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Severity of Cercospora Leaf Spot of Greengram in Relation to Weather Parameters and Age of the Crop

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ABSTRACT

The experiment was conducted to assess the severity of Cercospora leaf spot of greengram in relation to weather parameters and age of the crop through correlation and regression analysis during *kharif* and *rabi* 2015-16. Among the weather parameters studied, minimum temperature (-0.26), and evening relative humidity (-0.30) were significant and negatively correlating factors with PDI, there was a significant positive correlation between PDI and age of the crop (0.85). Minimum temperature, evening relative humidity and age of the crop were correlating factors with PDI.

Key words*:* Age of the crop, *Cercospora canescens*, Greengram, Weather.

Greengram or Mungbean [*Vigna radiata* (L.) Wilczek], a *kharif* season crop, is an important leguminous crop of South and Southeast Asia. Greengram crop covers a total world area of 5 m ha with a total production of 3 Mt (John, 1991). It is widely cultivated throughout the South Asia including India, Pakistan, Bangladesh, Sri Lanka, Thailand, Cambodia, Vietnam, Indonesia, Malaysia and South China.

The crop is of special significance in Andhra Pradesh as it fits well in rice–pulse cropping system as a relay crop particularly in Krishna–Godavari and North Coastal zones. It is also cultivated preceding crop to rice in Nagarjuna Sagar Project (NSP) right canal dryland areas and tank fed areas in Guntur and Prakasham districts.

Greengram suffers from many diseases caused by fungi, bacteria, viruses, nematodes and also abiotic stresses. Among the fungal diseases, Cercospora leaf spot is of common occurrence throughout Asia. The disease has been reported as a threat to greengram production in countries such as Thailand, Indonesia, Philippines and Columbia (Poehlman *et al.*, 1973). In India, leaf spot caused by *Cercospora canescens* Ellis & Martin was first reported from Delhi by Munjal *et al.* (1960) and is prevalent in all parts of the humid tropical areas of India (Pandey *et al*., 2009).

Weather parameters like temperature and relative humidity were found to greatly influence the disease incidence and severity in greengram (Sad and Singh, 1984). Hence the present study was undertaken to study the effect of weather parameters prevailing in Guntur district of Andhra Pradesh on disease incidence and severity through correlation and regression analysis

MATERIAL AND METHODS

Field experiment was conducted to assess the severity of Cercospora leaf spot of greengram in relation to weather parameters through correlation and regression analysis during *kharif* and *rabi* 2015-16 at RARS, Lam, Guntur. LGG 460 was sown in 25 sq m plots from 31.07.2015 to 16.12.2015 at 15 days intervals at different dates of sowing. Data on disease severity of Cercospora leaf spot was recorded by randomly tagging five plants on each date of sowing. Observations were recorded at four day intervals starting from 25 DAS up to 90 DAS in each plot. Severity data was categorised by adopting1-9 scale (Alice and Nadarajan, 2007) (Table 1) and Per cent Disease Index (PDI) was calculated.

Correlation and multiple regression analysis were carried out between PDI and weather parameters *viz*., maximum temperature (^{0}C), minimum temperature(^{0}C), morning relative humidity, evening relative humidity and rain fall (mm). The dat was recorded at the Meteorological observatory, RARS, Lam, Guntur.

Table 1. Disease scale for Cercospora leaf spot (1-9 scale).

Grade	Description
1	Free from diseases
2	Traces to pin head size spots on leaves
3	Spots slightly larger than pin heads
4	Spots occupying 2-5 % leaf area
5	Spots occupying 5-10 % leaf area
6	Spots occupying 10-25 % leaf area
7	Spots occupying 25-50 % leaf area
8	Spots occupying 50-75 % leaf area
9	Spots occupying more than 75 % leaf area

The per cent disease index (PDI) was computed from the above scale by using the following formula (Wheeler, 1969).

$$PDI = \frac{\text{Sum of all the numerical ratings}}{\text{No.of observations} \times \text{Maximum disease grade}} \times 100$$

RESULTS AND DISCUSSION

Cercospora leaf spot disease on greengram was first deserved on 14.9.15 when the corresponding maximum temperature, minimum temperature, R.H at morning, at evening age of the crop and rainfall were 32.0^{0}C, 23.5^{0}C, 100%, 89%, 44 days, 41.0 mm, respectively (Table 2). This is in confirmation with observations of Sad and Singh (1984) who reported that the rapid development of leaf spot caused by *C. canescens* in mungbean was favoured by a mean temperature of 22.5-23.5°C and relative humidity of 79-85%. The disease rapidly progressed between 21st November (PDI: 40.88%) and 3rd December (PDI: 46.52%). Leaf spot disease caused by *C. canescens* is a serious disease in mungbean growing areas of the country where high humidity prevails during the growing season (Bashir and Zubair, 1985). Shahbaz *et al.* (2014) reported that cercospora leaf spot can cause heavy defoliation in severe conditions on mungbean especially at optimum temperatures of 25-30^{0}C and RH of 90-100%. Kanade *et al*. (2015) reported that the favourable conditions for cercospora leaf spot development in groundnut is ranged between 26.0-32.0^{0}C and RH ranged between 61-79% and bright sunshine hours of 4-6 h/day. George *et al*. (2010) reported that high humidity more than 90% and day temperature of 27.0-32.0^{0}C and night temperature of 17.0^{0}C are favourable for Cercospora leaf spot disease in sugar beet.

Among the weather parameters studied, minimum temperature (-0.26), and evening relative humidity at (-0.30) were significant and negatively correlated factors with PDI, there was a significant positive correlation between PDI and age of the crop (0.85). Minimum temperature, evening relative humidity and age of the crop were correlating factors with PDI (Table 3).

When the data on per cent disease index was subjected to multiple linear regression (MLR) and correlation with weather variables, it was observed that the coefficient of determination (R^2) for PDI was 0.812 which showed that weather factors were able to cause the variation in PDI to an extent of 81.2%. The following equation was obtained.

Y = 15.03 - 0.59 Temp (Max)- 0.62 Temp (Min) + 0.17 R.H (A.M) - 0.26 R.H (P.M) + 0.70 (Age of the crop) - 0.03 (R.F).

It also evident from the multiple linear regression equation that among various factors studied the partial regression coefficient (b) for age of the crop was significant and positively correlated (0.85) with PDI. It showed that as the age of the crop increases there was an increase in disease severity to 0.85 per cent. Partial regression coefficient (b) for minimum temperature was significant and negatively correlated (-0.26). It showed that with every one unit decrease in evening relative humidity there would be 0.26 per cent

Table 2. Progression of Cercospora leaf spot of greengram with weather parameters and age in different dates of sowing.

DOS	Date of observation	Temperature (^{0}C)		Relative humidity (%)		Age of the crop (days)	Rainfall (mm)	PDI
		Max.	Min.	Morn.	Even.			
31.07.15	25.08.15	35.0	22.5	78	57	24	71.8	0.00
	29.08.15	33.5	25.4	77	57	28	7.20	0.00
	02.09.15	38.0	26.5	79	42	32	2.20	0.00
	06.09.15	30.5	25.8	100	85	36	1.80	0.00
	10.09.15	33.5	25.0	100	67	40	95.0	0.00
	14.09.15	32.0	23.5	100	89	44	41.0	2.66
	18.09.15	31.0	26.0	100	66	48	63.7	4.44
	22.09.15	33.0	26.0	100	67	52	5.80	6.22
	26.09.15	36.0	26.0	90	58	56	11.40	8.88
	30.09.15	31.5	25.0	100	76	60	23.0	9.33
	04.10.15	32.5	25.0	92	67	64	2.40	11.11
	08.10.15	35.5	25.5	92	67	68	2.70	12.88
	12.10.15	39.5	26.0	87	41	72	0.00	13.33
	16.10.15	37.5	25.0	92	62	76	9.70	16.44
	20.10.15	37.0	24.5	92	62	80	4.90	18.66
	24.10.15	36.4	23.5	92	56	84	0.00	21.33
	28.10.15	36.0	23.0	92	63	88	2.80	24.88
	01.11.15	36.0	23.0	92	63	92	0.00	26.66
17.08.15	14.09.15	32.0	23.5	100	89	28	41.0	0.00
	18.09.15	31.0	26.0	100	66	32	63.7	0.00
	22.09.15	33.0	26.0	100	67	36	5.80	2.66
	26.09.15	36.0	26.0	90	58	40	11.40	4.44
	30.09.15	31.5	25.0	100	76	44	23.0	6.22
	04.10.15	32.5	25.0	92	67	48	2.40	8.44
	08.10.15	35.5	25.5	92	67	52	2.70	11.11
	12.10.15	39.5	26.0	87	41	56	0.00	13.33
	16.10.15	37.5	25.0	92	62	60	9.70	17.33
	20.10.15	37.0	24.5	92	62	64	4.90	20.44
	24.10.15	36.4	23.5	92	56	68	0.00	23.55
	28.10.15	36.0	23.0	92	63	72	2.80	25.22
	01.11.15	36.0	23.0	92	63	76	0.00	26.66
	05.11.15	35.0	25.0	92	55	80	0.00	27.55
	09.11.15	29.0	23.5	100	92	84	0.20	31.11
	13.11.15	34.0	22.0	86	49	88	7.0	32.44
	17.11.15	30.0	17.0	100	100	92	49.0	38.22
	21.11.15	30.5	20.5	92	67	94	16.80	40.88
01.09.15	26.09.15	36.0	26.0	90	58	26	11.40	0.00
	30.09.15	31.5	25.0	100	76	30	23.0	2.66
	04.10.15	32.5	25.0	92	67	34	2.40	4.44
	08.10.15	35.5	25.5	92	67	38	2.70	8.44
	12.10.15	39.5	26.0	87	41	42	0.00	14.66

Table 2. contd....

DOS	Date of observation	Temperature (^{0}C)		Relative humidity (%)		Age of the crop (days)	Rainfall (mm)	PDI
		Max.	Min.	Morn.	Even.			
	24.10.15	36.4	23.5	92	56	54	0.00	23.11
	28.10.15	36.0	23.0	92	63	58	2.80	25.33
	01.11.15	36.0	23.0	92	63	62	0.00	26.22
	05.11.15	35.0	25.0	92	55	66	0.00	31.55
	09.11.15	29.0	23.5	100	92	70	0.2	32.44
	13.11.15	34.0	22.0	86	49	74	7.0	35.11
	17.11.15	30.0	17.0	100	100	78	49.0	38.22
	21.11.15	30.5	20.5	92	67	82	16.80	40.88
	25.11.15	33.0	20.0	100	61	86	0.00	42.22
	29.11.15	31.0	18.0	100	57	90	0.00	44.88
	03.12.15	32.0	19.0	100	96	94	0.10	46.52
15.11.15	12.12.15	33.0	21.0	100	71	26	0.00	0.00
	16.12.15	31.5	16.0	100	66	30	0.00	2.66
	20.12.15	33.5	19.0	100	62	34	0.00	4.88
	24.12.15	33.0	19.0	100	71	38	0.00	8.44
	28.12.15	31.5	15.0	100	44	42	0.00	11.11
	01.01.16	31.5	17.0	100	44	46	0.00	13.33
	05.01.16	31.5	17.5	96	60	50	0.00	17.22
	09.01.16	31.0	15.0	100	53	54	0.00	20.44
	13.01.16	31.0	15.5	100	59	58	0.00	24.22
	17.01.16	31.0	15.0	100	59	62	0.00	29.44
	21.01.16	30.5	20.0	100	60	66	0.00	31.52
	25.01.16	30.5	18.0	96	53	70	0.00	35.11
	29.01.16	33.0	16.5	100	53	74	0.00	38.66
	02.02.16	33.0	21.0	96	51	78	0.00	41.77
	06.02.16	32.0	19.5	96	60	82	0.00	43.33
	10.02.16	34.0	20.0	100	56	86	0.00	46.52
	14.02.16	33.0	19.0	100	45	90	0.00	48.44
	18.02.16	34.5	18.0	100	25	94	0.00	51.11
01.12.15	24.12.15	33.0	19.0	100	71	24	0.00	0.00
	28.12.15	31.5	15.0	100	44	28	0.00	2.66
	01.01.16	31.5	17.0	100	44	32	0.00	4.44
	05.01.16	31.5	17.5	96	60	36	0.00	6.22
	09.01.16	31.0	15.0	100	53	42	0.00	11.11
	13.01.16	31.0	15.5	100	59	44	0.00	17.22
	17.01.16	31.0	15.0	100	59	48	0.00	23.33
	21.01.16	30.5	20.0	100	60	52	0.00	29.44
	25.01.16	30.5	18.0	96	53	56	0.00	33.22
	29.01.16	33.0	16.5	100	53	60	0.00	35.66
	02.02.16	33.0	21.0	96	51	64	0.00	39.44
	06.02.16	32.0	19.5	96	60	68	0.00	42.52
	10.02.16	34.0	20.0	100	56	72	0.00	46.52
	14.02.16	33.0	19.0	100	45	76	0.00	48.33

Table 2. contd....

DOS	Date of observation	Temperature (^{0}C)		Relative humidity (%)		Age of the crop (days)	Rainfall (mm)	PDI
		Max.	Min.	Morn.	Even.			
	26.02.16	32.5	21.0	84	36	88	0.00	52.88
	01.03.16	34.0	21.0	96	47	92	0.00	53.11
16.12.15	09.01.16	31.0	15.0	100	53	24	0.00	0.00
	13.01.16	31.0	15.5	100	59	28	0.00	2.66
	17.01.16	31.0	15.0	100	59	32	0.00	9.33
	21.01.16	30.5	20.0	100	60	36	0.00	13.33
	25.01.16	30.5	18.0	96	53	40	0.00	17.22
	29.01.16	33.0	16.5	100	53	44	0.00	23.33
	02.02.16	33.0	21.0	96	51	48	0.00	27.44
	06.02.16	32.0	19.5	96	60	52	0.00	28.44
	10.02.16	34.0	20.0	100	56	56	0.00	34.22
	14.02.16	33.0	19.0	100	45	60	0.00	39.44
	18.02.16	34.5	18.0	100	25	64	0.00	42.52
	22.02.16	35.0	24.0	96	61	68	0.00	47.33
	26.02.16	32.5	21.0	84	36	72	0.00	48.33
	01.03.16	34.0	21.0	96	47	76	0.00	50.11
	05.03.16	35.0	20.0	91	53	80	0.00	52.33
	09.03.16	35.0	18.0	100	48	84	0.00	53.11
	13.03.16	36.0	23.0	96	43	88	0.00	56.44
	17.03.16	37.0	24.0	92	51	92	0.00	58.22

Table 3. Disease occurrence , crop stage and terminal disease severity of Cercospora leaf spot of greengram in each date of sowing.

S. No	Date of sowing	Date of first occurance of disease	Crop stage	Terminal disease severity of Cercospora (PDI)
1	31.07.2015	10.09.2015	Pod development stage	26.66
2	17.08.2015	22.09.2015	Pod formation stage	40.88
3	01.09.2015	30.09.2015	Flowering stage	46.52
4	15.11.2015	16.12.2015	Flowering stage	51.11
5	01.12.2015	28.12.2015	Flowering stage	53.11
6	16.12.2015	13.01.2016	Flowering stage	58.22

Table 4. Correlation between Cercospora leaf spot and weather factors during 2015-16.

Variable	Correlation co-efficient (r)
X_1 Maximum temperature (^{0}C)	0.03^{NS}
X_2 Minimum temperature (^{0}C)	-0.26*
X_3 Relative humidity at A.M (%)	0.06^{NS}
X_4 Relative humidity at P.M (%)	-0.30*
X_5 Age of the crop	0.85*
X_6 Rainfall (mm/day)	-0.05^{NS}

*Significant at 1% level r tab value 0.256 N= 108

increase in disease severity. Partial regression coefficient (b) for minimum temperature was significant and negatively correlated (-0.62) with PDI. It showed that every one unit increase in minimum temperature there would be 0.62 per cent decrease in disease severity.

Shahbaz *et al*. (2014) reported that Cercospora leaf spot could cause heavy defoliation in severe conditions on mungbean especially at optimum temperatures of 25.0-30.0^{0}C and RH of 90-100%.

Vankatraman and Kazi (1979) noticed that the maximum and minimum temperature ranges for Cercospora leaf spot in groundnut was 31.0^{0}C to 35.0^{0}C and 18.0^{0}C to 23.0^{0}C respectively.

LITERATURE CITED

Alice D and Nadarajan N 2007 Pulses. Screening techniques and assessment for disease resistance. *All India Coordinated Research Project on MULLaRP* -Tamilnadu Agricultural University. Kasturi Graphics and Printers, Coimbattore. 24.

Bashir M and Zubair M 1985 Survey report of *kharif* pulses in Islamabad. Pulses Programme, Technical Report. *National Agricultural Research Centre*, Islamabad.

John M P 1991 *The Mungbean*, Oxford and IBH Publishing Co. Pvt. Ltd., 375 pp.

Kanade S G Shaikh A AJadhav J D and Chavan C D 2015 Influence of weather parameters on tikka (*Cercospora* spp.) and rust (*Pucciniaarachidis*) of groundnut (*Arachis hypogeal* L.). *Asian Journal of Environmental Science*, 10 (1): 39-49.

Munjal R LLall G and Chona B L 1960 Some *Cercospora* species from India-IV. *Indian Phytopathology*, 13: 144-149.

Pandey S Sharma M Kumari S Gaur P M Chen W Kaur L Macleod W Basandrai A K Basandrai D Bakar A Sandhu J S Tripathi H S andGowda C L L 2009 Integrated foliar diseases management of legumes. *Indian Society of Pulses Research and Development*. Indian Instiute of Pulses Research Kanpur India. 143-161.

Poehlman J M 1973 The*mungbean*Oxford and IBH Publishing Company Ltd., 135 pp.

Sad V K and Singh B M 1984 Effect of environmental factors on the development of leaf spot (*Cercosporacanescens*Ellis & Martin) in mungbean. *Indian Phyto pathology*, 37 (3): 511-515.

Shahbaz M U Iqbal M A Rafiq M Batool A and KamranM 2014 Efficacy of different protective fungicides against Cercospora leaf spot of mungbean. *Pakisthan Journal of Phytopathology*, 26: 187-191.

Vankatraman S and Kazi S K 1979 A climatic disease calendar for tikka disease of groundnut.*Journal of Maharashtra Agricultural University*, India. 1: 259-264.

Wheeler B E J 1969 *An Introduction to Plant Diseases*. John Wiley Publication, London. 301.

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