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Characterization of *Sclerotium rolfsii* Sacc. causing Collar Rot in Chickpea Isolates using Cultural and Morphological Traits

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A B S T R A C T

Collar rot is one of the major diseases of chickpea caused by *Sclerotium rolfsii*. In the present study, morphological and cultural variability of 20 isolates of *Sclerotium rolfsii* isolated from major chickpea growing areas of Andhra Pradesh were studied based on their growth rate, colony colour and appearance and *Sclerotium* colour, arrangement and maturity days of sclerotia using two solid media viz., Potato Dextrose Agar and Czapex Dok Agar. The isolates, CSR 14, CSR 18 and CSR 20, had very fast growth on both PDA and CDA. The overall growth of the isolates was more (dense mycelial formation) on PDA compared to CDA. The site of sclerotia formation and its growth were varied with the isolate and most of the isolates showed peripheral formation in CDA while it was scattered in PDA. The isolate, CSR 14, showed light orange coloured sclerotial bodies formation in the central region on both PDA and CDA. Thus, the present demonstrated the existence of variability among the isolates and development of effective management strategies to overcome the disease at early crop growth period..

Introduction

Chickpea (*Cicer arietinum* L) is one of the major grain legumes grown worldwide and ranks second in the global farming. It belongs to the family *Fabaceae*, sub family *Papilionaceae*. Chickpea is a rich source of protein (20 to 25%) and also enriches soil fertility by biological nitrogen fixation. In India, the total area, production and productivity of grain legumes are 8.3 million hectares, 7.8 million tonnes and 931 kg/ha, respectively (FAOSTAT, 2016). In Andhra Pradesh it occupies an area of 4.7 lakh hectares and

production of 5.04 lakh tonnes with a productivity of 1061 kg/ha.

Diseases are one of the major factors responsible for reduction in yield of chickpea crop. Among the biotic stresses, diseases reduce the yield by infecting the plants from the time of sowing to harvest and is prone to many diseases *viz*., *Fusarium* wilt, dry root rot, collar rot, *Ascochyta* blight, *Verticillium* wilt, black root rot, *Phytophthora* root rot, wet root rot, foot rot, *Pythium* rot and seed rot *etc*.

Among the diseases, collar rot caused by *Sclerotium rolfsii* is one of the devastating soil-borne diseases of fungal origin (Maurya *et al.,* 2008) and is gaining importance elsewhere has been recently observed in different parts of the country.

It is a major disease causing 55-95% mortality of the seedlings of the crop during conducive environment. Keeping this in view, the present investigation was planned to study the variability among the isolates collected different chickpea growing regions of Andhra Pradesh.

Materials and Methods

Isolation of pathogen

The pathogen was collected from stem parts of chickpea infected plants by tissue segment method (Rangaswami and Mhadevam, 1999) on potato dextrose agar (PDA) Medium.

Small pieces of tissue of about 0.5cm from infected collar region was cut with sterile scalpel and were surface sterilized with 1% sodium hypochlorite for 30sec. The tissue pieces were subsequently washed three times with sterile distilled water and kept on blotting paper to avoid excess water. The pieces were transferred onto PDA medium containing petriplates and incubated at 26±1°C.

They were observed periodically to note the growth the fungus. Axenic cultures of the fungus was obtained by single hyphal tip method and maintained on PDA. The fungus was identified based on mycelial and sclerotial characters (Barnett and Hunter, 1972).

Cultural and morphological variability

Different isolates of *S. rolfsii* collected from Ryalaseema region were studied for their cultural and morphological characters, growth rate and sclerotial formation *etc*., using two solid media *viz*., potato dextrose agar (PDA) and czapek dox agar (CDA) media. All isolates of *S. rolfsii* were grown on PDA and CDA medium.

The mycelial disc of 0.5 cm diameter of each isolate was placed in the centre of the plate and replicated twice.

The inoculated plates were incubated at 26±1°C for 20 days. Radial growth of each colony in one direction was measured. Visual observations on sclerotial formation were recorded.

The morphological characters based on mycelia (mycelia growth, colony colour and appearance) and sclerotia (sclerotial colour, shape and their arrangement on surface media) were recorded at 7 and 20 days of incubation, respectively, for each isolate.

Results and Discussion

There was a considerable variation among the isolates in their total growth and growth rate in PDA and CDA (Table 1) (Plates 1-4). The maximum radial growth in PDA was recorded in 16 isolates *i.e.,* CSR 1, CSR 2, CSR 5, CSR 7, CSR 8, CSR 9, CSR 10, CSR 11, CSR 12, CSR 13, CSR 14, CSR 16, CSR 17, CSR 18, CSR 19 and CSR 20 (90.00mm). Among these isolates, CSR 14, CSR 18 and CSR 20, recorded 90.00mm growth within 3 DAI and considered as very fast growing isolates. The isolates, CSR 1, CSR 2, CSR 5, CSR 7, CSR 8, CSR 9, CSR 10, CSR 11, CSR 12, CSR 13, CSR 16, CSR 17 and CSR 19, recorded 90.00mm diameter growth at 4 DAI and considered as fast growing.

The isolates, CSR 4, CSR 3 and CSR 6, recorded growth of 81.00mm, 75.0mm and 70.0mm, respectively, at 6 DAI and categorized as moderate growing isolates. The isolate, CSR 15, recorded the least growth (50.00mm) and was considered as the slowest growing isolate.

There was a considerable variation among the isolates in their total growth and growth rate in CDA. The Isolates, CSR 2, CSR 7, CSR 8, CSR 9, CSR 10, CSR 12, CSR 13, CSR 14, CSR 18 and CSR 20, recorded maximum radial growth (90.00mm) at 4th DAI. Among these isolates, CSR 14, CSR 18 and CSR 20, recorded maximum radial growth (90.00mm) at 3rd DAI while, remaining isolates recorded maximum radial growth (90.00mm) at 4th DAI.

The remaining isolates were categorized as slow multiplying isolates. The least growth was observed in the isolate, CSR 17 (10mm) and considered as the slowest growing isolate among the 20 isolates. Sengupta and Das (1970), Sulladmath *et al.,* (1977) Lingaraju (1977), Pandey (1984), Nene *et al.,* (1996), Rajalakshmi *et al.,* (2006), Akram *et al.,* (2007), Ravindra *et al.,* (2008), Chauhan *et al.,* (2008), Basamma *et al.,* (2012), Zape *et al.,* (2013) and Shridha *et al.,* (2013) reported that the most suitable medium for better growth of *S. rolfsii* was Potato dextrose agar medium. Thus, the present observation confirmed earlier reports of PDA media suitability for the growth of *S. rolfsii* isolates.

The results of colony characters of *S. rolfsii* isolates on PDA and CDA (colony colour and appearance) are presented in Table 2. The results on PDA indicated that seven isolates (CSR 3, CSR 4, CSR 5, CSR 12, CSR 16, CSR 17 and CSR 19) had fluffy growth; four isolates (CSR 1, CSR 2, CSR 10 and CSR 15) showed cottony growth and the remaining eight isolates (CSR 2, CSR 3, CSR 4, CSR 14, CSR 15, CSR 16, CSR 18, CSR 19 and CSR 20) recorded dense mat growth. The isolate, CSR 20, formed thick dark brown mycelial growth on the medium. Flower pattern appearance of mycelium was recorded for the isolates, CSR 7 and CSR 8, while wavy pattern was seen in CSR 11, 12 and 16 isolates.

Colony characters (colony type and colour) of *S. rolfsii* isolates grown on CDA medium and the results indicated that four isolates (CSR 4, CSR 5, CSR 13 and CSR 16) had fluffy growth; six isolates (CSR 5, CSR 6, CSR 7, CSR 9, CSR 11 and CSR 13) showed cottony growth; five isolates (CSR 3, CSR 9, CSR 11, CSR 18 and CSR 20) recorded dense mat growth and the remaining four isolates (CSR 6, CSR 7, CSR 9 and CSR 20) recorded condensed growth.

The isolate, CSR 8 and CSR 13, showed flower pattern appearance of mycelium and the isolate, CSR 10 recorded wavy pattern. The present study on the growth of the isolates on PDA and CDA media clearly indicated that all the isolates of *S. rolfsii* produced dense

mycelial growth on PDA compared to CDA medium and is preferred media for multiplication and maintenance of the pathogen. Sclerotial characters like, time taken for production, colour and site of production varied among the isolates of *S. rolfsii* on PDA and CDA (Table 3).

The isolates, CSR 4, CSR 5, CSR 6, CSR 13 and CSR 15, took the maximum time of 22 days for the sclerotial production on PDA; CSR 2 and CSR 3 took 18 days; CSR 7 took 15 days; CSR 1, CSR 8, CSR 10, CSR 16, CSR 19 and CSR 17 took 11 days and CSR 9, CSR 11 and CSR 12 took 6 days. The isolates, CSR 14, CSR 18 and CSR 20 took only 4 days for sclerotial production on PDA indicating the virulence of the pathogen and the fastest growth and formation of sclerotial bodies.

The colour of sclerotia varied from brown (CSR 2, CSR 3, CSR 4 and CSR 5), light brown (CS1, CSR 6, CSR 8 and CSR13), dark brown (CSR 7, CSR 9, CSR 11, CSR 12, CSR 15, CSR 16 and CSR17), dark blackish brown (CSR 18, CSR 19 and CSR 20) to light orange (CSR 14).

The site of sclerotial production on PDA medium varied among isolates as most of the isolates produced scattered sclerotial bodies and spread over the medium whereas the isolates, CSR1 and CSR 14, produced the sclerotial bodies in the centre.

Sclerotial characters like time taken for production, colour and site of production on CDA varied among the isolates of *S. rolfsii*.

The isolates, CSR 4, CSR 13, CSR 15 and CSR 17 took the maximum time of 26 days for the sclerotial production; CSR 3 and CSR 8 took 22 days; CSR 6 took 19 days; CSR 2, 5 and CSR 7 took 14 days; CSR 1, CSR 9, CSR 10 and CSR 11 took 10 days, CSR 16 and CSR 19 took 11 days; CSR 2, CSR 12 and CSR 14 took 7 days and the isolates, CSR 18 and CSR 20 took only 3 days for sclerotial production indicating the fastness of the isolate to produce the sclerotial bodies.

Plate.1 Mycelial growth of *S. rolfsii* isolate at 5 DAI

Plate.2 Sclerotial formation after 20 days of incubation

Plate.3 Mycelial growth of *S. rolfsii* isolates on PDA media after 7 days

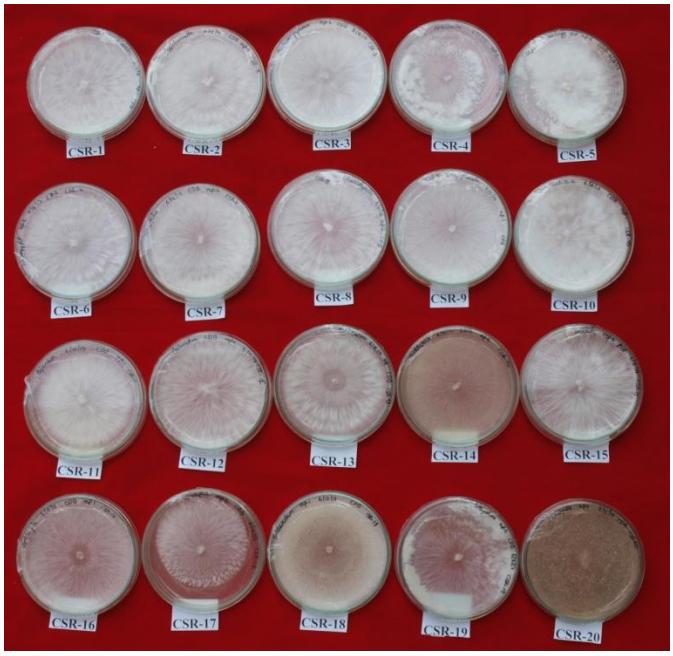

Plate.4 Mycelial growth of *S. rolfsii* isolates on CDA media after 7 days

Table.1 Total growth and growth rate of different isolates of *S. rolfsii* on PDA and CDA at 4th day after inoculation

S.No.	Isolate	Total growth on PDA (mm)	Growth rate (mm/day)	Total growth on CDA (mm)	Growth rate (mm/day)
1	CSR 1	90.00	22.50	75.00	18.75
2	CSR 2	90.00	22.50	90.00	22.50
3	CSR 3	75.00	18.75	72.00	18.00
4	CSR 4	81.00	20.25	31.00	7.75
5	CSR 5	90.00	22.50	24.00	6.00
6	CSR 6	70.00	17.50	46.00	11.50
7	CSR 7	90.00	22.50	90.00	22.50
8	CSR 8	90.00	22.50	90.00	22.50
9	CSR 9	90.00	22.50	90.00	22.50
10	CSR 10	90.00	22.50	90.00	22.50
11	CSR 11	90.00	22.50	85.00	21.25
12	CSR 12	90.00	22.50	90.00	22.50
13	CSR 13	90.00	22.50	90.00	22.50
14	CSR 14	90.00	22.50	90.00	22.50
15	CSR 15	50.00	12.50	64.00	16.00
16	CSR 16	90.00	22.50	58.00	14.50
17	CSR 17	90.00	22.50	10.00	2.50
18	CSR 18	90.00	22.50	90.00	22.50
19	CSR 19	90.00	22.50	75.00	18.75
20	CSR 20	90.00	22.50	90.00	22.50

Table 2 Comparative account of morphological characters of *S. rolfsii* on PDA & CDA

S. No.	Isolate	Growth	Colony colour	Appearance	Growth	Colony colour	Appearance
		PDA			CDA		
1	CSR 1	Fast	White	Cottony, upright growth	Moderate	Extra white	Thread like thick strands
2	CSR 2	Moderate	Extra white	Slight cottony, dense at margins	Fast	Extra white	Thick strands, upright growth at centre
3	CSR 3	Moderate	White	Fluffy, dense around centre, upright growth	Moderate	Cottony white	Slight dense, branches like aggregates at centre
4	CSR 4	Moderate	Extra white	Fluffy, dense at centre, upright growth	Slow	White	Fluffy aggregates around centre
5	CSR 5	Fast	White cottony	Thread like thin strands, Fluffy at margins	Moderate	Extra white	Thin hair like sparse growth, Fluffy, cottony at centre
6	CSR 6	Moderate	White	Thread like thick strands, sparse growth	Moderate	Extra white	Cottony, condensed at centre
7	CSR 7	Fast	White	Flower like pattern, thin strands, upright growth	Fast	Extra white	Cottony, condensed, upright growth
8	CSR 8	Fast	White	Thin strands, flower like pattern	Fast	Light white	Flower like pattern, thin strands
9	CSR 9	Fast	Extra white	Thin strands, branches like pattern on upper side, aggregate at centre	Fast	Extra white	Dense cottony condensed at margins
10	CSR 10	Fast	Extra white	Thick strands, upward growth and cottony at centre	Fast	Extra white	Thick strands, upward growth at margins wavy like pattern
11	CSR 11	Fast	White	Thin strands, suppressed, wavy like pattern	Moderate	Extra white	Dense cottony, aggregated
12	CSR 12	Fast	Cottony white	Fluffy at margins, wavy appearance	Fast	Extra white	Thick strands, sparse growth, aggregate at centre, upright growth
13	CSR 13	Fast	Extra white	Thick strands, sparse, upright growth	Fast	Extra white	Flower like, cottony, Fluffy, branches like clear at centre
14	CSR 14	Very fast	Light Orange	Thin strands, thick strands at centre	Very Fast	Light orange	Sparse, suppressed thin strands
15	CSR 15	Moderate	Light white	Suppressed, dense cottony at centre, upright growth	Moderate	White	Thick strands, upright growth (distance between strands is more than others)
16	CSR 16	Moderate	Light white	Fluffy, wavy margins towards at edges, dense at margins	Moderate	Slight white	Suppressed, Fluffy at margins
17	CSR 17	Fast	White	Suppressed, Fluffy at centre and upright growth	Slow	Light white	Sparse, suppressed growth
18	CSR 18	Very fast	Dirty white	Dense mat like appearance	Very Fast	Brown	Cottony, dense mat like appearance
19	CSR 19	Fast	Extra white and cottony	Thick strands, Fluffy, dense at margins, aggregate at centre& upright growth	Moderate	Dull white	Restricted growth, sparse thin strands
20	CSR 20	Very fast	Dirty white and light brownish	Suppressed strands and dense mat like appearance	Very Fast	Brown	Dense cottony, condensed at centre

Table 3 Sclerotial characters of different isolates of *S. rolfsii* on PDA & CDA

S. No	Isolate	Colour	Shape	Arrangement	Maturity (days)	Colour	Shape	Arrangement	Maturity(days)
		PDA				CDA			
1	CSR 1	Light brown	Spherical	Central and peripheral	11	Dark brown	Irregular	Peripheral	10
2	CSR 2	Brown	Spherical	Formed on upper petriplate	18	Dark brown	Spherical	Peripheral	14
3	CSR 3	Brown	Spherical	Peripheral	18	Dark brown	Irregular	Peripheral	22
4	CSR 4	Brown	Spherical	Scattered all over plate	22	Brown	Irregular	Centralised	26
5	CSR 5	Brown	Spherical	Peripheral	22	Dark brown	Spherical	Peripheral	14
6	CSR 6	Light Brown	Spherical	Scattered all over plate	22	Brown	Irregular	Peripheral	19
7	CSR 7	Dark Brown	Spherical	Scattered all over plate	15	Dark brown	Spherical	Scattered	14
8	CSR 8	Light Brown	Irregular	Scattered all over plate	11	Dark brown	Irregular	Scattered	22
9	CSR 9	Dark brown	Spherical	Formed at edges on upper petriplate	6	Dark brown	Spherical	Peripheral	10
10	CSR 10	Brown	Spherical	Scattered all over plate	11	Brown	Spherical	Peripheral and Scattered	10
11	CSR 11	Dark Brown	Spherical	Scattered all over plate	6	Dark brown	Irregular	Peripheral, Centralised and Scattered	10
12	CSR 12	Dark Brown	Spherical	Formed on upper petriplate	6	Dark brown	Spherical	Peripheral	7
13	CSR 13	Light Brown	Spherical	Peripheral	22	Brown	Spherical	Peripheral	26
14	CSR 14	Light orange	Irregular	Centralized and scattered	4	Light Orange	Irregular	Peripheral	7
15	CSR 15	Dark Brown	Irregular	Scattered all over plate	22	Dark brown	Irregular	Peripheral	26
16	CSR 16	Dark Brown	Spherical	Peripheral	11	Brown	Spherical	Peripheral	11
17	CSR 17	Dark Brown	Spherical	Scattered and peripheral	11	Dark brown	Spherical	Peripheral	26
18	CSR 18	Dark Brown	Spherical	Scattered all over plate	4	Blakish Dark brown	Spherical	Scattered	3
19	CSR 19	Light blackish Brown	Spherical	Scattered all over plate	11	Dark brown	Spherical	Peripheral and Scattered	11
20	CSR 20	Double dark Brown	Spherical	Scattered all over plate	4	Blakish Dark brown	Spherical	Scattered	3

Most of the isolates have produced dark brown coloured sclerotia (CSR 1, CSR 2, CSR 3, CSR 5, CSR 8, CSR 9, CSR 11, CSR 12, CSR 15, CSR 17 and 19) while brown coloured sclerotia were observed in the isolates, CSR 4, CSR 6, CSR 10 and CSR 16. The isolates, CSR 18 and CSR 20, produced dark blackish brown sclerotial bodies and the isolate, CSR 14, produced light orange coloured sclerotial bodies.

The site of sclerotial production on Czapex Dok Agar medium varied among the isolates and most of the isolates produced sclerotial bodies on periphery and spread over the medium.

The isolates, CSR 4, CSR 11 and CSR 14, produced sclerotial bodies in the centre of the petriplate.

Thus, the present study indicated that variations in sclerotial growth characters and the growth of isolates on media took more time in CDA compared to PDA.

Variability in cultural morphology *i.e*., mycelial growth rate, *Sclerotium* formation, and colour along with variations in sclerotial colour, shape and size and their orientation among *S. rolfsii* isolates have been reported by different scientists on various hosts and media (Punja and Grogan, 1983; Harlton *et al.,* 1995; Punja and Damiani, 1996; Zarani and Christensin, 1997; Butler and Day, 1998; Okabe *et al.,* 1998; Carpenter *et al.,* 1999; Almeida *et al.,* 2001; Sarma *et al.,* 2002; Adandonon *et al.,* 2005; Palaiah and Adiver, 2006; Okereke and Wokocha, 2007; Akram *et al.,*2008; Rakholiya and Jadeja, 2011; Sharma *et al.,* 2013; Thilaghavathi Rasu *et al.,* 2013 and Reddi *et al.,* 2014).

The differences among the isolates for cultural and morphological traits can be used for the identification of isolates and this form the basis for the study of virulence and genetic basis of variability which will guide for the establishment of better management practices for the control of the disease

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References

Adandonon, A., Aveling, T.A.S., Merwe, N.A.V and Sanders, G. 2005. Genetic variation among *Sclerotium* isolates from Benin and South Africa, determined using mycelial compatibility and ITS rDNA sequence data. *Australian Plant Pathology*. 34: 19-25.

Akram, A., Iqbal, M.S.H., Ahmed, N., Iqbal, U and Ghafoor, A. 2008. Morphological variability and mycelial compatibility among the isolates of *Sclerotinia sclerotiorum* associated with stem rot of chickpea. *Pakistan Journal of Botony*. 40(6): 2663-2668.

Akram, A., Iqbal, S.M., Qureshi, R.A and Rauf, C.A. 2007. Variability among the isolates of *Sclerotium rolfsii* associated with collar rot disease of chickpea in Pakistan. *Mycopathology*. 5: 23-28.

Almeida, A.M.R., Abdelnoor, R.V., Calvo, E.S., Tessnman, D and Yorinori, J.T. 2001. Genotypic diversity among Brazilian isolates of *Sclerotium rolfsii*. *Journal of Phytopathology*. 149(9): 493-502.

Barnett, H.L and Hunter, B.B. 1972. *Illustrated Genera of Imperfect Fungi*. Burgess Publishing Company, Minnesota.

Basamma., Naik, K., Madhura, C and Manjunath, L. 2012. Cultural and physiological studies on *Sclerotium* rolfsii causing scleotium wilt of potato. *International Journal of Plant Sciences*. 7(2): 216-219.

Butler, M.J and Day, A.W. 1998. Fungal melanins: A review. *Canadian Journal of Microbiology*. 44:1115-1136.

Carpenter, M.A., Frampton, C and Stewart, A. 1999. Genetic variation in New Zealand population of pathogen *Sclerotinia sclerotiorum*. *New Zealand Journal of Crop and Horticutural Sciences*. 27: 13-21.

Chauhan, V.B., Singh, V.B., Singh, P.N and Singh, R.B. 2008. Effect of media and temperature on growth of *Aspergillus fischeri:* A Bio control agent. *Annual Plant Protection Science*. 16: 249-250.

FAOSTAT 2016. Food and Agriculture Organization of the United Nations, Rome. http://faostat.fao.org.

Harlton, C.E., Levesque, C.A and Punja, Z.K. 1995. Genetic diversity in *Sclerotium rolfsii* and related species. *Phytopathology*. 85: 1269-1281.

Lingaraju, S. 1977. Studies on *Sclerotium rolfsii* Sacc. with respect to its survival in soil. *M.Sc.(Ag) Thesis*, University of Agricultural Sciences, Bengaluru, Karnataka, India.

Maurya, S.D., Singh, H., Singh, J and Srivastava. 2008. Management of collar rot of Chickpea (*Cicer arietinum*) by *Trichoderma harzianum* and plant growth promoting Rhizobacteria. *Journal of Plant Protection Research.* 48 (3): 347-354.

Nene, Y.L., Sheila, V.K and Sharma, B.S. 1996. A world list of chickpea and pigeonpea pathogens. 5th Edition. International Crops Research Institute for the Semi-Arid Tropics. Hyderabad 502324. 4: 1-27.

Okabe, I., Morikawa, C., Matsumoto, N and Yokoyama, K. 1998. Variation in *Sclerotium rolfsii* isolates in Japan. *Mycoscience*. 39(4): 399-407.

Okereke, V.C and Wokocha, R.C. 2007. *In vitro* growth of four isolates of *Sclerotium rolfsii* Sacc. in the humid tropics. *African Journal of Biotechnology*. 6(16): 1879-1881.

Palaiah, P and Adiver, S.S. 2006. Morphological and cultural variability in *Sclerotium rolfsii Sacc. Karnataka Journal of Agriculture Science.* 19 (1): 146-148.

Pandey, H.V. 1984. Studies on soil borne pathogens producing wilt like symptoms in chickpea. *M.Sc. Thesis*, JNKVV, Jabalpur.

Punja, Z.K and Damiani, A. 1996. Comparative growth, morphology and physiology of three *Sclerotinia* species. *Mycologia*. 88: 694-704.

Punja, Z.K and Grogan, R.G. 1983. Hyphal interactions and antagonism among field isolates and single-basidiospore strains of *Athelia (Sclerotium) rolfsii*. *Phytopathology*. 73: 1279-1284.

Sharma, P., Meena, P.D., Sandeep, K and Chauhan, J.S. 2013. Genetic diversity and morphological variability of S*clerotinia sclerotiorum* isolates of oilseed Brassica in India. *African Journal of Microbiology Research*. 7(18): 1827-1833.

Rajalakshmi, R., Reddy, N.P.E., Reddy, G.L.K and Devi, M.C. 2006. Morphological, physiological and biochemical variability among the isolates of *Sclerotium rolfsii* Sacc. *Journal of Research ANGRAU.* 5 (1): 52-62.

Rakholiya, K.B and Jadeja, K.B. 2011. Morphological diversity of *Sclerotium rolfsii* caused and pod rot of groundnut. *Journal of Mycology and Plant Pathology.* 41(4): 500-504.

Rangaswami, G and Mahadevan, A. 1999. Diseases of crop plants in India. Prentice Hall of India Pvt. Ltd., New Delhi.6079pp.

Ravindra, K., Mishra, P., Singh, G and Prasad, C.S. 2008. Effect of media, temperature and pH on growth and sclerotial production of *Sclerotium rolfsii*. *Annual Plant Protection Science*. 16 (2): 485-547.

Reddi, K.M., Santhoshi, M.V.M., Krishna, T.G and Reddy, K.R. 2014. Cultural and morphological variability *Sclerotium rolfsii* isolates infecting groundnut and its reaction to some fungicidal. *International Journal of Current Microbiology and Applied Sciences*. 3(10): 553-561.

Sengupta, P.K and Das, C.R. 1970. Studies on some isolates of *Sclerotium rolfsii*. *Z. Pflakranth P. Fl. Schutz*. 77: 582-584.

Sarma, B.K., Singh, U.P and Singh, K.P. 2002. Variability in Indian isolates of *Sclerotium rolfsii*. *Mycologia*. 94(6): 1051-1058.

Shridha, C., Chaurasia, A., Chaurasia, S and Chaurasia, S. 2013. Pathological studies of *Sclerotium rolfsii* causing foot-rot disease of Brinjal (*Solanum melongena* L.). *International Journal of Pharmacy and Life Sciences*. 5(1): 3257-3264.

Sulladmath, V.V., Hiremath, P.C and Anilkumar, T.B. 1977. Studies on the variation on *Sclerotium rolfsii* Sacc. in India. *Mysore Journal of Agricultural Research*. 11(3): 374-380.

Thilagavathi Rasu, Sevugapperumal, N., Thiruvengadam, R and Ramasamy, S. 2013. Morphological and genomic variability among *Sclerotium rolfsii* populations. *The Bioscan*. 8(4): 1425-1430.

Zape, A.S., Gade, R.M and Ravindra, S. 2013. Physiological studies on different media, pH and temperature on *Sclerotium rolfsii* isolated of soybean. *Scholarly Journal Agricultural Sciences*. 2(6): 238-241.

Zarani, F and Christensin, C. 1997. Sclerotial biogenesis in basidiomycetes *Sclerotium rolfsii*. *Mycologia*. 89: 592-602.

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