

Pathogenic Variability of Cercospora Leaf Spot Disease of mungbean caused by *Cercospora canescens* in Surveyed areas of Rajasthan

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ABSTRACT: The disease intensity of *Cercospora* leaf spot of mungbean was recorded from 29.38 to 51.20 per cent in all surveyed areas of Rajasthan. The highest disease intensity was recorded from Nagaur (50.33) and least from Tonk (32.07%). *Cercospora canescens* were isolated from infected plant leaves of mungbean. In variability studies, significant morphological, cultural and pathogenic variability were observed among ten isolates of *Cercospora canescens* collected from Nagaur, Jaipur, Sikar, Ajmer and Tonk. CerNg1 and CerNg2 showed maximum colony diameter (90.00 and 87.00 mm) followed by isolate CerJp1 (70.00 mm). Isolate CerNg1 showed greyish whitish colony colour with convex fluffy growth and greyish smooth margin with dense centre. The minimum colony growth was observed in isolate CerTk 2 (41.00 mm). The colony growth of among ten isolates varies from 41.00 to 90.00 mm with light greyish white to dull brownish colony colour. The CerNg1 isolate showed maximum length and width of conidia 30-300 μ and 2.5-5.0 μ , respectively. Among these pathogenic variability in Nagaur isolates found more virulent followed by Jaipur isolate and whereas Tonk (CerTk2) isolate was found less virulent.

Keywords: *Cercospora* leaf spot of mungbean, Pathogenic variability

INTRODUCTION

Mungbean [*Vigna radiata* (L.)] is one of the important pulse crop of India. It is widely cultivated throughout the Asia including India, Pakistan, Bangladesh, Sri Lanka, Thailand, Cambodia, Vietnam, Indonesia, Malaysia and South China. Leaf spot disease caused by *Cercospora canescens* Ellis and Martin is a serious disease in the mungbean growing areas of the country where high humidity prevails during the growing season. The productivity of pulse crops became stagnant for the last three decades because of less success in developing improved varieties and moreover it is grown on marginal and sub marginal lands. Average yield of the crop is very low mainly due to low inherent yield potential and susceptibility of the crop to diseases (Thakur *et al.*, 1977). Unique ability of biological nitrogen fixation, deep root system, mobilization of insoluble soil nutrients and bringing qualitative changes in soil physical properties, make them known as soil fertility restorers (Masood *et al.*, 2002). The total area covered under mungbean in India was 30.530 lakh hectares with a total production of 15.087 lakh tones having productivity of 494 kg/ha. The coverage of area and its production was maximum in Rajasthan *i.e.* 24.65 lakh hectares with annual production of 12.21 lakh tones with average productivity of 495 kg/ha. (Anonymous, 2019). Among the diseases, *Cercospora* leaf spot is a serious disease of mungbean (Verma and

Sandhu, 1992). The disease starts appearing about 30 to 40 days after planting. Depending upon the temperature and humidity, it spreads rapidly in susceptible varieties causing premature defoliation and reduction in size of pods and grains (Grewal *et al.*, 1980). Several workers had reported the effective control of the disease with the application of fungicides (Singh and Singh, 1978).

It is not only plays a very important role in human diet but also in improving the soil fertility by fixing the atmospheric nitrogen (Muhammad *et al.*, 2004). Inadequate nutrient status of soil is a particular problem for small land holders of the developing countries where much grain- legume production occurred (Peter and Vance, 2003). Among various factors responsible for low yields, biotic and abiotic stresses take a heavy toll of the crop, out of which diseases cause an estimated yield loss of 21.93 to 68.77% (Sharma *et al.*, 2008) and causes serious yield losses of up to 58% (Lal *et al.*, 2001) and 23% losses in yield have been reported (Quebral and Cagampang, 1970). Bhat *et al.*, (2008) recorded 7.83-43.73 per cent intensity of *Cercospora* leaf spot on various mungbean accessions. Symptoms of *Cercospora canescens* on *Vigna radiata* produced definite spots on leaves, which are at first brown, later turning grey or dirty grey with narrow reddish brown margin on both the surfaces (Munjal *et al.*, 1960). The causal organism *Cercospora* is a shy sporulating pathogen (Jamadar, 1988) and is soil and air borne in

nature. In view, of this, there is a need for systematic work which includes survey for knowing the disease severity. The present work was undertaken with the aim to know the study on survey, morphological, cultural and pathogenic variability of *Cercospora canescens*. The results obtained are presented in this paper.

MATERIALS AND METHODS

The present investigations were carried out during *kharif* season, Department of Plant Pathology, S.K.N. College of Agriculture, Sri Karan Narendra Agriculture University, Jobner, Jaipur Rajasthan. Jobner is situated at latitude 26°5' N, longitude of 75°20' E and altitude of 427 meters above MSL (mean sea level). The region falls under semi-arid eastern plain (Agro Climatic Zone-III A) of Rajasthan.

Disease intensity of Cercospora leaf spot of mungbean in surveyed areas of Rajasthan

Roving method of survey was followed to assess the intensity of *Cercospora* leaf spot disease of mungbean during 2017. The survey of major mungbean growing areas of Nagaur, Jaipur, Sikar, Ajmer and Tonk districts of Rajasthan was conducted at reproductive stage of the crop to record *Cercospora* leaf spot disease intensity and to collect disease samples. Survey was carried out in two villages from one tehsil of each district. Ten isolates were obtained with two villages from each district. The disease intensity was recorded as per 0-9 rating scale as given by (Metha and Mondal 1978) (Table 1 and Plate 1). Randomly selected ten plants from each field were rated as per following description and per cent disease intensity (PDI) on foliage was calculated using the formula of Krishna Prasad *et al.* 1979 and Uddin *et al.* (2013).

$$\text{Cercospora leaf spot disease intensity (\%)} = \frac{\text{Sum of total rating}}{\text{Total number of observation} \times \text{Highest grade in the scale}} \times 100$$

Standards for the assessment of disease intensity (Metha and Mondal 1978)

Table 1: Cercospora leaf spot disease rating scale on mungbean.

Sr. No.	Disease rating /grade	Per cent leaf area affected	Description
1.	0	-	no infection
2.	1	1-10	One spot to 10 per cent diseased area
3.	3	11-30	11-30 per cent diseased area
4.	5	31-50	31-50 per cent diseased area
5.	7	51-70	51-70 per cent diseased area
6.	9	>71	> 71 per cent diseased area



Scale 0 (No disease)



Scale 1(1-10% area affected)



Scale 3(11-30% area affected)



Scale 5(31-50% area affected)



Scale 7(51-70% area affected)



Scale 9(>71% area affected)

Plate 1: Cercospora leaf spot disease rating scale on mungbean.

The disease samples collected during survey were brought to the laboratory in paper bags for further studies.

To study the cultural, morphological and pathogenic variability of pathogen

To know the variability among the isolates of *Cercospora canescens* diseased plants of mungben were collected from five districts of Rajasthan. From each district, two isolates were maintained (Table 2). The pathogen was isolated on Malt Extract Agar medium and cultural, morphological and pathogenic studies were conducted.

Cultural and morphological variability among isolate of *Cercospora canescens*

Single spore cultures of different isolates established and maintained on Malt Extract Agar were studied for their cultural and morphological characters. Fifteen days old culture of each isolate was inoculated (5 mm diameter disc) separately on Malt Extract Agar and incubated at 25±2 °C. After fifteen day of incubation, mycelium growth of fungus, colony characters of each isolate such as colony diameter and colony colour. The measurements of size (length and width) of conidia and sporulation were taken with the help of Fluorescence microscopy.

Pathogenic variability of different isolate of *Cercospora canescens*

To test the pathogenic variability among the isolates, spore suspension of each isolate was prepared in sterilized distilled water separately by blending fifteen

days old fungal culture in pestle, mortar and filtered through cheese cloth, spore suspension was further diluted to 1×10⁵ spores/ml and 40 days old mungbean plant were separately inoculated with each isolates. Observations on disease intensity were recorded after fifteen days of inoculation as per following description and per cent disease intensity (PDI) on foliage was calculated using the formula of Krisna Prasad *et al.* 1979 and Uddin *et al.*, (2013).

RESULTS AND DISCUSSION

Disease intensity of *Cercospora* leaf spot of mungbean in surveyed areas of Rajasthan

A roving survey was conducted during *Kharif* 2017 in five mungbean growing districts of Rajasthan viz., Nagaur, Jaipur, Sikar, Ajmer and Tonk. Survey was carried out in two villages from one tehsil of each district. During the survey, discussions were held with the farmers concerned, regarding occurrence and severity of the disease. The results presented in (table 3 and fig.1) depicts that *Cercospora* leaf spot disease intensity was more severe in mungbean growing districts of Rajasthan. The disease intensity of *Cercospora* leaf spot of mungbean was recorded from 29.38 to 51.20 per cent in all surveyed areas of Rajasthan. The highest disease intensity was recorded from Rajaliya and Maroth village of Nagaur district with 51.20 per cent and 49.46 per cent respectively. Lowest disease intensity was observed from Tordi Sagar village (29.38 %) of Tonk district.

Table 2: The coding for each isolates were given as under.

Sr. No.	District	Tehsil	Village	Isolate no.
1.	Jaipur	Phulera	Tyod	CerJp1
2.	Jaipur	Phulera	Khatwadi	CerJp2
3.	Nagaur	Nawa	Rajaliya	CerNg1
4.	Nagaur	Nawa	Maroth	CerNg2
5.	Ajmer	Kekri	Mevda kalan	CerAj1
6.	Ajmer	Kekri	Juniya	CerAj2
7.	Tonk	Malpura	Ghati	CerTk1
8.	Tonk	Malpura	Tordi sagar	CerTk2
9.	Sikar	Dantaramgarh	Danta	CerSk1
10.	Sikar	Dantaramgarh	Chak	CerSk2

Table 3: Disease intensity of *Cercospora* leaf spot of mungbean in surveyed areas of Rajasthan.

Sr. No.	District	Tehsil	Village	Disease intensity (%)
1.	Jaipur	Phulera	Tyod	48.25
			Khatwadi	46.16
			Mean	47.21
2.	Nagaur	Nawa	Rajaliya	51.20
			Maroth	49.46
			Mean	50.33
3.	Ajmer	Kekri	Mevda kalan	40.60
			Juniya	38.48
			Mean	39.54
4.	Tonk	Malpura	Ghati	34.75
			Tordi sagar	29.38
			Mean	32.07
5.	Sikar	Danta ramgarh	Danta	45.33
			Chak	43.17
			Mean	44.25
Overall mean				42.68

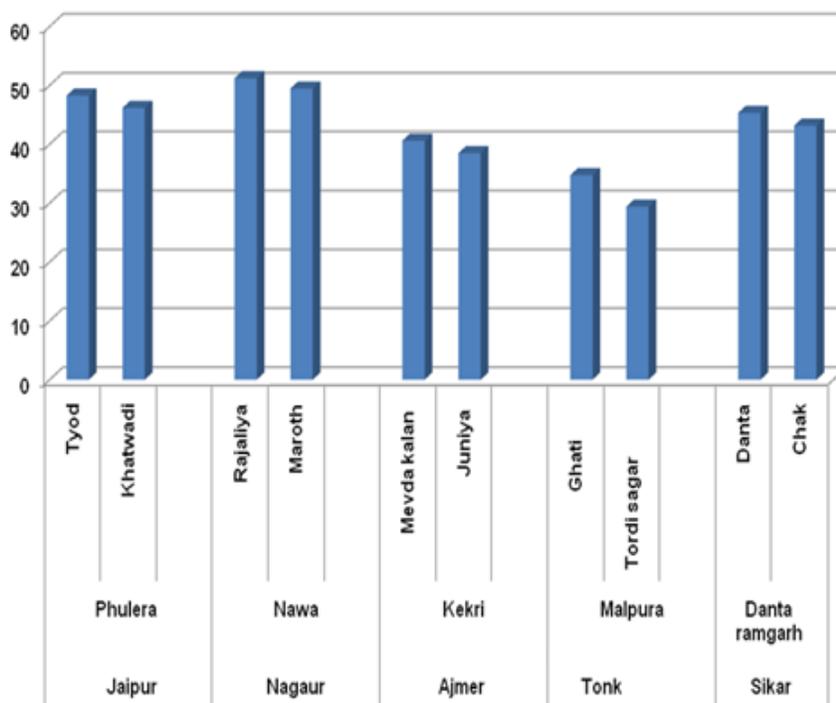


Fig. 1. Disease intensity of *Cercospora* leaf spot of mungbean in surveyed areas of Rajasthan.

Highest mean disease intensity 50.33 per cent was observed in Nawa tehsil of Nagaur district followed by Phulera (47.21%) tehsil of Jaipur district. The lowest mean disease intensity was recorded in Malpura tehsil of Tonk district with 32.07 per cent. These observations are in agreement with the earlier report of Khunti *et al.*, (2002) in *Cercospora* leaf spot of groundnut and found that the disease cause 35.40 per cent losses during 1995 to 1999. Saxena and Tripathi (2006) observed 47.20 per cent disease index severity in *Cercospora* leaf spot of mungbean and during 1997 to 2000. Hemachandra (2007) reported that highest disease intensity of *Cercospora* leaf spot of sugarbeet was noticed in Erode district (78.56 %) and Coimbatore (73.43%). Similar result were also found by Dubey and Singh (2010) surveyed on *Cercospora* leaf spot of palak and reported that highest per cent disease index was observed in Raichur district (57.30 %) followed by Dharwad district (53.30%). Poornima (2010) found that highest disease intensity (26.00%) and minimum grain yield observed due to *Cercospora* leaf spot of mungbean.

Cultural and morphological variability among isolate of *Cercospora canescens*

The cultural and morphological variability of the pathogen such as shape, colour, size of colony, size of conidia and septation were observed for different isolates of *C. canescens* with the help of fluorescence microscopy. The results showed that isolates of *C.*

canescens different in their colony characters, colony colour and colony diameter (Table 4, Fig. 2 and Plate 2).

Among ten isolates, isolate i.e. CerNg1 and CerNg2 showed maximum colony diameter (90.00 and 87.00 mm) followed by isolate CerJp1 (70.00 mm). Isolate CerNg1 showed greyish whitish colony colour with convex fluffy growth and greyish smooth margin with dense centre. Minimum colony growth was observed in isolate CerTk 2 (41.00 mm). The colony growth of among ten isolates varies from 41.00 to 90.00 mm with light greyish white to dull brownish colony colour. All the isolates showed various types of colony growth *viz.*, flatted colony with smooth margin, flat edges and fluffy raised colony with zig-zag margin. Morphological observations of each isolate revealed that Conidia were hyaline, straight to sub-straight or slightly curved, cylindrical and 2-12 septate and measuring 10-300 × 1.3-5.0 µm in size. The CerNg1 isolate showed maximum length and width of conidia 30-300 µ and 2.5-5.0 µ, respectively. These studies were supported with Gill and Singh (1962) on palak and Ferrater *et al.*, (2004) on mungbean and soyabean. Rajib *et al.*, (2014) were worked on *Cercospora* leaf spot of fenugreek and observed that conidiophores of *C. traversiana* were unbranched, geniculate, septate and developed in groups of 3-12 per fascicle. Conidia were hyaline, acicular, straight and slightly curved.

Table 4: Cultural and morphological variability among isolates of *Cercospora canesens*.

Isolate No.	Growth characters	Colony diameter (mm)	Conidia (μ)	Sporulation
CerJp-1	Good growth, light yellowish, flate edges white mycelium with light yellowish without dense centre	70.00	2-4 x 170 -196	+++
CerJp-2	Modrate mycelium growth, concave raised pluffy colony whitish centre with dull white edges smooth margin	67.00	3.5 – 4.0 x 24 -145	+++
CerNg-1	Whitish growth convex pluffy mycelial growth with dense centre, smooth margin	90.00	2.5-5.0 x 30-300	++++
CerNg-2	Good growth pure whitish concave pluffy raised edges with white raised colony centre with cottony growth	87.00	2.4-5.0 x 35 -215	+++
CerAj-1	Poor growth , concave, pluffy colony with concentric ring, raised, pluffy growth yellowish white with light greish colour centre of colony, concave centre	45.00	2-4 x 7- 96	++
CerAj-2	Poor growth, light pinkish with whitish dense colony at centre flated growth	53.00	2.0-4.5 x 10- 103	++
CerTk-1	Poor growth, dull white colony with light yellowish centre, flated colony growth with smooth margin	45.00	1.3 x 43-84	+
CerTk-2	Poor growth concave centre pluffy raised colony with flate edges, zig zag marginal colony growth whitish centre with dull white margin	41.00	1.3 x 38-57	-
CerSk-1	Modrate growth light yellowish white concave centre, pluffy raised colony growth with dense centre, flate edges, concentric ring	61.00	2.5 x 64 -142	++
CerSk-2	Modrate growth, convex pluffy dull whitish mycelial growth with concentric ring, whitish centre, zig zag edges	66.00	2-4 x 130- 180	+++

- = no sporulation, + = scanty sporulation (one to two spores per microscopic field), ++ = moderate sporulation (upto 10 spores per microscopic field), +++ = good sporulation (11 to 19 spores per microscopic field) and ++++ = abundant sporulation (20 and above spores per microscopic field)

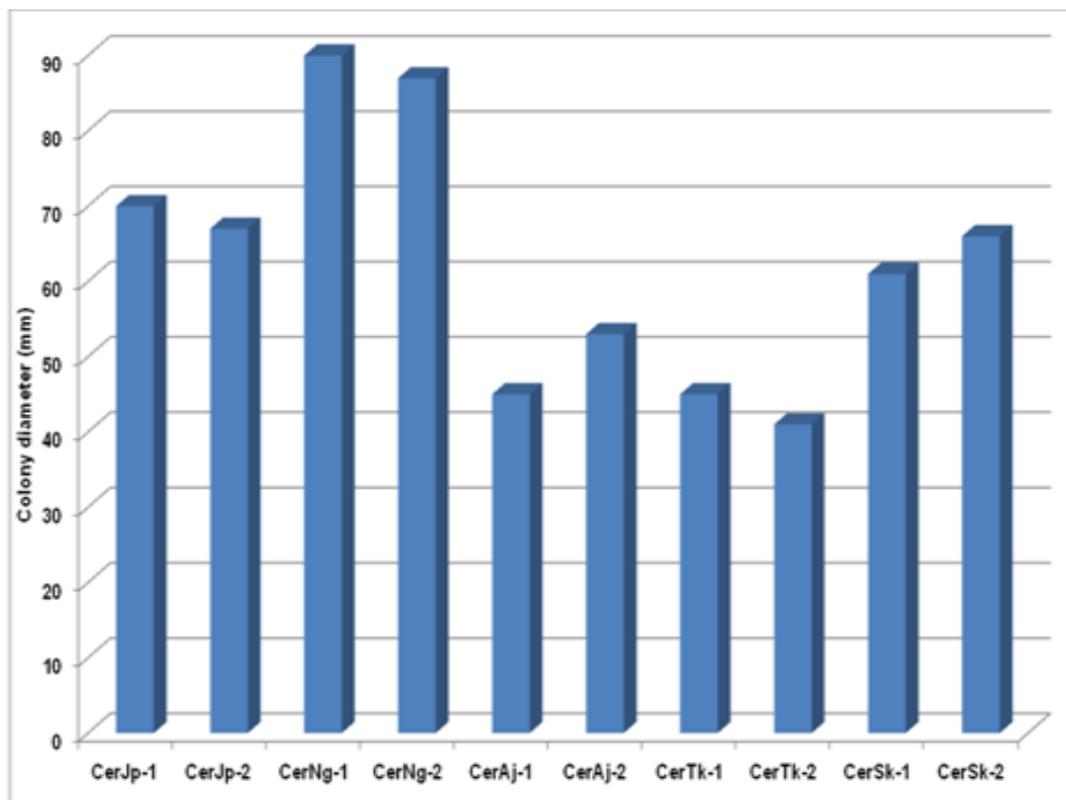


Fig. 2. Cultural and morphological variability among isolates of *Cercospora canesens*.

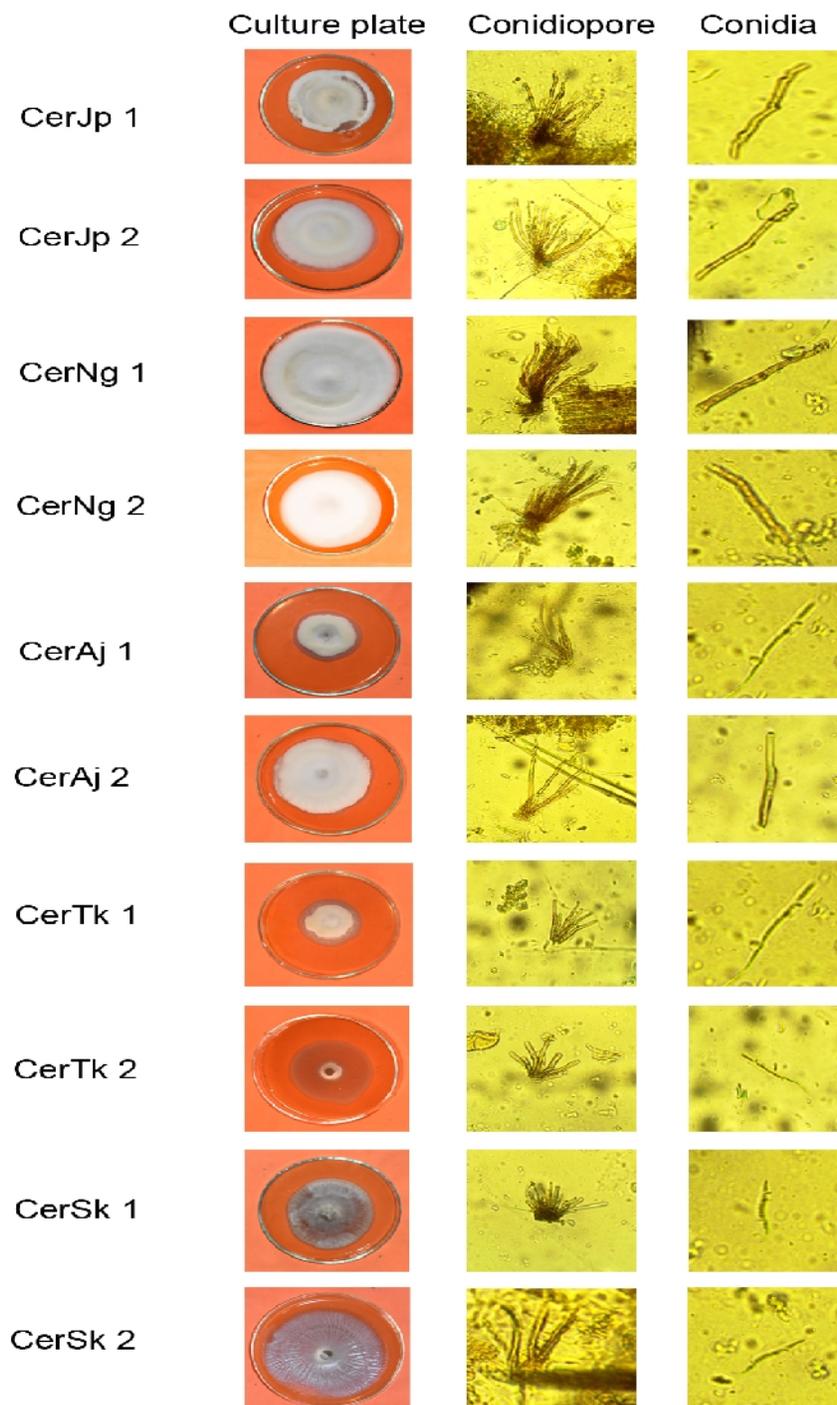


Plate 2: Cultural and morphological variability among isolates of *Cercospora canescens*.

Pathogenic variability of different isolation of *Cercospora canescens*

Results showed in Table 5 and Fig. 3 revealed that all the isolates were found pathogenic to mungbean and able to produce all characteristic symptoms of the disease. Maximum mean per cent disease intensity was found in Nagaur isolates with 54.48 per cent followed by Jaipur isolates (49.83%) and Ajmer isolates (47.00%). Among all the isolates lowest mean per cent disease intensity was recorded in Tonk isolate with

36.15 per cent followed by Sikar isolate (43.03%). Among these isolates CerNg1 was observed to be most virulent and produced highest (55.05%) disease intensity followed by CerNg2 isolate (53.90%). Whereas CerTk2 isolate was found less virulent with lowest disease intensity (35.30%). The overall mean disease intensity of five districts was recorded as 46.09 per cent. These findings were found similar with Rajib *et al.*, (2014) on *Vigna radiata* and Joshi *et al.*, (2006) on greengram.

Table 5: Pathogenic variability in different isolates of *Cercospora canescens*.

Sr. No.	Isolate No.	District	Tehsil	Village	Disease intensity (%)
1.	CerJp1	Jaipur	Phulera	Tyod	50.35
2.	CerJp2	Jaipur	Phulera	Khatwadi	49.30
				Mean	49.83
3.	CerNg1	Nagaur	Nawa	Rajaliya	55.05
4.	CerNg2	Nagaur	Nawa	Maroth	53.90
				Mean	54.48
5.	CerAJ1	Ajmer	Kekri	Mevda kalan	47.60
6.	CerAj2	Ajmer	Kekri	Juniya	46.40
				Mean	47.00
7.	CerTk1	Tonk	Malpura	Ghati	37.00
8.	CerTk2	Tonk	Malpura	Tordi sagar	35.30
				Mean	36.15
9.	CerSk1	Sikar	Danta Ramgarh	Danta	42.65
10.	CerSk1	Sikar	Danta Ramgarh	Chak	43.40
				Mean	43.03
				Overall mean	46.09

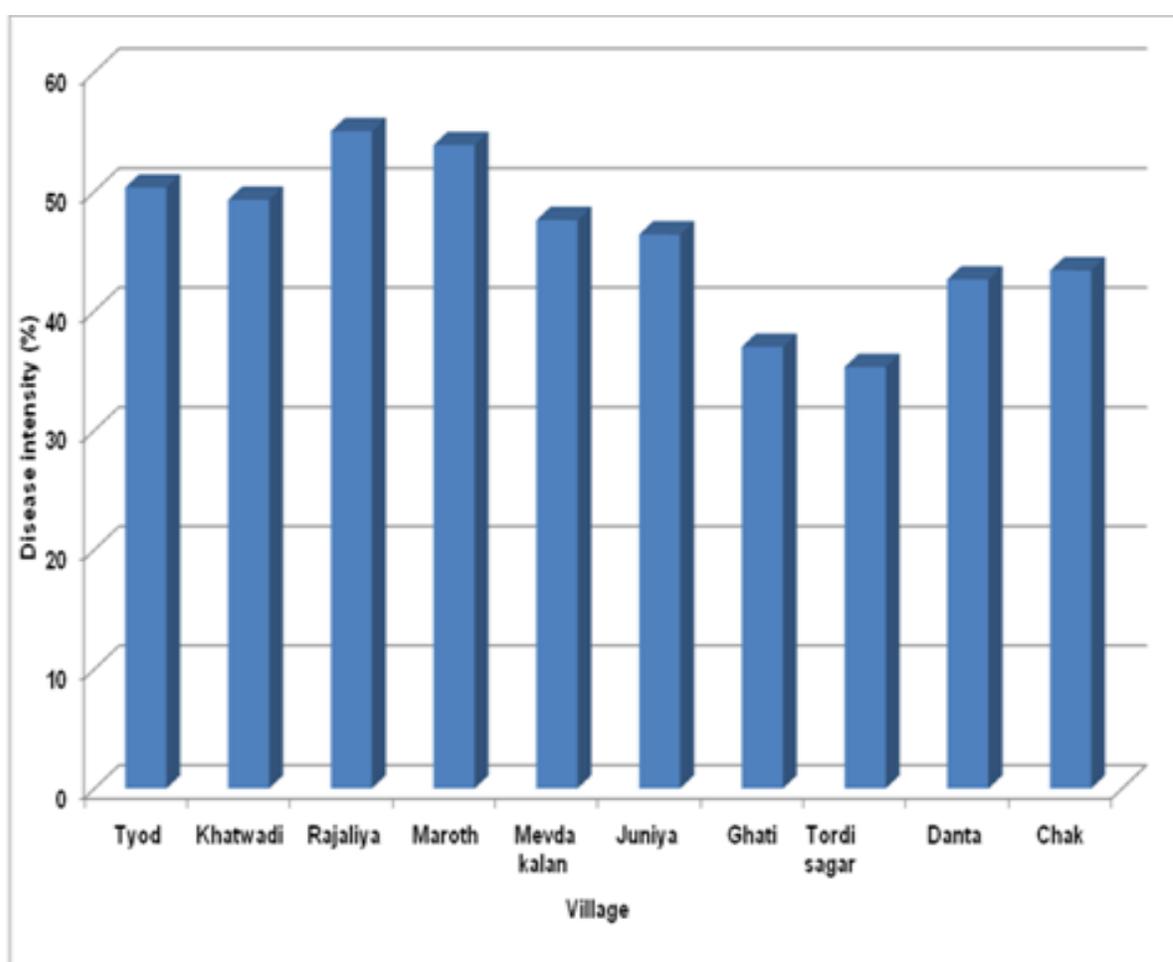


Fig. 3. Pathogenic variability in different isolates of *Cercospora canescens*.

CONCLUSION

Wide occurrence of *Cercospora* leaf spot of mungbean was recorded in all the selected district viz., Nagaur, Jaipur, Sikar, Ajmer and Tonk was surveyed during September 2017 (reproductive stage of crop). The disease intensity of *Cercospora* leaf spot of mungbean was recorded from in all surveyed areas of Rajasthan

with an overall mean of per cent and was, therefore, considered principle disease of the crop in surveyed area. The highest disease intensity was recorded from Rajaliya and Maroth village of Nagaur district, respectively. Lowest *Cercospora* leaf spot disease intensity was recorded from Tordi sagar village of Tonk district. The cultural and morphological pathogenic variability of the results showed that isolates of

Cercospora canescens different in their colony characters, colony colour and colony diameter. Among the ten isolates, isolate *i.e.* CerNg1 and CerNg2 showed maximum colony diameter and with greyish whitish colony colour, white convex fluffy growth and greyish smooth margin with dense centre. Minimum colony growth was observed in isolate CerTk 2.

FUTURE SCOPE

The present investigation has opened up new information and given rise to new ideas on leaf spot disease of mungbean caused by *C. canescens*. Hence the future lines of work are needed with there is a need to undertake an intensive survey for leaf spot disease of mungbean in all mungbean growing areas of Rajasthan and quantify the loss caused by pathogen. To identify the pathogenic and molecular variability in *C. canescens* help to disease management. Research in this field will give direction and help to disease intensity in relation to date of sowing. Detailed investigation on the epidemiology, cultural and pathogenic variability of leaf spot disease of mungbean is needed. Integrated disease management strategies for foliar diseases of mungbean need to be developed.

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Conflict of Interest. The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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