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Screening of cumin germplasms/Varieties against blight disease

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Abstract
The field trials on screening of germplasms/varieties were carried out during two consecutive *Rabi* seasons 2019-20 and 2020-21 at Institutional Farm, Collage of Agriculture, Swami Keshwanand Rajasthan Agricultural University, Bikaner. Blight caused by *Alternaria burnsii* (Uppal, Patel and Kamat) is a serious disease of cumin. Considering its regular occurrence and economic loss the blight pathogen was selected for present investigation to generate the information to find out the resistance of germplasms/varieties. Out of thirty entries tested, none was found completely free from disease also the recommended varieties of Rajasthan State *viz*., GC-4 was found highly susceptible to *Alternaria burnsii* under present investigation.

Keywords: germplasms, varieties, blight, pathogen, resistance

Introduction
Cumin (*Cuminum cyminum* L.) is an important seed spice and one of the earliest known major spices used by mankind and indispensible condiment consumed in every Indian home. Cumin locally known as Jeera or Jiru is belongs to the family Apiaceae (formerly called Umbelliferae) is an annual herb. Crop is mainly affected by three major diseases *viz*., blight (*Alternaria burnsii*), wilt (*Fusarium oxysporum* f. sp. *cumini*) and powdery mildew (*Erysiphe polygoni*) (Dange, 1995) [4].

Alternaria blight is considered to be the most devastating disease of cumin in sub-tropical countries. This disease is quite prevalent and destructive as it affects all above ground plant parts including seed, thus causing direct yield loss. *A. burnsii* affects cumin plant only after flowering stage and causes complete failure of the crop in some years depending on climatic conditions (Sastry and Anandaraj, 2013) [11]. The disease severity varied from 16-65% causing serious damage to the crop (Kalpana, 1993) [7]. *Alternaria burnsii* infect cumin and reduce the yield as well as economic value. It is quite prevalent and destructive as it affects all above ground plant parts including seed, thus, causing direct yield loss. Losses up to 70% have been reported (Holliday, 1980) [6]. The pathogen is seed and soil borne and the seed borne nature of pathogen was observed by (Uppal *et al.*, 1938) [15] and (Patel and Desai, 1971) [10].

Though high degree of host resistance against Alternaria blight has not been found in any genotype of cumin in India, however some degree of resistance has been reported by various workers. Edison and Kallupurackal, 1989 [5] recorded that the varieties RZ-19 and UC198 of cumin were tolerant to blight disease under field conditions in Rajasthan. Mehta and Solanki, 1990 [9] observed none of the cumin varieties and germplasms was found resistant to cumin blight. Only exotic cultures *viz*., EC-13203, EC-109636, WC-109, WC-199, MC-43, JC-160 and JC-163 showed some degree of resistance against Alternaria blight of cumin. Savaliya, 1991 [12] reported that only exotic cultures EC-13203 and EC-109635 gave resistant reaction and WC109, WC-199, MC-43, JC-160, JC-163 and GC-1 were moderately resistant against Alternaria blight of cumin. Mehra *et al*., 2002 [8] screened thirty cumin genotypes against Alternaria blight under field conditions in Haryana, none of the genotypes were found resistant to this disease. However, five genotypes viz., UC-198, UC-216, RZ-19, RZ-209 and HZ-21 were found moderately resistant and nine genotypes *viz.*, JC-9, JC-11, JC147, JEC-1, JEC-171, UC-193, UC-217, UC-218 and UC-89 were found moderately susceptible. Four genotypes Gujarat cumin-1, RS-1, Zeera Local-1 and Zeera Local-2 exhibited susceptible reaction and rest of the ten genotypes showed highly susceptible reaction. Arora *et al*., 2004 [2] evaluated cumin varieties for resistance to blight under field conditions, out of 10 varieties and two local

varieties screened none was found to be totally resistant to blight. Variety UC310 was found to be highly resistant to blight while varieties RZ-209 and UC-223 were found highly susceptible. RZ-19 was found to be moderately susceptible to highly susceptible. Other varieties were moderately susceptible. The Niwai local and Phagi local cumin varieties were found to be highly susceptible to blight. Sunder, 2005 [14] screened various cumin genotypes/varieties for resistance to Alternaria blight of cumin. Out of fifty genotypes/varieties of cumin evaluated against Alternaria blight under field and green house conditions, none was found resistant. However, five genotypes viz., AC-167, RZ-209, UC-198, UC-216 and JC-11 were found moderately resistant both under field and green house conditions. Rest of the genotypes/varieties showed susceptible to highly susceptible reaction. Singh, 2014 [13] revealed that in screening of cultivars CUM-11, GC-4 and RZ-209 were moderately resistant and none of the cultivar was found completely free from the blight. Abdul Wadud *et al*., 2021 [1] conducted field trials with four advanced lines of cumin *viz*., CN026, CN028, CN031 and CN038 in five agro-ecological zones (AEZ) to know the adaptation possibility of these lines against the incidence and severity of Alternaria blight of cumin in Bangladesh. Among all lines, CN026 was found as the best in germination capacity and other yield parameters in all locations. The incidence and severity of the disease was observed as high as 98% and 88%, respectively.

As neither genotype nor variety available at the National level has been found resistant against this disease. Although various fungicides control the Alternaria blight disease with dissimilar cost-benefit ratio. But the ideal and most economical means of managing the blight disease of cumin would be the use of resistant varieties. Under these circumstances there is a need to exploit genetically host resistance in existing germplasms/varieties for the identification of resistant sources so present investigation was taken to find out resistant germplasms/varieties for blight of cumin.

Material and Methods: Thirty entries of cumin collected from Agricultural Research Station, Mandor (Jodhpur) were grown in the field during the two *Rabi* crop seasons 2019-20 and 2020-21. Each entry was grown in a two row of 5 m length with row to row distance of 30 cm. All the recommended package and practices were followed for raising the crop in the field. Ten plants from each germplasm/variety were tagged randomly just after the appearance of the disease. The observations on disease severity were recorded at weekly interval on tagged plant following 0-5 rating scale and categorized them into different reaction grades on the basis of disease intensity.

Table 1: List of cumin germplasms/varieties collected from Agricultural Research Station, Mandor (Jodhpur)

S. No.	Germplasms/Varieties	S. No.	Germplasms/Varieties
1	MCU-2336	16	MCU-82
2	MCU-87	17	GC-4
3	MCU-25	18	MCU-91
4	MCU-79	19	MCU-2
5	IC-595365	20	IC-595336
6	MCU-118	21	MCU-85
7	MCU-81	22	MCU-111
8	MCU-11	23	IC-595353
9	MCU-89	24	MCU-80
10	MCU-5	25	MCU-30
11	MCU-109	26	MCU-7
12	IC-595362	27	MCU-23
13	MCU-22	28	MCU-110
14	MCU-94	29	MCU-10
15	MCU-27	30	MCU-44

Disease intensity was recorded at weekly intervals and each germplasm/variety was further categorized them on the basis of disease intensity. The germplasms/varieties included in the experiment are mentioned above Table 1. Observations of disease intensity were recorded on five randomly selected diseased plants in each line on 0-5 scale basis given by Chester (1959) [3] and Wheeler (1969) [17]. The following rating scale (Table 2) was used for leaf blight disease of cumin:

Table 2: Disease rating scale

Disease rating scale/grade	Per cent leaf area affected	Disease reaction
0	No disease symptom	Highly resistant (HR)
1	A few spots towards tip covering 10 per cent leaf area	Resistant (R)
2	Several dark brown patches covering upto 20 per cent leaf area	Moderately resistant (MR)
3	Several patches with paler outer zone covering upto 40 per cent leaf area	Moderately susceptible (MS)
4	Leaf blight covering upto 75 per cent leaf area or breaking of the leaves from center	Susceptible (S)
5	Complete drying of the leaves or breaking of the leaves from center	Highly susceptible (HS)

Observation

The per cent disease intensity (PDI) was calculated using the following formula:

$$\text{Per cent disease intensity} = \frac{\text{Sum of all individual disease rating}}{\text{Total number of plants assessment x maximum rating}} \times 100$$

Result and Discussion

The thirty cumin genotypes/variety of cumin were evaluated against *Alternaria burnsii* at College Research Farm, College of Agriculture, Bikaner during *Rabi* season 2019-20 and 2020-21. The symptoms of the disease were first noticed under field conditions after flowering stage after 60 days of sowing. The per cent disease intensity and disease reaction (DR) for each line is presented in Table 3.

The data of first *Rabi* season 2019-20 indicated that out of 30 genotypes tested, none was found resistant to Alternaria blight disease. However, four genotypes namely MCU-23, MCU-11, MCU-22 and MCU-7 were found moderate resistant (MR). The eight genotypes namely MCU-87, MCU-25, MCU-81, MCU-82, MCU-30, MCU-110, MCU-10 and MCU-5 were categorized as moderately susceptible (MS) against *Alternaria burnsii*. Three genotypes namely MCU-80, MCU-94 and IC-595365 were found susceptible (s) against *Alternaria burnsii*. The remaining fifteen genotypes *i.e*. MCU-79, MCU-118, MCU-89, MCU-109, IC-595362, MCU-27, GC-4, MCU-91, MCU-2, IC-595336, MCU-85, MCU-111, IC-595353, MCU-23, MCU-44 were recorded as highly susceptible (HS) during *Rabi* season 2019-20.

The data of *Rabi* season 2020-21 was indicated that out of 30 genotypes tested, none was found resistant against Alternaria blight disease similarly, four genotypes namely MCU-23, MCU-11, MCU-22 and MCU-7 were found moderate resistant (MR). The seven genotypes namely MCU-87, MCU-25, MCU-81, MCU-82, MCU-30, MCU-110 and MCU-10 categorized as moderately susceptible (MS) against *Alternaria burnsii*. The genotype MCU-5 and IC-595362 was found susceptible (S) during *Rabi* season 20120-21. Five genotypes namely MCU-80, MCU-94, IC-595365, MCU-5 and IC-595362 were found susceptible (s) against *Alternaria burnsii*. The remaining fourteen genotypes *i.e*. MCU-79, MCU-118, MCU-89, MCU-109, MCU-27, GC-4, MCU-91, MCU-2, IC-595336, MCU-85, MCU-111, IC-595353, MCU-23, MCU-44 were recorded as highly susceptible (HS) during *Rabi* season 2020-21.

The genotypes under the study were scored on a 0-5 rating scale given by Chester (1959) and Wheeler (1969) for their disease intensity (mortality%) and categorized when no mortality as resistant (HR), 1-10% mortality as resistant (R), 11-20% mortality as moderately resistant (MR), 21-40% mortality as moderately susceptible (MS) and 41-75% mortality as susceptible (S) and more than 75% mortality as highly susceptible (HS). Data presented in (Table 3 and fig. 1) and depicted in (plate 1) revealed that out of 30 genotypes tested under field conditions during both the seasons, none was found completely free from Alternaria blight infection and none was found (HR) highly resistant or (R) resistance. However, only four germplasm line MCU-23, MCU-11, MCU-22 and MCU-7 were categorized as moderately resistant (MR) in both the season. The seven genotypes MCU-87, MCU-25, MCU-81, MCU-82, MCU-30, MCU-110, MCU-10 were assessed as moderately susceptible (MS). Four genotypes *viz.*, MCU-80, MCU-94, IC-595365 and MCU-5 were categorized as susceptible (S). Rest of fifteen genotypes *i.e*. MCU-79, MCU-118, MCU-89, MCU-109, IC-595362, MCU-27, GC-4, MCU-91, MCU-2, IC-595336, MCU-85, MCU-111, IC-595353, MCU-23, MCU-44 were recorded as highly susceptible (HS) to *A. burnsii* infection in cumin during both the seasons (Table 4). However, genotype MCU-5 which was moderately susceptible (MS) in individual *Rabi* season 2019-20 but considered as under susceptible (S) category on the basis of average of both the *Rabi* seasons and IC-595362 was susceptible during *Rabi* 2020-21 but considered as under highly susceptible on the basis of average of both the *Rabi* seasons.

Table 3: Reaction of cumin germplasms/varieties against Alternaria blight *(Alternaria burnsii*) under field condition

S. No.	Germplasms/ Varieties	*Rabi* 2019-20		*Rabi* 2020-21		Pooled Data	
		Disease Intensity (%)	Disease Reaction	Disease Intensity (%)	Disease Reaction	Disease Intensity (%)	Disease Reaction
1	MCU-23	15.24 (22.85)*	MR	16.35 (23.74)	MR	15.79 (34.72)	MR
2	MCU-87	23.65 (29.01)	MS	25.53 (30.30)	MS	24.59 (29.65)	MS
3	MCU-25	26.45 (30.89)	MS	30.46 (33.37)	MS	28.45 (32.13)	MS
4	MCU-79	32.57 (34.75)	HS	33.6 (35.38)	HS	33.08(35.06)	HS
5	IC-595365	44.35(41.72)	S	42.75 (40.79)	S	43.55 (41.26)	S
6	MCU-118	78.46 (62.41)	HS	75.78 (60.53)	HS	77.12 (61.47)	HS
7	MCU-81	37.67 (37.82)	MS	36.89 (37.36)	MS	37.28 (37.59)	MS
8	MCU-11	13.76 (21.60)	MR	14.65 (22.15)	MR	14.20 (21.88)	MR
9	MCU-89	79.45 (63.15)	HS	80.85 (64.05)	HS	80.15 (63.60)	HS
10	MCU-5	37.53 (37.45)	MS	46.56 (43.00)	S	42.05 (40.22)	S
11	MCU-109	81.34 (64.56)	HS	82.53 (65.66)	HS	81.93 (65.11)	HS
12	IC-595362	85.39 (67.65)	HS	73.56 (60.92)	S	79.47(64.28)	HS
13	MCU-22	19.35 (25.92)	MR	20.96 (27.11)	MR	20.15(26.51)	MR
14	MCU-94	50.34 (45.17)	S	53.95 (47.25)	S	52.14 (46.21)	S
15	MCU-27	83.75 (66.44)	HS	84.78 (67.14)	HS	84.26 (66.79)	HS
16	MCU-82	30.69 (33.54)	MS	32.78 (34.90)	MS	31.73 (34.22)	MS
17	GC-4	85.93 (68.20)	HS	87.56 (69.63)	HS	86.74 (68.91)	HS
18	MCU-91	89.67 (71.85)	HS	92.67 (74.39)	HS	91.17 (73.12)	HS
19	MCU-2	82.96 (65.77)	HS	83.96 (66.58)	HS	83.46 (66.18)	HS
20	IC-595336	76.89 (61.37)	HS	77.95 (62.02)	HS	77.42 (61.69)	HS
21	MCU-85	85.55 (67.79)	HS	87.57 (69.67)	HS	86.56 (68.73)	HS
22	MCU-111	89.95 (71.81)	HS	90.45 (72.71)	HS	90.2 (72.26)	HS
23	IC-595353	78.25 (62.42)	HS	79.64 (63.36)	HS	78.94 (62.89)	HS
24	MCU-80	47.26(43.40)	S	49.75 (44.83)	S	48.50 (44.11)	S
25	MCU-30	43.87 (41.45)	MS	41.96 (40.33)	MS	42.91 (40.89)	MS
26	MCU-7	21.42 (27.45)	MR	23.78 (29.08)	MR	22.6 (28.26)	MR
27	MCU-23	83.14 (65.92)	HS	84.87 (67.27)	HS	84.005 (66.59)	HS

28	MCU-110	29.76 (33.00)	MS	30.97 (33.73)	MS	30.365 (33.36)	MS
29	MCU-10	32.96 (34.99)	MS	35.07 (36.26)	MS	34.015 (35.63)	MS
30	MCU-44	35.57 (72.77)	HS	38.57 (70.44)	HS	37.07 (71.61)	HS
	S Em (±)	2.49		2.60		2.15	
	C.D. (P=0.05)	7.07		7.37		6.12	
	C.V. (%)	8.79		9.04		7.52	

*values in parenthesis are angular transformed values

Table 4: Reaction of cumin germplasms/ varieties against Alternaria blight (*Alternaria burnsii*) under field condition (Pooled)

S. No.	Germplasms/Varieties	Number of Germplasms/Varieties	Host reaction
1.	NIL	-	Highly Resistance (HR)
2.	NIL	-	Resistance (R)
3.	MCU-23, MCU-11, MCU-22, MCU-7	4	Moderately resistant (MR)
4.	MCU-87, MCU-25, MCU-81, MCU-82, MCU-30, MCU-110, MCU-10	7	Moderately susceptible (MS)
5.	MCU-80, MCU-94, MCU-5, IC-595365	4	Susceptible (S)
6.	MCU-79, MCU-118, MCU-89, MCU-109, IC-595362, MCU-27, GC-4, MCU-91, MCU-2, IC-595336, MCU-85, MCU-111, IC-595353, MCU-23, MCU-44	15	Highly susceptible (HS)

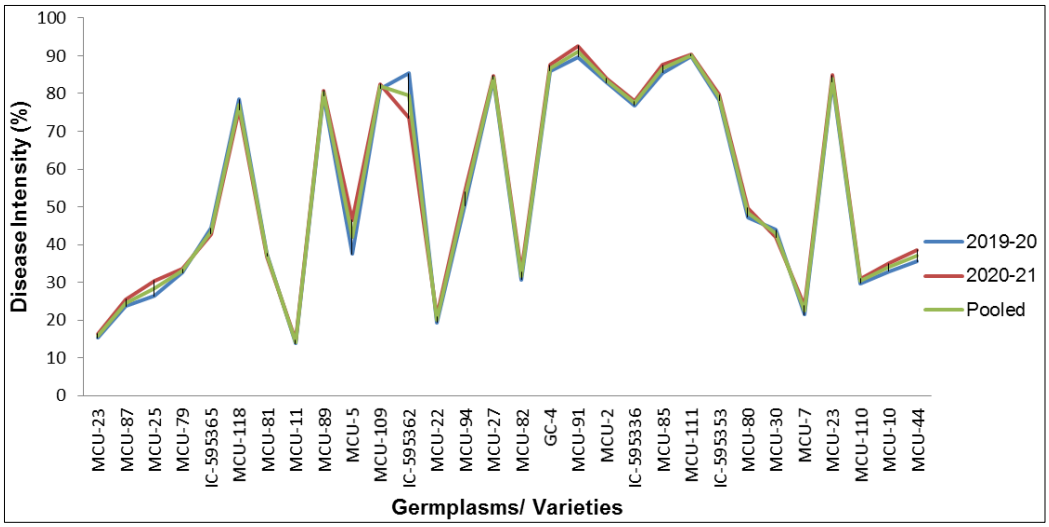

Fig 1: Reaction of cumin germplasms/ varieties against Alternaria blight (*Alternaria burnsii*) under field condition

Plate 1: Screening of germplasm/variety of cumin against blight disease under field conditions

Use of resistant variety is a cheapest and most economical method of disease control. Pooled data of two consecutive *Rabi* season 2019-20 and 2020-21 show that none of the germplasm or variety was found resistant against cumin blight. However, four germplasm entries *i.e.* MCU-23, MCU-11, MCU-22, MCU-7 were found moderately resistant (MR). Seven germplasm entries *i.e.* MCU-87, MCU-25, MCU-81, MCU-82, MCU-30, MCU-110, MCU-10 were found moderately susceptible (MS). Four germplasm entries *i.e.* MCU-80, MCU-94, MCU-5, IC-595365 were found

susceptible (S) and remaining fifteen entries were MCU-79, MCU-118, MCU-89, MCU-109, IC-595362, MCU-27, GC-4, MCU-91, MCU-2, IC-595336, MCU-85, MCU-111, IC-595353, MCU-23, MCU-44 found highly susceptible (HS). These lines were collected from Agricultural Research Station, Mandor (Jodhpur) and except a variety *i.e*. GC-4, there is no research is available for screening of other germplasm lines against Alternaria blight disease in cumin to the best of our knowledge.

Data of two years shows that no line was totally resistant against cumin blight also the variety GC-4 was found highly susceptible to Alternaria blight. Researcher have work on screening out of cumin blight on other germplasm lines show that no line or varieties were completely free from Alternaria blight caused by *A. burnsii* so this finding is in agreement with (Mehta and Solanki, 1990 [8]; Mehra *et al*., 2002 [7]; Arora *et al*., 2004 [2]; Sunder, 2005 [13]; Singh, 2014 [12]; Abdul Wadud *et al*., 2021) [1].

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