

Original Research Article

Cultural and Morphological Variability in isolates of *Rhizoctonia solani* Kuhn causing Sheath Blight of Rice

ABSTRACT

Sheath blight of rice caused by *Rhizoctonia solani* (telomorph: *Thanatephorus cucumeris*) has become a major constraint to rice production during the last two decades. Eleven *R. solani* isolates were collected from major rice growing states of India such as Karnataka, Tamil Nadu, Kerala, Andhra Pradesh, Telangana, Odisha. *Rhizoctonia solani* is known to show high variability in terms of morphological, cultural and sclerotial characters. Hence study was conducted at Research and Development, Rallis India Limited, Bangalore to know the variability among the isolates collected from different locations. Studies on cultural variability revealed that colony colour varied from whitish brown to pale brown with slow, moderate and abundant growth patterns. Among the eleven isolates, majority were fast growing followed by medium growth. Size of sclerotia ranged from minimum of 1.00mm (Rs-9) to maximum of 1.97mm (Rs-8). Maximum isolates had excellent number of sclerotia (>60) produced per petridish. All isolates took 3-4 days for initiation of sclerotia formation. Based on pattern of sclerotia formation, isolates produced sclerotia in central ring, scattered, central & scattered and central & peripheral manner. Sclerotia is formed either in aerial or surface mycelium or on both aerial and surface mycelium. Colour of sclerotia ranged from light brown to dark brown with rough texture.

Keywords: Rhizoctonia solani, Sclerotia, Isolates, colony

1. INTRODUCTION

Rice (*Oryza sativa* L.) is second most important cereal and staple food for more than half of the world's population. Extensive rice cultivation systems in order to meet the increasing demand, have brought a shift in pest and disease problems in rice. These biotic factors especially fungal pathogens are limiting the rice productivity to a greater extent. Sheath blight caused by *Rhizoctonia solani* Kuhn (*Thanatephorus cucumeris* (Frank) Donk) is one such disease which is having a major contribution for crop loss both in India and world (Lee and Rush, 1983; Webster and Gunnell, 1992). This disease was first time reported from Japan in 1910 by Miyaki. But in India, Paracer and Chahal reported this disease from Gurdaspur (Punjab) in 1963. The disease became established in many oriental countries and as a result is often referred to as "Oriental leaf and sheath blight", sheath blight, *Pellicularia* sheath blight, sclerotial blight and banded blight of rice (Dath and Premalatha, 1990). Isolates of *Rhizoctonia solani* show tremendous variation in morphological and pathogenic characteristics (Ogoshi, 1996). Meena *et. al.* (2001) reported great variation among the isolates with respect to mycelia and sclerotial characters. Variation of sclerotial characters like colour, size, texture were also studied by Kumar *et. al.* (2008). Seeing this wide range of variability, study was conducted to assess variability with respect to morphological and sclerotial characters among isolates.

2. MATERIAL AND METHODS

Sheath blight infected paddy samples were collected from various rice growing regions of India such as Karnataka, Tamil Nadu, Kerala, Andhra Pradesh, Telangana, Odisha. The pathogen was isolated and purified through hyphal tip/ single sclerotial method (Rangaswami and Mahadevan, 2004). Pure cultures were maintained in PDA slants and stored in refrigerator at 5°C for further studies. Cultural characters like colony colour, growth pattern and colony diameter were studied for all isolates. The colony colour was determined with the help of Munsell's soil color chart (Munsell, 1954). The colour of the colony was observed from bottom side of the culture plate. Growth pattern was recorded by observing visually according to growth of hyphae – as abundant, aerial mycelium obscured surface mycelium and touched the cover of the Petridish; moderate, aerial mycelium obscured surface mycelium without touching the cover, and slight- aerial mycelium did not obscure surface mycelium. Mycelial discs of 6mm diameter from 3 day old cultures of each isolates were transferred into the centre of sterilized PDA plates and incubated for 10 days at 27±2°C.

Sclerotial characters viz., colour, texture, number, size, time taken for initiation of sclerotial formation, pattern of sclerotial production and location of sclerotia were studied. Texture of sclerotia was grouped as smooth and rough category. Number of sclerotia was categorized as group-1 (poor), group-2 (1-10, fair), group-3 (11-20, moderate), group-4 (21-40, good), group-5 (41-60, very good) and group-6 (>60, excellent). The diameter of the sclerotia was measured with the help of Digital Vernier Calipers by harvesting 20 sclerotia randomly from each petriplate. Time taken for initiation of sclerotial formation was recorded in days. Pattern of sclerotial formation classified into 3 groups viz., central, peripheral and scattered. Location of sclerotia was observed on basis where actually the sclerotia is formed in the fungal colony i.e. Sclerotium formed within aerial mycelium, sclerotia formed at surface of the mycelium and other is sclerotia embedded in fungal mycelium itself.

3. RESULTS AND DISCUSSION

3.1 Colony colour: Out of eleven isolates, four isolates (KARS-1, KARS -2, TNRS -2 and TRS-1) of *Rhizoctonia solani* showed whitish brown colour, four isolates (TNRS-1, APRS-1, APRS-2 and KERS-1) were of light brown colour and three isolates (KARS -3, ODRS-1 and ODRS-2) were of pale brown colour (Table 1). Singh *et. al.* (2015) had also reported that colony colour ranged from whitish brown, light brown, yellowish brown, dark brown, pale brown to milky brown. Lal and Kandhari (2009) also reported varied colony colours i.e. light brown, yellowish brown, whitish brown, dark brown and very pale brown. Colony colours like light brown, dark brown and grey were also reported by Mughal *et. al.*, 2017.

3.2 Growth pattern: Among eleven isolates of *Rhizoctonia solani*, six isolates (KARS -1, KARS -2, KARS -3, TNRS-1, TNRS-2 and APRS-2) were bound to show abundant growth and categorized into the group-1. Two isolates (APRS-1 and TRS-1) were found to show moderate growth pattern and categorized into group-2, whereas remaining three isolates (KERS-1, ODRS-1 and ODRS-2) were categorized into group-3 (Table 1). Pralhad *et. al.* (2019), Lal and Kandhari (2009) and Burpee *et. al.* (1980) had also grouped the growth pattern into same three groups.

3.3 Growth rate: Based on growth rate, eleven isolates were categorized into three groups. Isolates (KARS -1, KARS -2, KARS -3, TNRS-1, TNRS-2 and APRS-2) with mean colony diameter of >65mm were categorized into group-1, medium growing isolate (TRS-1) was categorized into group-2 and remaining slow growing (30-49mm) isolates (APRS-1, KERS-1, ODRS-1 and ODRS-2) were categorized into group-3 (Table-1). Singh *et. al.* (2015) had also

reported growth rate of twenty five isolates as fast growing, medium growing and slow growing.

Plate 1: Isolates of *Rhizoctonia solani*

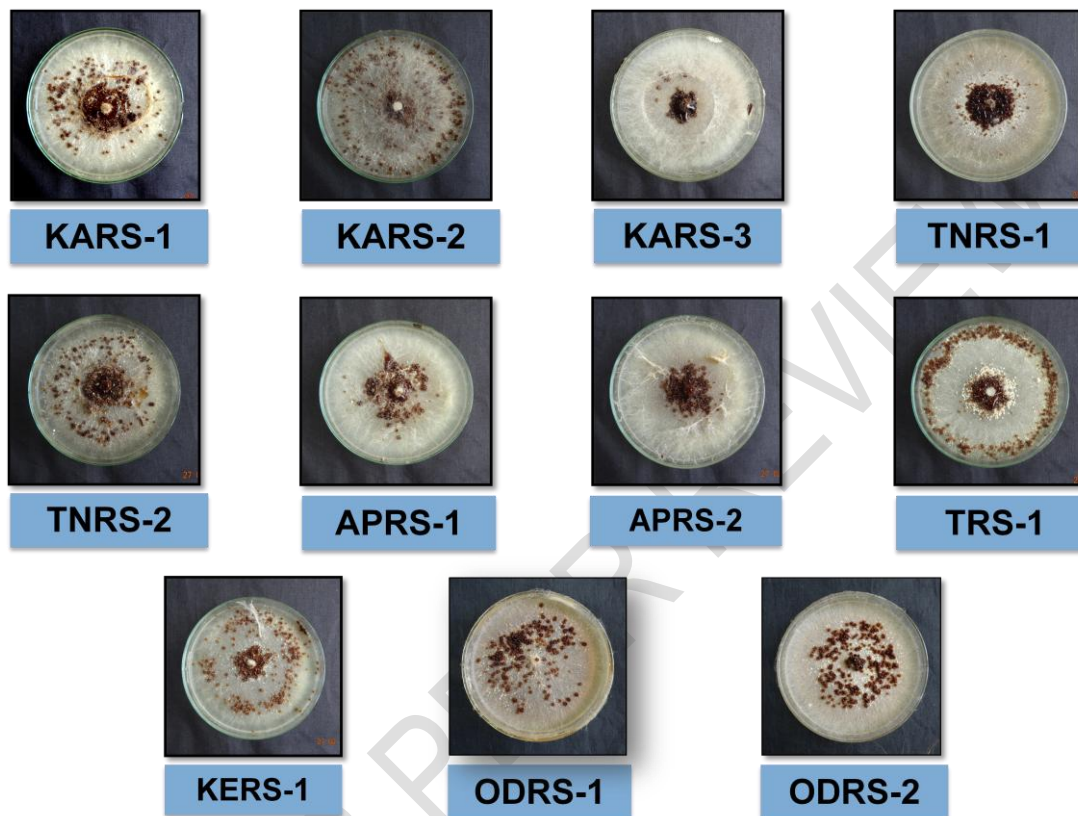


Table 1: Morphological variability studies of isolates of *Rhizoctonia solani* Sheath blight of rice (Mycelial characters)

| Isolates | Colony colour | Growth pattern | Colony growth diameter at different intervals (mm) | | | | |
|----------------------|---------------|----------------|--|-------|-------|-------|-------|
| | | | 24hr | 48hr | 72hr | 96hr | Mean |
| KARS (Gangavathi) -1 | Whitish brown | Abundant | 52.50 | 69.20 | 90.00 | 90.00 | 75.43 |
| KARS (Mandya) -2 | Whitish brown | Abundant | 49.80 | 61.10 | 90.00 | 90.00 | 72.73 |
| KARS (Kampli) -3 | Pale brown | Abundant | 53.70 | 67.30 | 90.00 | 90.00 | 75.25 |
| TNRS-1 (Thanjavur) | Light brown | Abundant | 48.60 | 59.10 | 88.80 | 90.00 | 71.63 |

| | | | | | | | |
|---------------------------|---------------|----------|-------|-------|-------|-------|-------|
| TNRS-2 (Coimbatore) | Whitish brown | Abundant | 50.60 | 60.30 | 86.80 | 90.00 | 71.93 |
| APRS-1 (Bapatla) | Light brown | Moderate | 13.40 | 26.30 | 54.80 | 86.80 | 45.33 |
| APRS-2 (West Godavari) | Light brown | Abundant | 65.00 | 76.70 | 89.30 | 90.00 | 80.25 |
| TRS-1 (Mokila) | Whitish brown | Moderate | 36.30 | 47.20 | 78.30 | 90.00 | 62.95 |
| KERS-1 (Ambalavayal) | Light brown | Slow | 9.00 | 15.10 | 36.80 | 68.90 | 32.45 |
| ODRS-1 (Jeypore) | Pale brown | Slow | 16.25 | 36.25 | 59.25 | 81.63 | 48.34 |
| ODRS-2 (Cuttack) | Pale brown | Slow | 13.75 | 31.13 | 49.38 | 66.13 | 40.09 |
| Sem± | | | 1.00 | 1.15 | 1.04 | 1.03 | |
| CD (5%) | | | 3.99 | 4.60 | 4.15 | 4.11 | |

3.4 Size of sclerotia: Based on the diameter of sclerotia, the isolates were categorized into two groups, Group-1 had diameter range from 1.00-1.49mm and group-2 had diameter range from 1.50-1.97mm. Maximum range of sclerotial diameter was observed in Rs-8 (1.97mm) and minimum in KERS-1 (1.00mm). Seven isolates (KARS -1, KARS -2, KARS -3, TNRS-2, KERS-1, ODRS-1 and ODRS-2) were categorized into group-1 with diameter range between 1.00-1.49mm. Remaining four isolates (TNRS-1, APRS-1, APRS-2 and TRS-1) were categorized into group-2 having diameter range between 1.50-1.97mm (Table 2). According to Basu *et. al.* (2004), the size of sclerotia ranged from 0.23 to 1.91mm. Similarly, Dath (1985) and IRRI (1986) also reported that diameter of sclerotia ranged from 1 to 3mm.

3.5 Number of sclerotia: Based on number of sclerotia, isolates were categorized into various groups. None of the isolates were categorized into group-1 (poor), group-2 (1-10, fair), group-3 (11-20, moderate) or group-4 (21-40, good). One isolate (APRS-1) was categorized into group-5 (41-60, very good) and remaining isolates (KARS -1, KARS -2, KARS -3, TNRS-1, TNRS-2, APRS-2, TRS-1, KERS-1, ODRS-1 and ODRS-2) were categorized into group-6 (>60, excellent) (Table 2). Pralhad *et. al.* (2019), Lal and Kandhari (2009) and Singh *et. al.* (2015) also categorized number of sclerotia into 6 groups.

3.6 Time taken for sclerotia formation: Seven isolates (KARS -1, KARS -2, KARS -3, TNRS-2, APRS-2, TRS-1 and ODRS-2) took 3 days for initiation of sclerotia formation whereas remaining four isolates (TNRS-1, APRS-1, KERS-1 and ODRS-1) took 4 days for initiation of sclerotia formation (Table 2). According to Meena *et. al.* (2001), time taken for sclerotia formation ranged from 3-11 days. Time taken for sclerotia formation also ranged from 3 to 6 days (Singh *et. al.*, 2015) and 4 to 8 days (Pralhad *et. al.*, 2019).

Table 2: Morphological variability of isolates of *Rhizoctonia solani* Sheath blight of rice (Sclerotial characters)

| Isolates | Size of sclerotia (Avg. Dia in mm) | No. of sclerotia/ petridish | Time taken for sclerotia formation (days) |
|----------|------------------------------------|-----------------------------|---|
| KARS -1 | 1.23 | 112 | 3 |
| KARS -2 | 1.38 | 120 | 3 |
| KARS -3 | 1.41 | 78 | 3 |
| TNRS-1 | 1.76 | 90 | 4 |
| TNRS-2 | 1.13 | 116 | 3 |
| APRS-1 | 1.85 | 50 | 4 |
| APRS-2 | 1.85 | 61 | 3 |
| TRS-1 | 1.97 | 83 | 3 |
| KERS-1 | 1.00 | 91 | 4 |
| ODRS-1 | 1.40 | 98 | 4 |
| ODRS-2 | 1.34 | 86 | 3 |
| Sem | 0.03 | 0.80 | |
| CD (1%) | 0.11 | 3.18 | |

3.7 Pattern of sclerotia formation: Based on the pattern of sclerotia formation in the petri dishes among various isolates, they were classified into three groups. Sclerotium formed in the central ring was observed in three isolates (KARS -3, APRS-2 and ODRS-2). Sclerotium were formed in the scattered manner in four isolates (KARS -1, KARS -2, TNRS-2 and KERS-1) whereas three isolates (TNRS-1, APRS-1 and ODRS-1) showed sclerotial formation in both central and scattered manner. None of the isolates showed peripheral manner of sclerotia formation whereas one isolate (TRS-1) showed both central and peripheral manner of sclerotia formation (Table-3). Pralhad *et. al.* (2019) and Singh *et. al.* (2015) also reported sclerotial formation in the same manner *i.e.* central, peripheral and scattered.

3.8 Location of sclerotia formation: Isolates were categorized into three groups, based on the location of sclerotia formation. First group included those isolates where sclerotium formed within the aerial mycelium. None of the isolates showed this pattern. Second group included those isolates where sclerotia formed at the surface of the mycelium (KARS -2, KARS -3, TNRS-1, APRS-2 and ODRS-2). None of the isolates had sclerotia embedded in fungal mycelium itself (Third group) whereas, six isolates (KARS -1, TNRS-2, APRS-1, TRS-

1, KERS-1 and ODRS-1) recorded sclerotia formation in both aerial and surface mycelium (Table 3). Location of sclerotia as aerial, surface and embedded was also reported by Lal and Kandhari (2009) and Singh *et. al.* (2002).

3.9 Colour of sclerotia: Based on the pigmentation of the sclerotium, isolates were assigned into two groups. Ten isolates (KARS -1, KARS -2, KARS -3, TNRS-1, TNRS-2, APRS-1, APRS-2, TRS-1, ODRS-1 and ODRS-2) showed dark brown sclerotia whereas one isolate (KERS-1) showed light brown sclerotia (Table 3). Hoa (1994) also reported that sclerotial colour ranged from brown, light/dark brown, black brown, chocolate brown, salmon and dark salmon. Mughal *et. al.* (2017) reported sclerotial colours like light brown and dark brown.

3.10 Texture of sclerotia: Based on the texture of sclerotia, the isolates were classified into two groups *i.e.* smooth and rough. All eleven isolates belonged to rough category of sclerotial texture (Table 3). Sclerotial texture was also classified into two groups – smooth and rough by Hoa (1994) and Singh *et. al.* (2015).

Table 3: Morphological variability of isolates of *Rhizoctonia solani* causing Sheath blight of rice (Sclerotial characters)

| Isolates | Pattern of sclerotia | Location of sclerotia | Colour of sclerotia | Texture |
|----------|----------------------|-----------------------|---------------------|---------|
| KARS-1 | Scattered | Aerial & surface | Dark brown | Rough |
| KARS-2 | Scattered | Surface | Dark brown | Rough |
| KARS-3 | Central | Surface | Dark brown | Rough |
| TNRS-1 | Central & scattered | Surface | Dark brown | Rough |
| TNRS-2 | Scattered | Aerial & surface | Dark brown | Rough |
| APRS-1 | Central & scattered | Aerial & surface | Dark brown | Rough |
| APRS-2 | Central | Surface | Dark brown | Rough |
| TRS-1 | Central & peripheral | Aerial & surface | Dark brown | Rough |
| KERS-1 | Scattered | Aerial & surface | Light brown | Rough |
| ODRS-1 | Central & scattered | Aerial & surface | Dark brown | Rough |
| ODRS-2 | Central | Surface | Dark brown | Rough |

4. CONCLUSION

Sheath blight disease of rice caused by a soil borne pathogen, *Rhizoctonia solani* is having high economic importance in India. From the experimental results, it is quite evident that all the eleven isolates of *R. solani* were highly different from each other with respect to all the characters examined *viz.*, colony colour, growth pattern, growth rate, size of sclerotia,

number of sclerotia, time taken for sclerotia formation, pattern & location of sclerotia formation, colour & texture of sclerotia.

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