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Variability studies of *Phomopsis vexans* (Sacc. & Syd.) Harter

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Diseased samples of leaves and fruits of brinjal showing typical blight and rotting symptoms, respectively, were collected in perforated polyethylene bags from different locations at different stages of crop growth. These sample bags were brought to laboratory for isolation and identification. A total of eighteen isolates of *Phomopsis vexans* were selected for further variability studies. Considerable variations were recorded among *P.vexans* isolates in their morphological and cultural characters basing on their distinct colony colour *viz*. white, dull white and black; on the basis of colony type *viz*. aerial, subaerial and appressed towards margin; on the basis of colony shape viz. circular and irregular; on the basis of zonation *viz*. distinct, indistinct and absent, and on the basis of radial growth recorded after seven days of inoculation, pycnidia formation and conidia (α and β) size, Physiological studies on different media viz. Potato Dextrose Agar (PDA), Oat Meal Agar (OMA), Corn Meal Agar (CMA), Richard's Agar (RA) and Water Agar (WA) were conducted by inoculating 5 mm disc of actively growing fungus. Variability to cause leaf blight and fruit rot on brinjal cultivar Pusa Purple Long was on the basis of per cent disease intensity was recorded on fruits and on leaves.

Key words: Isolates, morphological and cultural, physiological, pathological, *Phomopsis vexans*, variability

INTRODUCTION

The egg plant or brinjal (*Solanum melongena* L.) is an important commercial vegetable crop of Jammu region accounting for 950 ha area with total production of 13,775 MT (Annonymus, 2008). Variability studies on different isolates of the leaf blight and fruit rot pathogen [*Phomopsis vexans* (Sacc. & Syd.) Harter] are conducted by various workers to study the morphological, cultural, physiological and pathological characters (Pawar and Patel, 1957; Panwar and Chand, 1968; Islam *et al*., 1990). Kumar and Sugha (2004) have conducted variability studies among thirty seven isolates of *P. vexans* and observed that they are found to vary in their colony colour, type, time taken for formation of pycnidia, sporulation density and their ability in causing pre- and post-emergence damping-off in seedlings. Akhtar (2007) has studied the host-pathogen interactions in terms of parasitic fitness and aggressiveness of the pathogen (100 isolates) on the host. It is important to study the variability among different isolates to know their aggressiveness against the host. Our studies have been conducted to observe the variability among different isolates of *P.vexans* on morphological, cultural, physiological and pathological characters.

MATERIALS AND METHODS

Brinjal leaves and fruits showing typical blight and rotting symptoms, respectively, were collected from fields at different locations of Jammu division, during the surveys. The pathogen associated with the leaf blight and fruit rot was isolated and identified *Phomopsis vexans* (Sacc. & Syd.) Harter, and its identification was confirmed by Indian Type Culture Collection (ITCC) identification/supply services, Division of Plant Pathology, IARI, New Delhi, and the allotted ID number is ID number- 6465.07.

Morphological and cultural studies

Eighteen isolates were selected for studying the variability among them on the basis of their distinct colony colour *viz*. white, dull white and black; on the basis of colony type *viz*. aerial, subaerial and appressed towards margin; on the basis of colony

shape viz. circular and irregular; on the basis of zonation *viz*. distinct, indistinct and absent, and on the basis of radial growth recorded after seven days of inoculation. The colony type, shape and zonation were assessed after ten days of incubation, whereas, colony colour was recorded after 15-25 days of incubation. To observe and record pycnidial and conidial morphology, 25 days old cultures were used. The size of α and β conidia were measured with the help of ocular micrometer. Each isolate was given a Pv number from 1 to 18. Pure cultures of all the 18 isolates of *P. vexans* were maintained applying single spore isolation technique. The variability traits of the eighteen selected isolates were further considered on the basis of their physiological, and pathological studies.

Physiological studies

The eighteen selected isolates of *Phomopsis vexans* were individually grown on Petriplates containing Potato Dextrose Agar (PDA), Oat Meal Agar (OMA), Corn Meal Agar (CMA), Richard's Agar (RA) and Water Agar (WA) medium by inoculating 5 mm disc of actively growing fungus. The Petriplates were incubated at 25±2°C and observations on the radial growth of the isolates were recorded at an interval of 24 hrs till the pathogen fully covered the media of the Petriplate. The data were recorded for a maximum of seven days.

Isolates of *Phomopsis vexans* were categorized into three categories such as fast growing, which covered the entire Petriplate; moderately growing, reaching the colony radial growth of 30-44 mm and slow growing having less than 30 mm radial growth after seven days of their inoculation on different media. The average growth rate per day was calculated using the following formula (Verma, 1997): $rg = (cd_2 - cd_1)/(t_2 - t_1)$, where, rg = rate of mycelial growth (mm/day), cd_2 = mean radius of colony at time t_2, cd_1 = mean radius of colony at time t_1, t_2 = time when mean radial growth of colony was cd_2, and t_1 = time when mean radial growth of colony was cd_1

Pathological studies

Virulence of all the eighteen *Phomopsis vexans* isolates was evaluated through pathogenicity tests which were performed on highly susceptible and widely grown brinjal cultivar- Pusa Purple Long (PPL). Surface sterilized (0.1% mercuric chloride) seeds of PPL were sown in trays filled with autoclaved soil and 25 days old seedlings were transplanted in pots filled with sterilized soil. One seedling per pot was maintained. A week after transplanting, the seedlings were artificially spray inoculated with the conidial suspension ($1\times10^5 ml^{-1}$) of the isolates, separately. Seedlings sprayed with sterilized distilled water served as check. Forty five days after inoculation, per cent disease intensity was recorded on fruits and on leaves.

The per cent disease intensity on leaf was recorded using 1-12 point scale proposed by Horsfall and Barratt (1945) given as Grade = Per cent leaf area : 1 = 0, 2 = 0-3, 3 = 3-6, 4 = 6-12, 5 = 12-25, 6 = 25-50, 7 = 50-75, 8 = 75-87, 9 = 87-94, 10 = 94-97, 11 = 97-100, 12 = 100.

The per cent disease intensity on fruit was recorded using 1-8 point scale (Kumar, 1998) given as Grade = Hull rot%: 1 = 0, 2 = 0-10, 3 = 11-25, 4 = 26-50, 5 = 51-75, 6 = 76-90, 7 = 91-100, 8 = 100.

The per cent disease intensity on leaf blight and fruit rot were calculated as given below (Wheeler, 1969):

$$\text{Per cent disease intensity} = \frac{\text{Total sum of numerical ratings}}{\text{Number of samples observed} \times \text{Maximum disease rating}} \times 100$$

RESULTS

Morphological and cultural studies

A perusal of data presented in Table 1 revealed that of the 18 isolates, 11 isolates, constituting 61.11 per cent of the total isolates, exhibited colonies having aerial growth in the Petriplates, five, amounting to 27.78 per cent, showed subaerial colonies and two (Pv-9 and Pv-18) amounting to 11.11 per cent, exhibited appressed colony type. The pattern of zonation in the colonies revealed that out of 18 isolates, two isolates (11.11%) grew without any zonation, four (22.22%) with distinct zonation, whereas, in the remaining 12 isolates (66.67%) there was indistinct and not very clear zonation. Five isolates amounting to 27.78 per cent had irregular colony shape on the medium, whereas, the remaining 13 isolates (72.22 %) had circular colonies. Thirteen

isolates (72.22%) exhibited white colony colour, whereas, four isolates (22.22%) showed dull white colour and one isolate (05.56%) had black colony colour. Fifty per cent of the colonies (9 isolates) achieved the maximum radial growth of 45 mm in seven days, whereas, in the remaining 9 isolates the radial growth varied from 28.65 to 43.05 mm after seven days of inoculation at 25±2°C. Isolates of *P. vexans* took variable time in producing pycnidia. Isolate Pv-13 took minimum (8 days) time and Pv-9 took maximum (22 days) time to produce pycnidia, whereas, twelve isolates (66.67%) took 8 to 15 days to produce pycnidia and six isolates took 15 to 22 days to produce pycnidia. Out of 18 isolates, smallest size of alpha conidia were recorded from isolate Pv-1 (5.29×1.82 µm), whereas, it was maximum in isolate Pv-5 (11.40×2.70 µm). Smallest size of beta conidia were recorded from isolate Pv-1 and Pv-12 (16.00×0.75 µm each), whereas, it was maximum in isolate Pv-5 (22.75 × 1.50 µm).

Table. 1: Morphological and colony characters of *Phomopsis vexans* isolates on Potato Dextrose Agar

Isolate	Type	Shape	Colony characters			Pycnidia formation (days)	Conidial size (µm)	
			Colour	Zonation	Radial growth* (mm)		α Conidia	β Conidia
Pv-1	Aerial	Circular	White	Indistinct	45.00	12	5.29 × 1.82	16.00 × 0.75
Pv-2	Aerial	Circular	White	Indistinct	43.05	16	8.30 × 2.25	19.50 × 0.85
Pv-3	Aerial	Circular	White	Absent	37.35	19	7.42 × 1.95	17.50 × 1.00
Pv-4	Subaerial	Circular	White	Indistinct	45.00	14	6.50 × 2.40	16.50 × 0.75
Pv-5	Aerial	Circular	Dull white	Distinct	45.00	9	11.40 × 2.70	22.75 × 1.50
Pv-6	Aerial	Irregular	White	Indistinct	33.30	20	9.20 × 2.22	20.00 × 1.00
Pv-7	Subaerial	Circular	White	Indistinct	41.07	10	5.85 × 2.10	16.50 × 0.75
Pv-8	Subaerial	Irregular	White	Indistinct	45.00	15	7.25 × 2.85	17.50 × 1.00
Pv-9	Appressed	Circular	Dull white	Distinct	28.65	22	9.32 × 2.50	21.00 × 1.25
Pv-10	Aerial	Irregular	White	Indistinct	45.00	12	6.45 × 2.25	17.00 × 0.75
Pv-11	Aerial	Irregular	Blackish	Distinct	39.70	19	8.75 × 2.95	19.50 × 1.25
Pv-12	Aerial	Circular	White	Indistinct	31.00	13	5.70 × 2.12	16.00 × 0.75
Pv-13	Aerial	Circular	Dull white	Indistinct	45.00	8	8.7 × 2.50	20.50 × 1.25
Pv-14	Subaerial	Circular	White	Indistinct	35.60	20	8.10 × 2.70	19.00 × 1.00
Pv-15	Aerial	Irregular	White	Absent	45.00	14	10.25 × 3.10	22.00 × 1.75
Pv-16	Aerial	Circular	White	Distinct	45.00	10	7.85 × 1.90	18.50 × 0.75
Pv-17	Subaerial	Circular	White	Indistinct	40.10	15	9.5 × 2.50	21.50 × 1.50
Pv-18	Appressed	Circular	Dull white	Indistinct	45.00	11	8.6 × 2.90	20.00 × 1.25

*After seven days

Physiological studies

The selected 18 isolates of *Phomopsis vexans* were grown on five different media and it was observed that after three days of inoculation (Table 2), Richard's Agar medium supported maximum radial growth for all the isolates (except Pv-9 and Pv-17) with maximum radial growth in isolate Pv-13 (34.75 mm) and minimum in isolate Pv-9 (11.55 mm). Richard's Agar medium was followed by Oat Meal Agar medium for all the isolates except Pv-9 and Pv-17, which recorded more radial growth on Oat Meal Agar medium. On Oat Meal Agar medium, maximum radial growth was recorded in isolate Pv-13 (27.00 mm) and minimum in Pv-9 (11.85 mm). Maximum radial growth on Potato Dextrose Agar medium was recorded in isolate Pv-13 (22.45 mm) and minimum in Pv-9 (09.90 mm). On Corn Meal Agar medium maximum radial growth was recorded for isolate Pv-13 (23.90 mm) and minimum in Pv-9 (07.70 mm). Maximum radial growth on Water Agar was recorded for isolate Pv-13 (21.15 mm) and minimum in Pv-9 (05.25 mm).

Table. 2: Radial growth of *Phomopsis vexans* isolates on different culture media

Isolate	Potato Dextrose Agar			Oat Meal Agar			Corn Meal Agar			Richard's Agar			Water Agar		
	Radial growth (mm) after			Radial growth (mm) after			Radial growth (mm) after			Radial growth (mm) after			Radial growth (mm) after		
	3 days	5 days	7 days	3 days	5 days	7 days	3 days	5 days	7 days	3 days	5 days	7 days	3 days	5 days	7 days
Pv-1	20.0	42.0	45.0	24.1	45.0	45.0	18.3	34.0	45.0	27.8	43.0	45.0	17.1	27.7	32.1
Pv-2	17.6	34.9	43.0	19.4	37.6	45.0	14.6	29.0	39.0	24.6	37.5	45.0	13.6	21.1	26.3
Pv-3	13.9	29.1	37.3	17.3	31.6	42.6	12.3	26.1	35.9	19.8	32.8	41.0	12.2	21.0	24.9
Pv-4	21.6	42.0	45.0	25.1	45.0	45.0	19.6	36.0	44.4	30.1	40.9	45.0	17.0	23.6	29.6
Pv-5	19.9	35.5	45.0	21.4	40.2	45.0	15.3	28.0	41.9	22.6	36.1	45.0	15.1	24.9	28.0
Pv-6	14.8	24.6	33.3	15.4	29.4	38.6	10.8	21.6	29.6	17.1	29.6	35.2	08.5	11.2	14.7
Pv-7	19.2	31.8	41.7	20.3	35.8	45.0	11.7	24.2	37.3	26.3	34.0	44.0	11.0	16.8	21.3
Pv-8	19.2	36.4	45.0	23.0	41.8	45.0	18.2	30.0	40.3	23.2	39.0	45.0	16.1	26.1	29.1
Pv-9	09.9	19.8	28.6	11.8	24.2	33.0	07.7	16.6	24.6	11.5	23.4	31.4	05.2	08.8	12.0
Pv-10	19.6	38.0	45.0	25.2	43.0	45.0	19.0	32.2	42.0	32.3	40.3	45.0	16.9	28.0	30.9
Pv-11	17.2	31.7	39.7	20.5	33.4	42.6	11.0	22.6	33.8	25.3	33.6	42.3	09.3	14.5	18.2
Pv-12	12.7	23.3	31.0	13.4	25.7	35.1	09.7	20.3	27.3	14.3	27.4	34.6	09.1	13.2	16.2
Pv-13	22.4	42.3	45.0	27.0	45.0	45.0	23.9	38.4	45.0	34.7	43.4	45.0	21.1	30.3	34.5
Pv-14	14.2	26.3	35.6	16.3	29.1	39.0	12.8	22.0	30.0	17.5	25.7	36.8	07.5	11.4	17.8
Pv-15	20.7	41.5	45.0	23.5	45.0	45.0	21.9	35.3	45.0	28.1	37.3	45.0	18.3	25.4	27.6
Pv-16	20.0	33.8	45.0	21.3	38.2	45.0	17.0	31.2	44.0	22.4	34.9	45.0	11.2	18.2	23.6
Pv-17	15.4	29.2	40.1	17.2	34.4	45.0	10.0	24.7	35.6	15.9	30.0	40.7	07.1	10.8	15.7
Pv-18	21.1	39.5	45.0	22.5	44.2	45.0	19.7	31.0	41.1	33.2	39.1	45.0	15.6	20.3	25.1
CD (P=0.05)	0.75	0.81	0.56	0.49	0.45	0.31	0.54	0.53	0.40	0.50	0.57	0.38	0.59	0.61	0.57
SE (m)	0.26	0.29	0.20	0.17	0.16	0.11	0.19	0.19	0.14	0.18	0.20	0.13	0.21	0.22	0.20

The data presented in the Table 2 further revealed that after five days of inoculation Oat Meal Agar medium supported maximum growth of all the isolates except Pv-3, Pv-6, Pv-11 and Pv-12 which exhibited more growth on Richard's Agar medium. On Oat Meal Agar medium maximum radial growth (45.00 mm) was recorded in Pv-1, Pv-4, Pv-13 and Pv-15, and minimum in isolate Pv-9 (24.20 mm). Radial growth on Oat Meal Agar medium for all the isolates except Pv-3, Pv-6, Pv-11 and Pv-12, was followed by Richard's Agar medium. On Richard's Agar medium maximum radial growth was recorded for isolate Pv-13 (43.40 mm) and minimum in Pv-9 (23.40 mm). On Potato Dextrose Agar medium maximum radial growth was recorded for isolate Pv-13 (42.30 mm) and minimum in Pv-9 (19.85 mm). Maximum radial growth on Corn Meal Agar medium was recorded for isolate Pv-13 (38.40 mm) and minimum in Pv-9 (16.65 mm). When compared to other media, Water Agar medium supported minimum radial growth for all the isolates tried, however, maximum radial growth on Water Agar medium was recorded for isolate Pv-13 (30.30 mm) and minimum in Pv-9 (08.80 mm).

Table. 3: Growth rate of different *Phomopsis vexans* isolates on different media under *in vitro* conditions

Growth Pattern*	Potato Dextrose Agar	Oat Meal Agar	Corn Meal Agar	Richard's Agar	Water Agar
Fast = 45 mm	Pv-1, Pv-4, Pv -5, Pv-8, Pv -10, Pv-13, Pv-15, Pv-16 and Pv-18	Pv-1, Pv-2, Pv-4, Pv -5, Pv-7, Pv-8, Pv-10, Pv-13, Pv-15, Pv -16, Pv -17 and Pv -18	Pv-1, Pv-13 and Pv-15	Pv-1, Pv -2, Pv -4, Pv -5, Pv-8, Pv -10, Pv -13, Pv -15, Pv -16 and Pv-18	-
Moderate = 30– 44 mm	Pv-2, Pv-3, Pv -6, Pv -7, Pv -11, Pv-12, Pv-14; Pv-18	Pv-3, Pv -6, Pv -9, Pv -11, Pv-12 and Pv-14	Pv-2, Pv-3, Pv -4, Pv -5, Pv-7, Pv -8, Pv -10, Pv -11, Pv-14, Pv -16, Pv -17 and Pv-18	Pv-3, Pv -6, Pv -7, Pv -9, Pv-11, Pv -12, Pv-14 and Pv-17	Pv-1, Pv -10 and Pv-13
Slow = < 30 mm	Pv-9	-	Pv-6, Pv -9 and Pv-12	-	Pv-2, Pv-3, Pv-4, Pv-5, Pv-6, Pv-7, Pv-8, Pv-9, Pv-11, Pv-12, Pv -14, Pv-15, Pv -16, Pv -17 and Pv-18

*Radial growth after seven days

The mycelial growth observed at the end of seven days (Table 2) revealed that Oat Meal Agar medium continued to support maximum radial growth for all the isolates when compared to other media. It supported maximum growth (45.00 mm) in the 12 isolates (66.67%) Pv-1, Pv-2, Pv-4, Pv-5, Pv-7, Pv-8, Pv-10, Pv-13, Pv-15, Pv-16, Pv-17 and Pv-18, and minimum in isolate Pv-9 (33.00 mm). On Richard's Agar medium maximum growth (45.00 mm) was recorded in 10 isolates (55.56%) Pv-1, Pv-2, Pv-4, Pv-5, Pv-8, Pv-10, Pv-13, Pv-15, Pv-16 and Pv-18, and minimum was recorded in isolate Pv-9 (31.40 mm). In Potato Dextrose Agar medium maximum growth (45.00 mm) was recorded from 9 isolates (50%) Pv-1, Pv-4, Pv-5, Pv-8, Pv-10, Pv-13, Pv-15, Pv-16 and Pv-18, and minimum in isolate Pv-9 (28.65 mm). On Corn Meal Agar medium maximum growth (45.00 mm) was recorded with 3 isolates (16.67%) Pv-1, Pv-13 and Pv-15, whereas, minimum growth was recorded in isolate Pv-9 (24.60 mm). Water Agar supported maximum growth in isolate Pv-13 (34.55 mm) and minimum in Pv-9 (12.05 mm).

On the basis of their growth rate on different media (Table 3) the 18 isolates of *Phomopsis vexans* studied were categorized into three groups. Fast growing, which covered the entire petriplate by seventh day; moderately growing, reaching the colony radial growth of 30-44 mm in seven days; and slow growing, having less than 30 mm radial growth in seven days. On Potato Dextrose Agar medium isolates Pv-1, Pv-4, Pv-5, Pv-8, Pv-10, Pv-13, Pv-15, Pv-16 and Pv-18 were grouped as fast growing, whereas, isolates Pv-2, Pv-3, Pv-6, Pv-7, Pv-11, Pv-12, Pv-14 and Pv-17 as moderately growing and Pv-9 was grouped in the slow growing category. On Oat Meal Agar medium isolates Pv-1, Pv-2, Pv-4, Pv-5, Pv-7, Pv-8, Pv-10, Pv-13, Pv-15, Pv-16, Pv-17 and Pv-18 were grouped in the fast growing category, whereas, isolates Pv-3, Pv-6, Pv-9, Pv-11, Pv-12 and Pv-14 were grouped in the moderately growing category. On Corn Meal Agar medium isolates Pv-1, Pv-13 and Pv-15 were grouped in the fast growing category, whereas, isolates Pv-2, Pv-3, Pv-4, Pv-5, Pv-7, Pv-8, Pv-10, Pv-11, Pv-14, Pv-16, Pv-17 and Pv-18 were grouped in the moderately growing category and isolates Pv-6, Pv-9 and Pv-12 in slow growing category. On Richard's Agar medium isolates Pv-1, Pv-2, Pv-4, Pv-5, Pv-8, Pv-10, Pv-13, Pv-15, Pv-16 and Pv-18 were grouped as fast

growing, whereas, isolates Pv-3, Pv-6, Pv-7, Pv-9, Pv-11, Pv-12, Pv-14 and Pv-17 were grouped in the moderately growing category. On Water Agar medium none of the 18 isolates were grouped in the fast growing category, whereas, isolates Pv-1, Pv-10 and Pv-13 were grouped in the moderately growing category and remaining isolates as slow growing.

Table. 4: Comparative virulence of *Phomopsis vexans* isolates against brinjal cv Pusa Purple Long

Isolate	Leaf blight intensity (%)	Fruit rot intensity (%)
Pv-1	36.96 (37.42)*	26.37 (30.89)
Pv-2	30.07 (33.24)	21.91 (27.90)
Pv_3	42.12 (40.45)	30.67 (33.61)
Pv-4	21.27 (27.45)	11.37 (19.70)
Pv-5	32.43 (34.70)	23.91 (29.26)
Pv-6	39.12 (38.70)	28.75 (32.41)
Pv-7	10.63 (19.01)	04.71 (12.44)
Pv-8	28.38 (32.18)	15.66 (23.30)
Pv-9	51.26 (45.70)	35.87 (36.78)
Pv-10	24.41 (29.60)	15.45 (23.14)
Pv-11	45.06 (42.15)	33.25 (35.20)
Pv-12	60.95 (51.30)	49.66 (44.79)
Pv-13	27.54 (31.64)	18.75 (25.65)
Pv-14	33.24 (35.19)	22.08 (28.02)
Pv-15	20.52 (26.92)	12.50 (20.69)
Pv-16	47.23 (43.39)	37.37 (37.67)
Pv-17	35.85 (36.76)	23.83 (29.21)
Pv-18	27.60 (31.68)	17.29 (24.56)
Control	00.00 (00.00)	00.00 (00.00)
CD (P=0.05)	0.57	0.86
SE (m)	0.20	0.30

*Values in parenthesis are angular transformed

Pathological studies

Pathological studies of the 18 selected isolates of *Phomopsis vexans* were conducted on the susceptible brinjal variety 'Pusa Purple Long' in pots under controlled conditions. Per cent disease intensity for leaf blight and fruit rot was recorded for the individual isolates after 45 days of inoculation of the conidial suspension of all the eighteen isolates selected for variability studies. A perusal of the data presented in the Table 4 revealed that intensity of disease on leaves as well as on fruits by the isolates were significantly different from each other. Minimum leaf blight (10.63%) and fruit rot (04.71%) intensity was recorded by isolate Pv-7, whereas, it was maximum (60.95 and 49.66%, respectively), by isolate Pv-12. Leaf blight intensity recorded for isolate Pv-13 and Pv-18 was statistically at par with each other, thus indicating no significant difference between the virulence of these two isolates. However, leaf blight intensity recorded by all the other isolates was significantly different from each other. Fruit rot intensity recorded with isolates Pv-2 and Pv-14, Pv-5 and Pv-17, and Pv-8 and Pv-10 were statistically at par with each other, whereas, all the other isolates were significantly different from each other.

DISCUSSION

Variability studies of the 18 isolates revealed variation of aspects such as time taken for pycnidia formation, conidial morphology (α and β conidia) and cultural characters (type, colour, zonation, shape and radial growth of colony). Variability in the morphological and cultural characters of isolates of *P. vexans* has been reported from Punjab and Haryana (Panwar and Chand, 1968; Islam *et al.* 1990) and from other regions of India. Kumar and Sugha (2004) reported variation in the colony colour, type, and time taken for formation of pycnidia, sporulation density of the thirty seven isolates. Akhtar and Chaube (2006) conducted variability studies on fifty *P. vexans* isolates and revealed significant differences in radial growth and other morphological characters on PDA. Munatanola *et al.* (1985) have reported the variability in the isolates of *Phomopsis helianthi* from Yugoslavia.

Physiological studies were conducted on five different media (Potato Dextrose Agar, Corn Meal Agar, Oat Meal Agar, Richard's Agar and Water Agar medium) to observe the variability in radial growth of the 18 isolates of *Phomopsis vexans*. After seven days, OMA supported the maximum growth (45 mm) in 12 isolates, whereas, RA medium supported 10 isolates, PDA 9 isolates and CMA 3 isolates. In Water Agar maximum growth attained during the period was 34.55 mm in isolate Pv-13. Minimum radial growth (33.00 mm) was recorded on OMA,

followed by RA (31.40 mm), PDA (28.65 mm), and CMA (24.60 mm) and WA (12.05 mm) medium. It was observed that the best radial growth after seven days was obtained by all the isolates on OMA, PDA and RA medium. Pawar and Patel (1957) also made similar observations and revealed that the best radial growth of *P. vexans* was observed on Potato Dextrose, Host Decoction and Oat Meal Agars and fair growth on Brown's and Richard's Agars, while it was very poor on Host Decoction and plain Agar thus conforming our results. Dhakate *et al.* (2006) conducted similar studies and revealed that maximum radial growth after seven days was recorded on Host Fruit Extract, Richard's and Potato Dextrose Agar.

Variability in the virulence of all the 18 isolates of *Phomopsis vexans* was observed against brinjal cultivar Pusa Purple Long in a pot experiment under controlled conditions and it was observed that isolate Pv-12 was more virulent, producing maximum leaf blight (60.95%) and fruit rot intensity (49.66%), whereas, *P. vexans* isolate Pv-7 was least virulent and was able to incite only 10.63 and 04.71 per cent leaf blight and fruit rot intensity, respectively. Differences in pathogenicity indicate that variability among the isolates exists even at the pathogenicity level also. Panwar and Chand (1968) also conducted similar studies to observe the virulence of three isolates of *P. vexans* on eight brinjal varieties and observed that isolate C was most virulent to all the varieties. Nooij and Damme (1988) had also reported variation in pathogenicity among 36 isolates of *P. subordinaria* on three different genotypes of *Plantago lanceolata*, whereas, Islam *et al.* (1990) demonstrated distinct pathogenic strains of *P.* vexans on the basis of differential reaction on brinjal genotypes. Similar observations were recorded when pathogenicity tests were conducted on 11 genotypes of brinjal by testing seven different strains of *P. vexans* and majority of the strains differed in their pathogenic behaviour (Kumar and Sugha, 2004). Variations in aggressiveness of five different isolates of *P. vexans* against brinjal genotype Pant Rituraj were reported by Akhtar and Chaube (2006). Akhtar (2007) reported that severity of leaf blight caused by different isolates on the same genotype differed exhibiting differences in the aggressiveness/ virulence of the isolates. Thus the results obtained from the present studies on morphological characteristics, physiological traits on different media, pathogenic behaviour and sensitivity to fungicides indicate the existence of variation in the *P. vexans* isolates.

Our studies recorded variations among different isolates of *P. Vexans* which were observed in morphological and cultural *viz.* colony characters and conidia size, physiological characters on the basis of rate of radial growth on Oat Meal, Potato Dextrose, Corn Meal and Richard's Agar media. The isolates Pv-1, Pv-13 and Pv-15 were categorized as fast growing and isolates Pv-3, Pv-11 and Pv-14 as moderately growing, whereas, isolate Pv-9 was categorized as slow growing. During pathological studies isolate Pv-12 was observed as the most virulent on brinjal cv PPL causing leaf blight and fruit rot intensity whereas, Pv-7 was least virulent among all the eighteen isolates.

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