies among different parameters of epiphytotics revealed that maximum relative humidity, minimum relative humidity and number of rainy days showed significant positive effect and minimum temperature showed significant negative effect on *Cercospora* leaf spot disease of sesame. Multiple regression equation between per cent disease index of above mentioned diseases and weather variables exhibited strong relationship among different components of epiphytotics. The coefficient of multiple determination (R^2) indicated that the combined effect of different weather variables favoured the disease development causing upto 99.0 per cent variations in the disease incidence and intensity of the above-mentioned diseases.

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