J. Farm Sci., 36(4): (360-363) 2023

RESEARCH PAPER

Cultural and morphological variability among *Rhizoctonia solani* isolates from different districts of Karnataka

RAGHUNANDANA[1] AND S. K. PRASHANTHI[1]

[1]Department of Plant Pathology
University of Agricultural Sciences, Dharwad - 580 005, India
E-mail :raghunandanaadke@gmail.com

(Received: November, 2023 ; Accepted: December, 2023)

DOI: 10.61475/JFS.2023.v36i4.07

Abstract: Sheath blight of rice caused by *Rhizoctonia solani* Kuhn (Teleomorph: *Thanatephorus cucumeris* (Frank) Donk) is gaining devastating potential in India. The pathogen is reported to show variation in expression of symptoms on the genotypes grown in different locations. Twenty isolates from different districts of Karnataka were collected to examine the cultural and morphological variability. In the PDA culture, the isolates displayed a significant variation in colony characteristics, ranging from compact sparse to compact dense mycelial development and from white to brown in color. Variations in sclerotial production, distribution, abundance, and color were also noted, resulting in colonies that ranged in color from light brown to dark brown, along with central to scattered distribution, rough to smooth sclerotia. *R. solani* isolates from other districts may also have their biology examined using the same cultural and morphological criteria as were employed in this study.

Key words: Morphology, Rice, Sclerotia, Sheath blight, Variability

Introduction

Rice (*Oryza sativa* L.) is a staple food crop for majority of the world's population, accounting for more than 23 per cent of global calories consumed (Abbas *et al*., 2021). India has the largest area under rice cultivation and placed second rank in production after China with a total annual production of 129.47 mt from an area of 46.27 mha with a productivity of 2798 kg ha^{-1}. In Karnataka, it is grown in an area of 1.39 mha with an annual production and productivity of 4.32 mt and 3089 kg ha^{-1} respectively (Anon., 2022). To increase rice production, high-yielding cultivars have been introduced in many nations. Unfortunately, many kinds of diseases affect rice, which frequently poses, a significant biological barrier to its production. Among these rice blast caused by *Magnaporthe oryzae* Couch and bacterial leaf blight (*Xanthomonas oryzae* pv. *oryzae* (Ishiyama) Swings *et al.*) are the widespread diseases.

Sheath blight disease is increasing at alarming rate and it is considered as a major threat to rice after blast disease (Persaud *et al*., 2021). Sheath blight disease is caused by basidiomycetous necrotrophic fungus *Rhizoctonia solani* Kuhn AG1-IA (teleomorph: *Thanatephorus cucumeris* (Frank) Donk) and is ubiquitous throughout the world (Bracker and Butler, 1963). In India, the annual yield loss due to sheath blight has been estimated 5.2 to 50 per cent depending on the environmental conditions, agronomic practices and cultivars used (Chaudhary *et al.,* 2023). *R. solani* is a polyphagous fungus that causes various symptoms on the leaf blade and sheath and within the same population, variations exist in its appearance on growing medium, pathogenicity in the field, and physiology (Nagaraj *et al*., 2019; Kipsumbai *et al*., 2022). This pathogen overwinters usually as mycelium or sclerotia in soil or in/on plant parts and variability in *R. solani* has also been reported by many investigators, and many attempts have been made to organize its isolate into groups on the basis of cultural, morphological, physiological and pathological characteristics (Singh *et al*., 2014; Nagaraj *et al*., 2019). Although the classification based on cultural and morphological characters is considered as a gold standard for studying the variability of *R. solani* to categorize into different groups.

Material and methods

Collection of isolates: A roving survey was conducted during *kharif* 2022 in different rice growing districts of Karnataka (Belagavi, Gadag, Haveri, Koppal, Mandya, Mysuru, Raichur, Shivamogga, Uttara Kannada and Vijayanagara). Rice plants showing typical sheath blight symptoms were collected from the surveyed areas. A total of 20 samples representing different districts of Karnataka were collected and stored at 4^{o}C for further use.

Isolation of pathogen: The diseased plant parts were washed in running water followed by sterile distilled water to remove any surface contaminants. Then the tissues were dissected in to 0.5-1 cm size with a sterile blade. The cut pieces were surface sterilized with 2 per cent sodium hypochlorite solution for 1 min and rinsed three times with sterile distilled water. After surface drying, disease tissues were placed on water agar (2%) and incubated at 28 ^{o}C for 24h. Later, pure cultures for all isolates were prepared by transferring mycelial tips to potato dextrose agar (PDA) medium. After 2 to 3 days, cultures were examined microscopically for hyphal characteristics of *R. solani*.

Morphological characterization: The *R. solani* isolates were grown in Petri dish containing potato dextrose agar (PDA) by incubating for 7 days at 28±1 ^{o}C. Totally 20 isolates of *R. solani* were studied for their colony and sclerotial characteristics. The observation on colony characters (color and texture) and sclerotial characteristics such as sclerotial texture, distribution

Table 1. Different districts of Karnataka surveyed and designation of code to all collected *Rhizoctonia solani* isolates

District	Taluka	Isolate	Isolate code
Mysuru	Nanjangud	Hadinaaru	RS-1
Mandya	Shrirangapattana	Garakahalli	RS-2
Haveri	Ranebennur	Makanoor	RS-3
Mysuru	Nanjangud	Kempisiddengundi	RS-4
Gadag	Mundaragi	Malagatti	RS-5
Vijayanagara	Hospete	Kampli	RS-6
Haveri	Ranebennur	Jaalimaldi	RS-7
Mysuru	Nanjangud	Immavu	RS-8
Haveri	Ranebennur	Haralahalli	RS-9
Gadag	Mundaragi	Singatalur	RS-10
Uttara kannada	Yellapura	Bavigadde	RS-11
Raichur	Sindhanur	Dhadesugur	RS-12
Shivamogga	Bhadravathi	Baranduru	RS-13
Mandya	Mandya	Bevinahalli	RS-14
Koppal	Gangavathi	Marali	RS-15
Belagavi	Khanapur	Naagaragaali	RS-16
Raichur	Sindhanur	Sasalmari	RS-17
Haveri	Ranebennur	Chouddayyadanpur	RS-18
Vijayanagara	HoovinaHadagali	Kuruvatti	RS-19
Mysuru	Nanjangud	Bokkhalli	RS-20

pattern, relative abundance, color and honey dew formation by sclerotia were recorded.

Results and discussion

Collection and isolation of the pathogen: Rice plants exhibiting sheath blight symptoms on leaves and sheath were collected and these symptoms resembled a typical "snake-skin" pattern (Plate 1). A total of 20 isolates were collected from the different districts of Karnataka and representative coding is assigned for all the isolates (Table 1). Pathogen was isolated on PDA medium and further it was identified based on characteristic mycelial branching. In young and advanced hyphae, branching of the mycelium was observed close to the distal septum of a cell. In hyphae that were older, branching might take place anywhere in the cell. Constriction of branched hyphae was noticed at the point of origin and formation of septum at right angle in the point of origin (Plate 2). The mycelial and sclerotial characteristics are in conformity as previously described (Bracker and Butler, 1963).

Morphological characterization of *Rhizoctonia solani* isolates: The cultural and morphological variability was examined in 20 isolates of *R. solani* covering different districts of Karnataka. In our study considerable variation was found in colony and sclerotial morphology of *R. solani* isolates even within different districts (Table 2, Plate 3). All the 20 isolates exhibited a typical right angle branching of the hyphae. A considerable variation was observed in colony characters, colony color varied from white to different shades of brown and colony texture was varied from compact sparse to compact dense but interestingly, two isolates RS-16 and RS-20 exhibited compact fluffy colony texture. Five sclerotial parameters were recorded, indicating a significant variation in sclerotial characters. Among the collected isolates sclerotial texture varied from rough to smooth; majority of the isolates have shown sclerotia; distribution from irregular to periphery except isolates RS-6 (sub-central), RS-4, RS-7 and RS-18 (sub-central to periphery). Sclerotial abundance was varied from low (7 isolates), medium (5 isolates) to high (8 isolates) and sclerotial color varied from light brown to dark brown except two isolates RS-19 and RS-20 which exhibited mustard yellow colored sclerotia. The above findings lead us to very significant conclusions that the isolates from different districts of Karnataka show a considerable variation in cultural and morphological characteristics based on the geographical origin. It is concluded that there is significant variation in the sclerotial morphology, color, and texture of the geographically distinct isolates of *R. solani* from Karnataka. The more variations in the type and color of mycelium and size, color, number and type of sclerotia were observed among the isolates of *R. solani* (Singh *et al.,* 2014). The studies on cultural

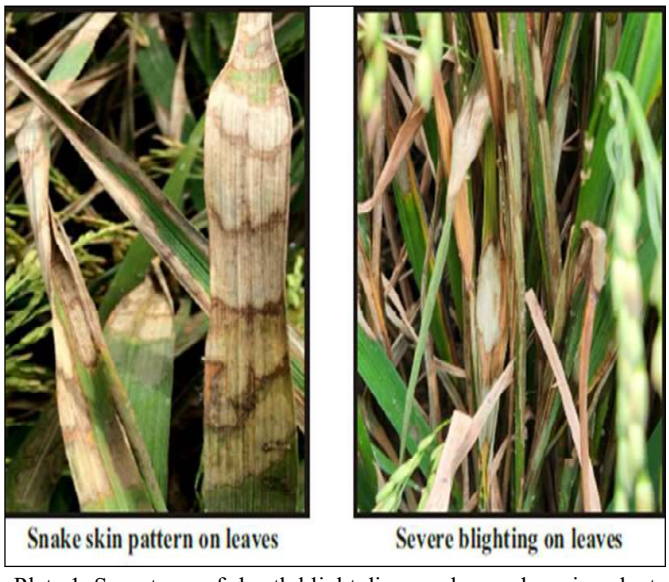

Plate 1. Symptoms of sheath blight disease observed on rice plant during survey

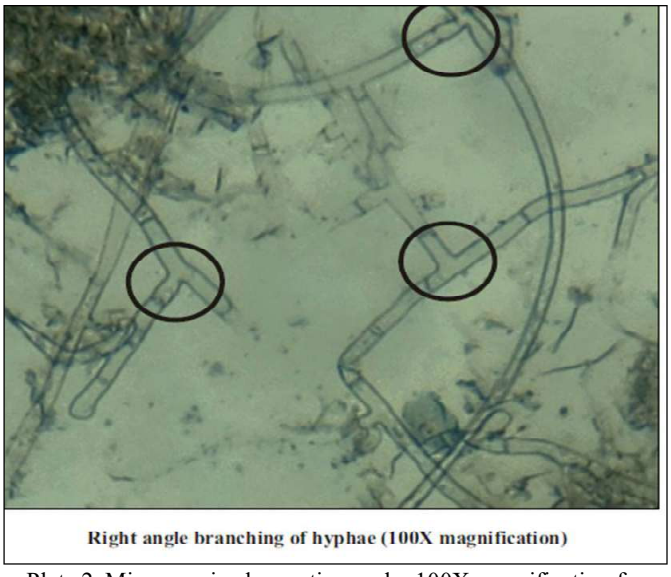

Plate 2. Microscopic observation under 100X magnification for mycelial characteristics

Table 2. Cultural and morphological characters of *Rhizoctonia solani* isolates collected from different districts of Karnataka

Isolate	Branching pattern of hyphae	Colony characters		Sclerotial characters				
		Colony color	Colony texture	Texture	Distribution pattern	Relative abundance of sclerotia	Color of sclerotia	Honeydew formation
RS-1	Right angle	Dark brown	Compact dense	Rough	Irregular	Medium	Dark brown	Yes
RS-2	Right angle	White	Compact sparse	Smooth	Periphery	Low	Dark brown	No
RS-3	Right angle	Pale brown	Compact sparse	Rough	Periphery	Low	Dark brown	Yes
RS-4	Right angle	White	Compact sparse	Rough	Sub-central to periphery	Low	Dark brown	Yes
RS-5	Right angle	Pale brown	Compact sparse	Rough	Periphery	Low	Light brown	Yes
RS-6	Right angle	White	Compact cottony	Smooth	Sub-central	High	Light brown	No
RS-7	Right angle	Yellow brown	Compact dense	Smooth	Sub-central to periphery	High	Light brown	No
RS-8	Right angle	Pale brown	Compact sparse	Rough	Periphery	Medium	Dark brown	Yes
RS-9	Right angle	White	Compact sparse	Rough	Periphery	Low	Dark brown	Yes
RS-10	Right angle	White	Compact sparse	Smooth	Periphery	Medium	Dark brown	Yes
RS-11	Right angle	White	Compact sparse	Rough	Periphery	Low	Dark brown	Yes
RS-12	Right angle	Yellow brown	Compact dense	Smooth	Irregular	High	Light brown	No
RS-13	Right angle	Brown	Compact dense	Rough	Irregular	Medium	Dark brown	Yes
RS-14	Right angle	White	Compact sparse	Rough	Periphery	Low	Dark brown	Yes
RS-15	Right angle	white	Compact dense	Smooth	Irregular	High	Light brown	No
RS-16	Right angle	White	Compact fluffy	Smooth	Irregular	High	Light brown	No
RS-17	Right angle	White	Compact dense	Smooth	Irregular	High	Light brown	No
RS-18	Right angle	White	Compact sparse	Smooth	Sub-central to periphery	Medium	Light brown	No
RS-19	Right angle	Yellow brown	Compact sparse	Smooth	Periphery	High	Mustard yellow	No
RS-20	Right angle	Yellow brown	Compact fluffy	Smooth	Irregular	High	Mustard yellow	No

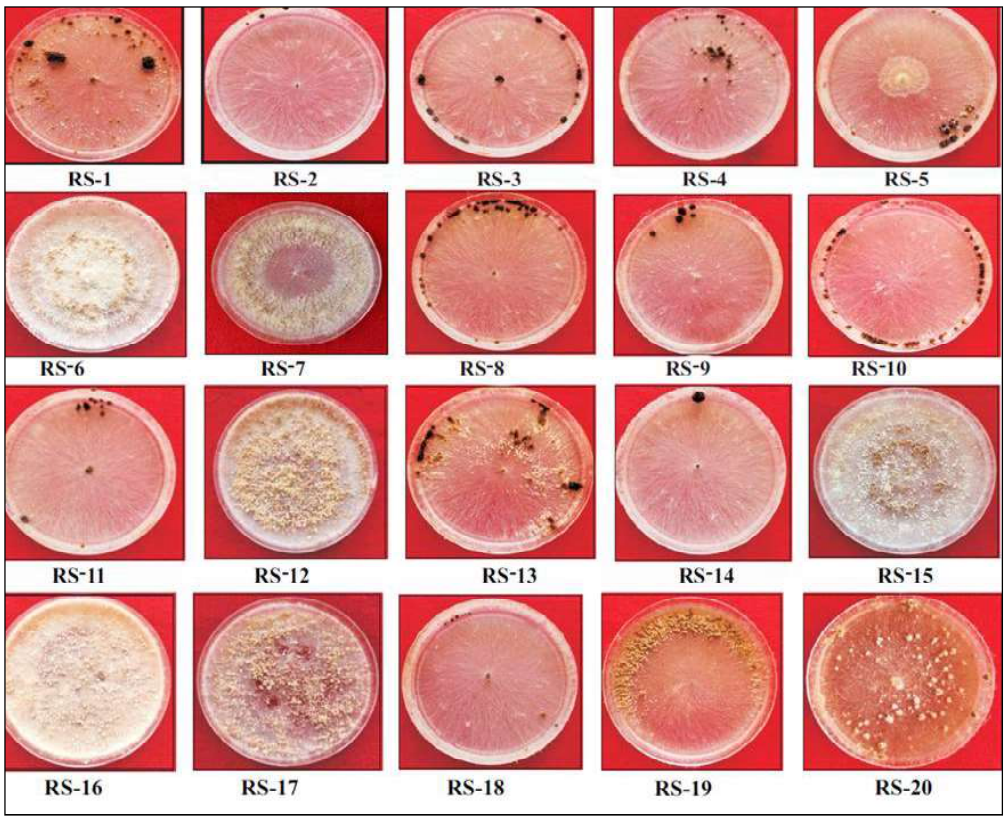

Plate 3. Cultural and morphological characteristics of *Rhizoctonia solani* observed on PDA medium

characteristics like colony color, surface and pattern of distribution of sclerotia, are also in agreement with the findings of Goswami *et al.* (2010) and Kipsumbai *et al.* (2022).

Conclusion

The cultural and morphological characters of the pathogen varied with respect to different districts of Karnataka. Parameters used in present study can be helpful in understanding biology and physiology of the pathogen. Variation in morphological characters is attributed to molecular and population structure of the pathogen so, further study using molecular markers might be helpful for correlating the morphology with genetic and geographical origin of pathogen.

References

Abbas A, Fu Y, Qu Z, Zhao H, Sun Y, Lin Y, Xie J, Cheng J and Jiang D, 2021, Isolation and evaluation of the biocontrol potential of *Talaromyces* spp. against rice sheath blight guided by soil microbiome. *Environmental Microbiology*, 23(10): 5946-5961.

Anonymous, 2022, Area, production and productivity of rice. www.indiastat.com.

Bracker C K and Butler E E, 1963, The ultra structure and development of septa in hyphae of *Rhizoctonia solani* associated with the plant debris. *Phytopathology*, 49:192-198.

Chaudhary S, Sagar S, Lal M, Tomar A, Kumar J, Kumar V and Kumar M, 2023, Morpho-genetic variability of *Rhizoctonia solani* population causing sheath blight disease in rice (*Oryza sativa* L.). *Journal of Environmental Biology*, 44(1): 108-121.

Goswami B K, Bhuiyan K A and Mian I H, 2010, Morphological and pathogenic variations in the isolates of *Rhizoctoniasolani* in Bangladesh. *Bangladesh Journal of Agricultural Research*, 35(3): 375-380.

Kipsumbai P K, Hunjan M S and Sekhon P S, 2022, Morpho-cultural, pathological and genetic variability in *Rhizoctonia solani* isolates infecting crops in rice based cropping pattern of Punjab, India. *Saudi Journal of Pathology and Microbiology*, 7(11): 401-415.

Nagaraj B T, Gururaj S, Pramesh D, Naik M K, Patil M B, Yadav M K and Patil N B, 2019, Morphological, genetic and virulence diversity of *Rhizoctonia solani* isolates from different rice growing regions of Southern India. *Research Journal of Biotechnology*, 4(5): 16-23.

Persaud R, Mc Gowan D and Persaud M, 2021, Managing the imminent danger of rice blast (*Pyricularia oryzae* Cav.) and sheath blight (*Rhizoctonia solani* Kuhn) disease: A critical review article. *American Journal of Agriculture and Forestry*, 9(6): 409-423.

Singh V, Kumar S, Lal M and Hooda K S, 2014, Cultural and morphological variability among *Rhizoctonia solani* isolates from trans-gangetic plains of India. *Research on Crops*, 15(3): 644-650.