International Journal of Botany Studies
www.botanyjournals.com
ISSN: 2455-541X
Received: 12-11-2021, Accepted: 27-11-2021, Published: 13-12-2021
Volume 6, Issue 6, 2021, Page No. 1029-1032

Survey and occurrence of sheath blight disease of rice (*Oryza sativa* L.) and variability in pathogen (*Rhizoctonia solani* Kuhn) in coastal region of Cuddalore district of Tamil Nadu

R Kannan, K Sanjeev Kumar
Department of Plant Pathology, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Tamil Nadu, India

Abstract
Survey and Variability in 15 isolates of *Rhizoctonia solani* Kuhn. causing sheath blight of rice with morphology and pathogenicity studies. A survey carried out to assess the occurrence of sheath blight disease incidence in major paddy growing areas of coastal region of Cuddalore district of Tamil Nadu, India revealed the endemic nature of disease. The maximum PDI was recorded in T.S. Pettai (39.7%) followed by Andarmullippallam (35.2%) and Karamedu (33.5%). Studies on morphological characterization of *R. solani* isolates showed that isolates were highly variable in mycelial growth, colour and sclerotial parameters. Among the fifteen isolates of *R. solani*, the isolate Rs15 was found to be more virulent.

Keywords: survey, variability, sheath blight, *rhizoctonia solani*, morphological characterization, rice

Introduction
Rice (*Oryza sativa* L.) brings a stable food crop of India, play significant role in the food security system. The crop is an important integral part of India dietary and staple food of more than 60 per cent and its cultivation has spread too many parts of the world due to its versatility (Neha *et al.*, 2013). This crop is attacks by more than 70 diseases are caused by fungi, bacteria, viruses and nematodes on rice among which, Sheath blight caused by *Rhizoctonia solani* Kuhn [Teleomorph: *Thanatephorus cucumeris* (Frank) Donk]. This disease is a soil borne, occurs throughout temperate and tropical production areas and is most prominent where ever rice is grown under intense production systems (Savary and Mew, 1996) [11] and is second only to rice blast as the most economically important fungal disease of rice (Savary *et al*., 2006) [12].

The pathogen survives as mycelia or resistant structures known as sclerotia in plant debris and on weeds in rice growing areas. *R.solani* to produce sclerotia with a thick outer layer allows them to float and survive in water and also survives as mycelium by colonizing soil organic matter as a saprophyte, particularly as a result of plant pathogenic activity (Zachow *et al*., 2011) [21]. The sclerotia present in the soil or on plant tissue germinate to produce vegetative threads (hyphae) of the fungus that can attack a wide range of crops.

The natural infection of the sheath blight disease occurs at the seedling, tillering and booting stages of rice. Infection usually starts near the water line of rice plants in paddy fields. Lesions develop upward to the upper leaf sheaths and leaf blades. The centre of lesion become grayish white with brown margin, later several spots coalesce and show blight symptoms (Ou, 1985) [6]. Thus entire plant often gets killed under severe cases (Rush and Lindberg, 1984) [10]. At present it is one of the major production constraints in the states of Tamil Nadu, coastal areas of Andhra Pradesh, Kerala, Karnataka, Haryana, Uttar Pradesh, Bihar, West Bengal, Odisha, Uttarakhand, Punjab, and Chhattishgarh. Hence, the present study was conducted to survey, Isolation and identification of pathogen associated with sheath blight and establishing their pathogenicity

Materials and Methods
Survey on the occurrence of sheath blight of rice in coastal region of Cuddalore district
A Fixed plot survey was conducted to assess the extent of sheath blight occurrence of rice in coastal region of Cuddalore district. The villages where rice is traditionally grown are selected for assessing the prevalence of sheath blight disease. Fifteen locations were selected for the survey. During the survey, plants affected due to sheath blight disease were found and also soil type, stages of the crop and total number of plants observed were counted and recorded. For disease scoring, the typical assessment system for rice developed by the International Rice Research Institute (SES, 2002) [13] was followed.

Disease scale
0 - No infection
1 - Vertical spread of the lesions up to 20% of plant height
3 - Vertical spread of the lesions 21 - 30% of plant height
5 - Vertical spread of the lesions 31 - 45% of plant height
7 - Vertical spread of the lesions 46 - 65% of plant height
9 - Vertical spread of the lesions > 65% of plant height

$$\text{Disease severity \%} = \frac{\text{Sum of disease grades} \times \text{No. of infected tillers/ hill}}{\text{Total No. of Tillers} \times \text{Maximum disease grades} \times \text{No. of tillers}} \times 100$$

Isolation, maintenance of the pathogen
The pathogen was isolated on potato dextrose agar (PDA) medium from the diseased specimen showing the typical symptoms. The infected portion of the sheath was cut into small bits, surface sterilized in 0.1 per cent mercuric chloride solution for 30 sec., washed in repeated changes of sterile distilled water and plated onto PDA medium in sterilized Petri dishes. The plates were incubated at room temperature (28±2ºC) for five days and were observed for the fungal growth. The fungus was subsequently purified and maintained on PDA slants and used for further studies.

The native isolates of *R.solani* isolated from the different locations in coastal region of Cuddalore districts were designated as Rs1 to Rs15. The mycelia growth of different isolates was assesses at five days after inoculation. Also the cultural variability *viz*., mycelial growth, colony colour, colony character and sporulation were assessed following standard procedures and recorded.

Pathogenicity test

The pathogenicity of the isolates was tested on BPT 5204 variety of rice grown in cement pots using Sclerotia inoculum method. The leaf sheaths of *R. solani* were inoculated with 10 days old sclerotia. The sclerotial balls were kept in between the leaf sheath with the help of a sterilized forceps. A small piece of wet cotton was kept above the sclerotial balls for maintaining the moisture condition (Singh *et al*., 2001) [14]. The pathogen was isolated from the infected area of the inoculated leaf sheath and compared with the original isolate to satisfy Koch's postulates

Result and Discussion

Survey on the incidence of sheath blight of rice in coastal region of Cuddalore district

The data presented in table 1 on the fixed plot survey conducted in major rice growing areas of coastal region of Cuddalore district, indicated that the Per cent Disease Index (PDI) varied with low to high level. The maximum PDI was recorded in T.S. Pettai (39.7%) followed by Andarmullippallam (35.2%), Karamedu (33.5%) and moderate incidence was noticed in Ariyakoshty (29.1%), Pudhupettai (28.5%), Poochimedu (26.5%) with the least level of incidence noticed in Samiyarpettai (13.5%). These results were in the accordance of Neha *et al.* (2013) and Thakur *et al.* (2017) [16]. Plant variety and nitrogenous fertilizers are one of the major factors influencing sheath blight disease yield losses in rice, both during dry and wet seasons (Qi Yuan *et al.* 2007) [9]. The variation in the extent of the disease incidence might be due to the prevalence of the isolates of the pathogen differing in their virulence. Also, the difference in the disease incidence might be attributed to the availability of potential inoculums, host and environment interaction (Pal *et al.*, 2015) [7]. The temperature and relative humidity are considered to be the important factors for sheath blight infection and therefore the disease is more common (Pasalu *et al*. 2005) [8]. All these earlier reports corroborates with the present findings.

Cultural characters of different isolates of *R. solani*

The results revealed that fifteen isolates of *R.solanii* exhibited a great variability with respect to mycelial growth, colony colour, colony character and sclerotia production (Table 2). Among the fifteen isolates, the maximum mycelial growth was recorded by Rs2 (90.00 mm), Rs5 (90.00 mm) and Rs15 (90.00 mm) at seventh day of inoculation. The minimum mycelial growth was recorded by Rs4 (61.25 mm). A similar such variation in the mycelial growth among the isolates of *R. solani* was observed earlier by Lal *et al.,* (2014) [3]. Upadhyay *et al.,* (2013) [19] also observed morphological variation in *R. solani* isolates in respect to their colour, size and shape, sclerotia production and etc,

The colony morphology of all the isolates showed whitish brown to light brown, septate, aerial/submerged and branched mycelium. The colour of the scletotia was brown to light brown colour. The isolates of Rs1, Rs4, Rs7, Rs9, Rs11, Rs13 and Rs15 produced aerial, very pale brown colour of mycelium and large size sclerotia. Some isolates such as Rs3, Rs10 and Rs14 exhibited aerial, yellowish brown mycelial colour. The isolates of Rs6, Rs8 and Rs12 showed aerial, light brown and the isolate Rs2 and Rs5 produced aerial, submerged whitish colour mycelium. Based on pattern of sclerotial production 15 *R. solani* isolates were grouped into four categories *viz.*, sclerotia Scattered grouping (3), Lower and peripheral ring (5), Grouped at centre and peripheral ring (3), Grouped at centre(4) and also based on colour of sclerotia production were grouped in two categories like Light brown and brown. Similar observations had been made by Toda *et al.,* (1999) [18]. Upadhyay *et al.,* (2013) [19] observed that such type of categorization based on the pattern of formation and arrangement among rice *R. solani* isolates. Manjunatha *et al*. (2018) [4] also reported that colony colour ranged from brown, light brown, dark brown and yellowish brown. Discoloration of growth media is mainly attributed to the production of pigments by the pathogen. Difference in the intensity of the colour might also correspond to the amount of pigments released by their respective isolate in the media.

Effect of *R. solani* isolates on the incidence of Sheath blight of rice (var. BPT 5204)

The data depicted in table 3revealed varied levels of pathogenicity with different isolates. Among the isolates of *R. solani* collected from different conventional rice growing coastal region of Cuddalore districts in Tamilnadu, the isolate collected from T.S. Pettai (Rs15) village was found to be the most virulent, recording the highest incidence and the isolate Rs12 collected from Samiyar pettai was the least virulent. The variability in the pathogenicity among isolates of *R. solani* was reported by several workers (Thind and Aggarwal (2008) [17]; Khodaryari *et al.,* (2009); Lal *et al.,* (2014) [3]. The results of present study are in agreement with these earlier reports. Further, from the present study, it was discernible that the rice crop showed more incidence of sheath blight which could be due the fact that, the crop/ variety is susceptible during the maximum tillering stage. These results were in accordance with the findings of Swain *et al.,* (2005) [15]; Basu and Gupta (1992) [1]; Xiao *et al.,* (2008) [20]. Also, it is noteworthy that the isolates which produced faster mycelial growth and more sclerotia were highly virulent and produced higher sheath blight incidence which could be due the virulence of the pathogenic isolates.

Table 1: Survey on the incidence of sheath blight of rice in coastal region of Cuddalore district

Sl. no.	Locality	Isolates	Variety	Crop stage	Soil type	Sheath blight (%)
1	Akkarai Jeyakondappattinam	Rs1	ADT 38	Panicle initiation	Clay loam	18.4 (25.40)
2	Andarmullippallam	Rs2	BPT 5204	Panicle initiation	Clay loam	35.2 (36.39)
3	Ariyakoshty	Rs3	BPT 5204	Panicle initiation	Clay loam	29.1(32.64)
4	C.Manambadi	Rs4	ADT 44	Panicle initiation	Clay loam	19.3(26.06)
5	Karamedu	Rs5	ADT 49	Panicle initiation	Clay	33.5(35.37)

6	Killai	Rs6	BPT 5204	Panicle initiation	Clay loam	20.2(26.71)
7	Naduthittu	Rs7	BPT 5204	Grain filling	Clay loam	18.9(25.77)
8	Pethanagkuppam	Rs8	BPT 5204	Grain filling	Clay loam	22.4(28.25)
9	Ponnanthittu	Rs9	ADT 38	Panicle initiation	Sandy loam	17.6(24.81)
10	Poochimedu	Rs10	BPT 5204	Panicle initiation	Clay loam	26.5(30.98)
11	Pudhupettai	Rs11	BPT 5204	Panicle initiation	Clay loam	28.5(32.27)
12	Samiyar pettai	Rs12	BPT 5204	Panicle initiation	Clay loam	13.5(21.56)
13	Samuttykuppam	Rs13	CR 1009	Grain filling	Sandy loam	18.9(25.78)
14	Singarathoppu	Rs14	CR 1009	Grain filling	Sandy loam	17.2(24.50)
15	T.S. Pettai	Rs15	BPT 5204	Grain filling	Clay loam	39.7(39.05)

Data in parentheses indicate angular transformed values

Table 2: Cultural characters of different isolates of *R. solani*

S.No	Isolates	Colour of mycelium	Topography	Colour and Arrangement of sclerotia	Sclerotial Size (µm)	Mycellial growth (mm)
1.	Rs1	Very pale brown	Aerial	Brown, Scattered grouping	L	76.54
2.	Rs2	Whitish brown	Aerial, submerged	Light brown, Lower and peripheral ring	M	90.00
3.	Rs3	Yellowish brown	Aerial	Brown, Grouped at centre and peripheral ring	M	63.15
4.	Rs4	Very pale brown	Aerial	Brown, Scattered grouping	L	61.25
5.	Rs5	Whitish brown	Aerial, submerged	Light brown, Lower and peripheral ring	L	90.00
6.	Rs6	Light brown	Aerial	Brown, Lower and peripheral ring	M	78.89
7.	Rs7	Very pale brown	Aerial	Brown, Grouped at centre	L	70.58
8.	Rs8	Light brown	Aerial	Light brown, Grouped at centre and peripheral ring	L	83.61
9.	Rs9	Very pale brown	Aerial	Brown, Grouped at centre and peripheral ring	L	62.97
10	Rs10	Yellowish brown	Aerial	Brown, Grouped at centre	S	80.39
11	Rs11	Very pale brown	Aerial	Light brown, Lower and peripheral ring	L	89.82
12	Rs12	Light brown	Aerial	Light brown, Grouped at centre	M	73.64
13	Rs13	Very pale brown	Aerial	Light brown, Grouped at centre	L	79.46
14	Rs14	Yellowish brown	Aerial	Light brown, Scattered grouping	S	68.17
15	Rs15	Very pale brown	Aerial	Light brown, Lower and peripheral ring	L	90.00

S- Small (< 1.5 mm), M- Medium (1.5 mm) and L- Large (1.5 to 3mm) (Basu *et al.* (2004)

Table 3: Effect of *R. solani* isolates on the incidence of Sheath blight of rice (var. BPT 5204)

Sl. no.	Isolates	Lesion structure	Sheath blightincidence (%)
1.	Rs1	Elliptical, Elongated	45.76 (42.57)
2.	Rs2	Elongated	62.21 (52.07)
3.	Rs3	Elliptical, Amorphous, Elongated	49.81 (44.89)
4.	Rs4	Elliptical, Elongated	58.36 (49.81)
5.	Rs5	Elliptical, Elongated	56.45 (48.71)
6.	Rs6	Elongated	45.26 (42.28)
7.	Rs7	Elliptical, Amorphous, Elongated	32.28 (34.62)
8.	Rs8	Elliptical	34.39 (35.90)
9.	Rs9	Elliptical, Elongated	37.47 (37.74)
10.	Rs10	Elliptical	29.96 (33.19)
11.	Rs11	Elliptical, Elongated	37.21 (37.59)
12.	Rs12	Elliptical, Amorphous, Elongated	29.85 (33.12)
13.	Rs13	Elliptical	40.36 (39.44)
14.	Rs14	Elliptical, Elongated	35.62 (36.64)
15.	Rs15	Elliptical, Elongated	68.21 (55.68)

Data in parentheses indicate angular transformed values

References

1. Basu A, Gupta PKS. Cultural and pathogenic variation in rice isolates of *Rhizoctonia solani* Kuhn. Beitrage zur Tropischen Land wirts chaft and Veterinarmedizin, 1992:30(3):291-297.
2. Khodayari M, Safaie N, Shamsbakhsh M. Genetic diversity of Iranian AG1-IA isolates of *Rhizoctonia solani*, the cause of rice sheath blight, using morphological and molecular markers. Journal of Phytopathology,2009:157(11/12):708-714.

3. Lal M, Singh V, Kandhari J, Sharma P. Diversity analysis of *Rhizoctonia solani* causing sheath blight of rice in India. African Journal of Biotechnology,2014:13(51):4594-4605.
4. Manjunatha OB, Vidya Sagar V, Prakasam, Narendra Reddy CN. Variability Studies on Sheath Blight of Rice in Karnataka, India. Int J Curr Microbiol App Sci,2018:7(10):724-736
5. Neha KV, Balabaskar P, Naveenkumar R. Survey and occurrence of *Rhizoctonia solani* (Kuhn) causing sheath blight of rice and *in vitro* efficacy of bacterial antagonists against *Rhizoctonia solani* (Kuhn). Journal Environmental biology,2016:37:1421-1427.
6. Ou SH. Rice disease Commonwealth Mycological Institute, Kew, Surray, UK, 1985.
7. Pal R, Biswas MK, Mandal D, Seni A, Naik BS. Prevalence of sheath blight disease of rice in west central table land zone of Odisha. Intl. J. Bio-Res. Environ. Agrl. Sci,2015:1(3):103-107.
8. Pasalu IC, Katti G, Krishnamurthy P, Subba Rao LV, Reddy CS, Subbaiah SV. Integrated pest management in rice. Technical bulletin no. 15. Directorate of rice research, Rajendranagar, Hyderabad, AP, India, 2005, 53.
9. QiYuan T, ShaoBing P, Buresh RJ, YingBin Z, Castilla NP, Mew TW, XuHua Z. Rice varietal difference in sheath blight development and its association with yield loss at different levels of N fertilization. Field Crops Research,2007:102(3):219-227
10. Rush MC, Lindberg CD. Controlling sheath blight in rice. Lousiana Agriculture,1984:27:16-18
11. Savary S, Mew TW. Analyzing crop losses due to *Rhizoctonia solani*: rice sheath blight, a case study. In: Rhizoctonia.species: taxonomy, molecular biology, ecology, pathology and disease control (Eds.: B. Sneh, S.J. Hare, S. Neate and G. Dijst). Kluwer, Dordrecht, 1996, 237-244.
12. Savary S, Teng PS, Willocquat L, Nutter FW Jr. Quantification and modeling of crop losses: a review of purposes. Annual Review of Phytopathology,2006:44: 89-112.
13. SES. Standard evaluation system for rice: Rice Knowledge Bank. International Rice Research Institute, Philippine, 2002.
14. Singh A, Rohilla R, Singh US, Savary S, Willocquet L, Duveiller E. An improved inoculation technique for sheath blight of rice caused by *Rhizoctonia solani.* Can. J. Plant Pathol,2001:24:65-68
15. Swain NC, Chhotray AK, Mahapatra SS. Pathogenic variability of *Rhizoctonia solani* causing sheath blight of rice and its management. Journal of Plant Protection and Environment.2005:2(1):96-99
16. Thakur L, Lakpale N, Tiwari PK, Pradhan A. Epidemiological studies on sheath blight disease of rice in Chhattisgarh Plains Agroclimatic Zone of Chhattisgarh, India. Int. J. Curr. Microbiol. App. Sci,2017:6(11):1351-1361.
17. Thind TS, Aggarwal R. Characterization and pathogenic relationships of *Rhizoctonia solani* isolates in a potato-rice system and their sensitivity to fungicides. Journal of Phytopathology,2008:156(10): 615-621.
18. Toda T, Hyakumachi M, Arora DK. Genetic relatedness among and within different *Rhizoctonia solani* anastomosis groups as assessed by RAPD, ERIC and REP-PCR. Microbiological Research,1999:154 (3):247-258
19. Upadhyay BK, Dubey SC, Singh R, Tripathi A. Morpho-molecular characterization of Indian isolates of *Rhizoctonia solani* infecting mungbean. Research Journal of Biotechnology,2013:8(11):92-99.
20. Xiao Y, Liu M, Li G, Zhou E, Wang L, Tang J *et al*. Genetic diversity and pathogenicity varia- tion in *Rhizoctonia solani* isolates from rice in Sichuan Province, China. Rice Sciences,2008:15:137-144.
21. Zachow C, Grosch R, Berg G. Impact of biotic and a-biotic parameters on structure and function of microbial communities living on sclerotia of the soil borne pathogenic fungus *Rhizoctonia solani*. Appl. Soil Ecol,2011:48:193-200