

Variability of Blight Pathogen (*Alternaria burnsii* Uppal et al.) of Cumin (*Cuminum cyminum* L.)

P. S. Mali, R. K. Jaiman, A. T. Parmer

Received 28 June 2016 ; Accepted 29 July 2016 ; Published online 24 August 2016

Abstract Blight caused by *A. burnsii* is the major disease of cumin. In all, fifteen isolates of *A. burnsii* were collected from cumin growing areas of North Gujarat and designated as Ab 1 to Ab 15 found pathogenic on cumin variety GC-2. Studies were made on cultural variations in colony growth, growth pattern and colony color. The colony diam ranged from 65.00 mm (Ab 1) to 89.00 mm (Ab 9). The growth pattern varied circular with zonation growth to fluffy growth, circular growth and circular flat growth. The mycelium color varied from greenish to black color, greenish to grey color, dirty white color to black color. Conidia length varied from 25.00 to 51.80 μ m, while conidia breadth varied from 11.60 to 17.60 μ m. The length of conidia beak varied from 8.52 to 11.76 μ m, while breadth of conidia beak varied from 7.20 to 8.68 μ m. The horizontal septa varied from 1–3 to 3–7, while vertical septa varied from 0–3. Studies on pathogenic variability revealed that the disease intensity on cumin varied from 35.09 to 55.41%.

Keywords Cumin, *Alternaria burnsii*, Variability.

Introduction

Cumin (*Cuminum cyminum* L.) belongs to the family Umbelliferae is one of the important seed spices used mainly in Indian cookery. It is widely grown in Rajasthan, Uttar Pradesh and Gujarat. Cumin seeds are essential ingredients used in mixed spices and curry powder. It is also used for flavoring soups, sausages, pickles, cheese and for seasoning bread and cakes. Cumin seeds have been considered stimulative, carminative and astringent, hence used in [diarrhea and dyspepsia]. Cumin oil is used in perfumery and flavoring liquors. Unfortunately, such as important crop suffers from several serious diseases. *Alternaria* blight is one of such diseases that occurs more or less every year in Gujarat and influences production leading to fluctuation in the market prices of cumin seed. The disease is attaining an alarming situation and may become a limiting factor for cumin cultivation in this region. Several researchers have been reported the losses due to this disease up to 80% [1, 2]. The disease is air borne and there for, it becomes difficult to manage the disease through chemical and biological means. The only practical relation of this problem lies in the breeding of resistant varieties. Variability of blight pathogen is of great concern in breeding program for development of high yielding disease resistant variety. It is essential to identify and understand variability in the blight pathogen to work out strategies for durable and stable resistant cumin varieties. The information on cultural, morphological and pathological variation among different isolates of blight pathogen is meager. An attempt was made to study variation in cultural, mor-

P. S. Mali
 Department of Plant Pathology, C. P. College of Agriculture,
 S. D. Agricultural University, Sardarkrushinagar 385506,
 Gujarat, India

R. K. Jaiman*, A. T. Parmer
 College of Horticulture, S. D. Agricultural University, Jagudan,
 Dist Mehsana 382710, Gujarat, India
 e-mail: jaimanrs74@gmail.com

*Correspondence

Table 1. List of fifteen isolates of *Alternaria burnsii* obtained from different locations of cumin growing areas of North Gujarat.

Sl. No.	Isolates	Village	Locations Taluka	District
1.	Ab-1	Jagudan	Mehsana	Mehsana
2.	Ab-2	Charol	Kadi	Mehsana
3.	Ab-3	Dethali	Becharaji	Mehsana
4.	Ab-4	Khambhasan	Modasa	Sabarkantha
5.	Ab-5	Keserpura	Idar	Sabarkantha
6.	Ab-6	Jetpur	Khedbrahma	Sabarkantha
7.	Ab-7	Siya	Dhanera	Banaskantha
8.	Ab-8	Lorvada	Tharad	Banaskantha
9.	Ab-9	Vav	Vav	Banaskantha
10.	Ab-10	Sultanpura	Radhanpur	Patan
11.	Ab-11	Bortvada	Sami	Patan
12.	Ab-12	Vansa	Harij	Patan
13.	Ab-13	Ratanpura	Bhachu	Kachchh
14.	Ab-14	Pragpara	Rapar	Kachchh
15.	Ab-15	Nakhatrana	Nakhatrana	Kachchh

phological and pathological of isolates collected from North Gujarat region.

Materials and Methods

Collection and pathogenicity

Cumin (*Cuminum cyminum* L.) plant with typical blight symptoms were collected from different locations of North Gujarat and Kachchh regions such as Banaskantha, Sabarkantha, Mehesana, Patna and Kachchh districts of Gujarat and designated as Ab1 to Ab15 as mentioned in Table 1. The pathogen *Alternaria burnsii* was isolated from diseased plant parts and established on PDA slants. The pathogenicity of the purified fungus of each isolate was tested in pots. Healthy seeds of cumin variety GC-2 were sown @ 10 seeds/pot. The inoculums of different isolates were multiplied on PDA. Leaves, stem and branches of five week old plants were injured gently by delicate hair brush and then the ten days old spore suspension was sprayed through the atomizer in the morning period. Another set of uninjured and injured plants served as control. Observations on per cent disease intensity were recorded periodically.

Cultural and morphological variability

Fifteen isolates of *A. burnsii* were obtained from the infected plant parts of locally grown cumin cultivars

at diverse locations of North Gujarat during 2011-12. The isolates were maintained and multiplied on Potato Dextrose Agar (PDA) medium. To study the morpho-cultural characteristics of *A. burnsii*, PDA plates were inoculated with 4 mm dia mycelia disc obtained from the periphery of actively growing fungal colony of 7-d-old cultures of each of 15 isolates and three plates of each isolate were then incubated at $27\pm 2^{\circ}\text{C}$

Table 2. Pathogenic reaction of fifteen isolates of *Alternaria burnsii* on cumin variety GC-2. *Arc-sin transformed values. Figures in parentheses are retransformed values.

Sl. No.	Isolates	Per cent blight intensity	
		Injured plant	Uninjured plant
1.	Ab-1	41.22 (43.42)*	34.93 (32.78)*
2.	Ab-2	43.95 (48.16)	37.25 (36.63)
3.	Ab-3	53.29 (64.26)	50.23 (59.07)
4.	Ab-4	46.56 (52.72)	38.04 (37.97)
5.	Ab-5	50.17 (58.97)	46.70 (52.96)
6.	Ab-6	47.16 (53.76)	39.44 (40.35)
7.	Ab-7	49.32 (57.51)	45.10 (50.17)
8.	Ab-8	51.19 (60.71)	48.00 (55.22)
9.	Ab-9	56.78 (69.98)	55.66 (68.17)
10.	Ab-10	52.41 (62.78)	49.06 (57.06)
11.	Ab-11	48.84 (56.68)	43.44 (47.27)
12.	Ab-12	54.38 (66.08)	51.93 (61.97)
13.	Ab-13	43.06 (41.61)	35.65 (33.96)
14.	Ab-14	47.91 (55.07)	42.00 (44.77)
15.	Ab-15	55.07 (67.21)	53.86 (65.21)
16.	Control	–	–
CD ($p \leq 0.05$)		3.44	3.00

Table 3. Cultural characteristics of fifteen isolates of *Alternaria burnsii* on PDA after eight days of incubation at 27±2°C.

Isolates	Colony diameter (mm)	Colony color	Growth pattern
Ab-1	65.00	Greenish to grey	Circular with zonation
Ab-2	70.00	Dark green	Flat growth
Ab-3	85.00	Dirty white, green at middle	Circular
Ab-4	72.00	Greenish to black	Circular with zonation
Ab-5	81.00	White and Green color	Circular, Zonation and Fluffy
Ab-6	75.00	Greenish to black	Fluffy
Ab-7	80.00	Dirty white	Circular
Ab-8	82.00	Dirty white, green at middle	Fluffy
Ab-9	89.00	Dirty white with greenish black	Circular Fluffy
Ab-10	84.00	Greenish to black	Circular Fluffy
Ab-11	78.00	Greenish to black	Flat
Ab-12	87.00	Greenish to black	Circular flat
Ab-13	68.00	Olive green, later black	Circular Fluffy
Ab-14	76.00	Slight green	Circular
Ab-15	88.00	Green and middle dirty white	Fluffy
CD ($p \leq 0.05$)	1.45		

and maintained. The radial growth, pigmentation of mycelium, pigmentation of substrate, number of conidia, length and width of conidia, number of septa (horizontal and vertical), length and width of beak of conidia beak were measured. The length and breadth of conidia was measured by ocular and stage micrometer. The numbers of conidia were counted by hemocytometer.

Pathogenic variability

The pathogenic variability of fifteen isolates was

studied through spray inoculation technique. In this study cumin varieties viz., GC-2, GC-3 and GC-4 were evaluated for blight reaction against collected isolates. Twenty genetically pure seeds of cumin varieties were sown in per pot. Inoculum of each isolate was multiplied individually on PDA for 7 days at 27±2°C. Thirty five days old plants of each variety in each pot was sprayed (1×10^5 spores / ml) separately through atomizer in the evening period. Before spray leaves, stems and branches of cumin plants were injured gently by delicate hair brush. Three pots as

Table 4. Measurement of conidia of fifteen isolates of cumin blight pathogen in potato dextrose agar medium after 15 days of incubation at 27±2°C.

Isolates	Conidia		Septa		Beak		No. of conidia (Spores / ml)
	Length (µm)	Breadth (µm)	Horizontal	Vertical	Length (µm)	Breadth (µm)	
Ab-1	51.02	17.60	3-6	0-3	09.72	08.08	50.0×10^4
Ab-2	30.28	13.28	2-4	0-2	09.76	08.12	52.0×10^4
Ab-3	51.80	17.00	3-7	1-3	10.16	08.60	62.0×10^4
Ab-4	29.00	13.40	1-3	0-2	11.76	08.40	56.0×10^4
Ab-5	32.88	16.80	3-6	1-3	08.52	07.92	59.5×10^4
Ab-6	39.20	15.60	2-6	0-2	10.40	08.12	55.3×10^4
Ab-7	30.00	14.50	1-5	0-2	10.40	08.00	58.8×10^4
Ab-8	28.40	14.40	1-3	0-2	09.40	08.00	60.2×10^4
Ab-9	51.60	16.52	3-7	0-3	10.00	08.36	67.8×10^4
Ab-10	25.00	15.80	1-3	0	11.16	08.08	62.4×10^4
Ab-11	28.30	14.30	2-3	0-3	09.50	07.20	55.5×10^4
Ab-12	47.60	17.00	2-6	0-2	09.60	08.20	64.4×10^4
Ab-13	32.00	11.60	2-4	0-2	10.12	07.92	50.6×10^4
Ab-14	49.60	21.20	3-7	0-3	09.68	08.68	55.6×10^4
Ab-15	43.20	16.00	2-6	1-2	09.20	08.52	65.0×10^4

Table 5. Pathogenic variability among fifteen isolates of *Alternaria burnsii* against three cumin varieties. *Arc-sin transformed values. Figures in parentheses are retransformed.

Sl. No.	Isolates	PDI in cumin varieties			Mean
		GC-2	GC-3	GC-4	
1.	Ab-1	42.63 (45.86)*	32.25 (28.47)	30.38 (25.57)	35.09 (33.04)
2.	Ab-2	45.33 (50.75)	36.56 (35.48)	31.68 (27.58)	37.85 (37.75)
3.	Ab-3	54.13 (65.66)	50.60 (59.71)	47.65 (54.61)	50.79 (60.03)
4.	Ab-4	46.53 (52.66)	37.95 (37.85)	33.07 (29.77)	39.18 (39.94)
5.	Ab-5	51.22 (60.77)	47.22 (53.87)	42.60 (45.81)	47.01 (53.50)
6.	Ab-6	47.56 (54.46)	39.51 (40.47)	34.86 (32.66)	40.65 (42.43)
7.	Ab-7	50.02 (58.71)	44.81 (49.65)	40.26 (41.76)	45.03 (50.05)
8.	Ab-8	51.98 (62.06)	49.05 (57.04)	44.49 (49.10)	48.51 (56.11)
9.	Ab-9	58.51 (72.71)	52.33 (62.65)	52.34 (62.67)	55.41 (67.77)
10.	Ab-10	53.11 (63.96)	45.57 (50.99)	45.57 (50.99)	49.42 (57.68)
11.	Ab-11	49.29 (57.45)	43.21 (46.87)	39.17 (39.89)	43.89 (48.06)
12.	Ab-12	55.90 (68.56)	52.25 (62.51)	50.54 (59.60)	52.90 (63.61)
13.	Ab-13	44.58 (49.26)	35.11 (33.07)	31.49 (27.28)	37.06 (36.31)
14.	Ab-14	48.43 (55.97)	41.02 (43.07)	36.94 (36.11)	42.13 (44.99)
15.	Ab-15	56.96 (70.27)	54.37 (66.06)	51.37 (61.02)	54.23 (65.83)
	Mean	50.41 (59.38)	44.50 (49.12)	40.83 (42.74)	45.28 (50.48)
	Isolates		Varieties	Isolates × Varieties	
CD ($p = \leq 0.05$)		0.36	0.16	0.63	

three replication for each variety and isolate was maintained. Parallel three pots of each variety, without inoculation of any isolate was maintained as control. The inoculated plants were inspected daily for the first appearance of blight symptoms and per cent disease intensity was recorded at 15th days after appearance of first symptoms by using the 0—5 scale adopted by Anwer et al. [3]. The per cent disease intensity was worked out formula given by Datur and Mayee [4].

Results and Discussion

Pathogenicity

There was a significant difference among fifteen isolates in their ability to induce blight disease in susceptible variety GC-2 and mean blight intensity in injured plant ranged from 41.22% (Ab-1) to 56.78% (Ab-9) (Table 2). The maximum blight intensity 56.78% was recorded by Ab-9 followed by Ab-15 (55.07%), Ab-12 (54.38%) and Ab-3 (53.29%). The minimum blight intensity 41.22% was produced by Ab-1 followed by Ab-13 (43.06%) and Ab-2(43.95%). Thus Ab-9 was virulent isolate. The present findings are in conformity with the findings of the research work of

Shekhawat et al. [5] who observed considerable difference in virulence of different isolate of *Alternaria burnsii*.

Cultural variability

All the isolates of *A. burnsii* showed significant variation in colony growth, growth pattern and colony color. The colony diam ranged from 65.00 mm (Ab-1) to 89.00 mm (Ab-9) (Table 3). The maximum colony diam 89.00 mm was recorded in Ab-9 followed by Ab-15 (88.00 mm) Ab-12 (87.70 mm), while minimum colony diam 65.00 mm was observed in Ab-1 followed by Ab-13 (67.00 mm) and Ab-2 (70.00 mm). Isolates differed in their growth pattern considerably on potato dextrose agar (PDA) medium. The isolates Ab-1 and Ab-4 produced circular with zonation growth, while isolate Ab-5 produced circular with zonation and fluffy growth. Isolates Ab-2 and Ab-11 produced flat growth, while isolates Ab-9, Ab-10 and Ab-13 produced circular fluffy growth. Isolates Ab-6, Ab-8 and Ab-15 produced fluffy growth. Isolates Ab-3, Ab-7 and Ab-14 produced circular growth and Ab-12 produced circular flat growth. Colony color varied among different isolates on PDA. Isolates Ab-4, Ab-6, Ab-10, Ab-11 and Ab-12 produced greenish to black collar

while isolate Ab-1 produce greenish to grey color. Isolates Ab-3 and Ab-8 produce dirty white color and green at middle, Ab-9 produce dirty white with greenish black in color, while Ab-15 produce green color and dirty white in middle. Isolate Ab-2 produce dark green color, while Ab-14 produce slight green color. Isolate Ab-5 produce white and green color while isolate Ab-7 produce dirty white color. Isolate Ab-13 produce olive green but later it turns to black in color. Thus, there was a considerable variation observed among fifteen isolates of cumin blight pathogen in respect of colony characters, colony color and colony diameter. Pipliya and Jadeja [6] found variation in colony color, colony type and growth habit in eighty isolates of *Alternaria burnsii* collected from Saurashtra region of Gujarat. Shekhawat et al. [5] found cultural variation among five isolates of *A. burnsii* in regards to growth character and colony color.

Morphological variability

The morphological variability of fifteen isolates of *A. burnsii* revealed the variation in size of conidial length, breadth, beak length, breadth, horizontal and vertical septa (Table 4). The length of conidia varied from 25.00 μm in isolate Ab-10 to 51.80 μm in isolate Ab-3, while the breadth of conidia ranged from 11.60 μm in isolate Ab-13 to 17.60 μm in isolate Ab-1. The length of conidia beak varied from 8.52 μm in isolate Ab-5 to 11.76 μm in Ab-4, while the breadth of conidia beak varied from 7.20 in isolate Ab-11 to 8.68 μm in isolate Ab-14. The horizontal septa varied from 1—3 in isolate Ab-4, Ab-8 and Ab-10 to 3—7 in isolate Ab-3, Ab-9 and Ab-14. Number of vertical septa varied from 0—3. Number of conidia / ml varied from 50.0×10^4 in isolate Ab-1 to 67.8×10^4 in Ab-9 (Table 4). The present findings are in agreement with Shekhawat et al. [5].

Pathogenic variability

Variation in respect of blight intensity was noticed among different varieties as well as isolates (Table 5). Among different three varieties, significantly maximum mean blight intensity 50.80% was observed in GC-2. The minimum mean blight intensity 40.83% was recorded in GC-4. The moderate blight intensity 44.58% was observed in GC-3. Among different fifteen isolates, maximum mean blight intensity 55.41% was recorded in Ab-9 followed by Ab-15 (54.23%) and Ab-12 (52.90%). The minimum blight intensity 35.09% was observed by Ab-1 followed by Ab-13 (37.06%) and Ab-2 (37.85%). The results of present findings are in accordance with the research work done by, Shekhawat et al. [5].

References

1. Joshi NC (1955) Notes on two diseases of *Cuminum cyminum* L. from Ajmer State. *Sci Cult* 21 : 101—102.
2. Savaliya RL (1991) *Alternaria brassicicola* (Schweins) Wiltsh inciting a serious blight of cumin (*Cuminum cyminum* L.)—A new record. PhD thesis. Gujarat Agric Univ, Sardarkrushinagar.
3. Anwer MM, Lal G, Kakani RK, Meena RS, Mehta RS (2009) Serious of national workshops on cumin, fenel, coriander and fenugreek proceedings and recommendations. Nat Res Center on Seed Spices, Tabiji, Ajmer, pp 32.
4. Datur VV, Mayee CD (1981) Assessment of loss in tomato yield due to early blight. *Ind Phytopath* 34 : 191—192.
5. Shekhawat N, Trivedi A, Sharma SK, Kumar A (2013) Cultural, morphological and pathogenic variability in *Alternaria burnsii* causing blight of cumin. *J Mycol Pl Pathol* 43 : 80—83.
6. Pipliya BH, Jadeja KB (2008) Cultural variability and mancozeb sensitivity of different isolates of *Alternaria burnsii*. *J Mycol Pl Pathol* 38 : 121—122.