Int.J.Curr.Microbiol.App.Sci (2017) *6*(11): 3856-3864

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 6 Number 11 (2017) pp. 3856-3864**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2017.611.452

Host Range Studies of Rice Sheath Blight Fungus *Rhizoctonia solani* (Kuhn)

B.T. Nagaraj[1], Gururaj Sunkad[1], D. Pramesh[2*], M.K. Naik[1] and M.B. Patil[1]

[1]Department of Plant Pathology, University of Agricultural Sciences, Raichur-584 104, Karnataka, India
[2]Rice Pathology Laboratory, All India Co-ordinated Rice Improvement Programme, Agricultural Research Station, Gangavathi-583 227, Karnataka, India
**Corresponding author*

Keywords

Rice, *Rhizoctonia solani*, Sheath blight, Weeds, Sclerotia, Host range.

Article Info

Accepted:
28 September 2017
Available Online:
10 November 2017

A B S T R A C T

The pathogen, *Rhizoctonia solani* has a wide host range infecting crops and weed plants. In order to find out the host range of *R. solani* causing rice sheath blight, 26 plant species were selected which are commonly found in rice growing ecosystem. These plant species belonging to six families were grown and inoculated with fungus in glasshouse condition. Twenty five plant species found infected and one plant species devoid of infection. Diseased tissues of plants species belong to family Graminaceae, Cyperaceae produced typical symptoms of sheath blight. The fungus produced typical root rot and bark peeling symptoms in plant species belongs to family, Leguminaceae, Malvaceae, Amaranthaceae, The fungus not able to infect one weed species belongs to family Fabaceae, Indian joint vetch (*Aeschynomene indica*).

Introduction

Sheath blight disease of rice is caused by the fungus *Rhizoctonia solani* Kuhn (teleomorph *Thanetophorus cucumeris* Frank Donk.). The *R. solani* is cosmopolitan fungus with a very wide host range and attacks large number of crop plants and weeds (Ou, 1972). At one stage, it was claimed that there is hardly any plant species, which cannot be infected by *R. solani* (Singh *et al.*, 1999). Kozaka (1961) from Japan recorded 188 species of plants from 32 families that can be infected by this fungus. This fungus causes banded leaf and sheath blight in maize, rice and sorghum, damping-off in cotton, aerial blight and stem rot in mungbean and soybean, sheath rot in sugarcane, heart rot in cabbage, black scurf and sprout canker in potato and foliar blights of fruits and plantation crops (Tangonan and Quebral, 1992). The fungus has a worldwide distribution (Ogoshi, 1987) and isolates of *R. solani* are highly variable in aggressiveness. The host range of *R. solani* is extensive. The pathogen is capable of causing seedling damping-off, root rot, collar rot, stem canker, crown rot, bud and fruit rots, and foliage blight on a variety of susceptible agriculturally important crops (Baker 1970; Anderson 1982) like soybean (*Glycine max* L. Merr., Liu and Sinclair, 1991), cotton (*Gossypium hirsutum* L.; Brown and

McCarter, 1976), canola (*Brassica campestris* L.; Yitbarek *et al.,* 1987), wheat (*Triticum aestivum* L.; Wiseman *et al.,* 1995), beet (*Beta vulgaris* L.; Carling *et al.,* 1987), potato (*Solanum tuberosum* L. subsp. *tuberosum;* Escande and Echandi 1991) and rosemary (*Rosemarinus officinalis* L.; Conway *et al.,* 1997). *Rhizoctonia solani* also infects a number of turfgrass species (Couch, 1995).

Several weeds like *Cyperus rotundus*, *Cyperus difformis*, *Cynodon dactylon*, *Echinochloa colonum*, *Commelina obliqua* and *Amaranthus viridis* were also identified as collateral hosts and the pathogen perpetuates in these hosts in absence of rice plants (Acharya and Sengupta, 1998). The host range studies of *R. solani* indicated that it was successfully infected 14 different plant species belonging to three families. This proves that weeds and plants serve as collateral hosts and helped in the spread of the disease in next season (Srinivas *et al.,* 2014). The present investigation is carried out for the identification of host range of *R. solani* causing rice sheath blight. Hence, there is a need to collect information on the off season survival of *R. solani* in rice ecosystem on different plant species. Considering the above reason, the present study was under taken by using different crops and weed species from rice growing ecosystem.

Materials and Methods

The different crops and weed seeds from rice growing ecosystem were collected during summer, labeled and stored. In order to find out the host range of *R. solani* (RS-1) isolate, 26 plant species belonging to six families were grown in pots (30 cm diameter) filled with sterilized soil. Seeds were sown in pot containing soil amended with 30 mg N, 9.7 mg P, and 18.5 mg K per kilogram of soil using urea, single superphosphate, and murate of potash, respectively. The pots were inoculated with the sclerotia of the test fungus grown on PDA for 7 days at 28±1 ^{o}C. The sclerotia were placed in the root zone with the help of sterile forceps for plant species belongs to family Leguminaceae, Malvaceae, Amaranthaceae and Fabaceae. For the plant species belongs to Graminaceae and Cyperaceae family the sclerotia were placed by opening the sheath region. Then the inoculated sheaths were covered with moist cotton and sprinkled with a few drops of sterile distilled water regularly for 24 hours to maintain ~100 per cent humidity procedure was followed in accordance with Srinivas *et al.,* (2014) and Adhipathi *et al.,* (2013).

Inoculation was done in the evening and inoculated plants were sprayed with water next morning. Inoculated plants were kept under high humid conditions and were observed regularly for the appearance of the disease symptoms. The trial was carried out in the pots under glasshouse condition. Five seedlings were maintained in each pot. After inoculation of the plants, the pots were placed in glasshouse. The uninoculated control plants served as negative control. The symptoms were recorded 7 days after inoculation.

Results and Discussion

Host range studies indicated that pathogen (*R. solani*) successfully infected almost all the plant species. Typical sheath blight, root rot and bark peeling symptoms were started appearing 7 days after inoculation. Twenty five plant species belonging to six families were found infected and one plant species devoid of infection (Table 1). Diseased tissues of plants species belong to family Graminaceae crops (Maize, Wheat, Jowar, Bajra and Ragi), weeds (Torpedo grass, Crowfoot grass, Swollen fingergrass, Jungle rice, Jointed goatgrass, Viper grass, Knot grass, Bermuda grass and Hairy crab grass) and Cyperaceae (Umbrella sedge and Nutgrass) produced typical symptoms of sheath blight.

Fig.1 Symptoms induced by *Rhizoctonia solani* on different crop plants

Fig.2 Symptoms induced by *Rhizoctonia solani* on different weeds hosts

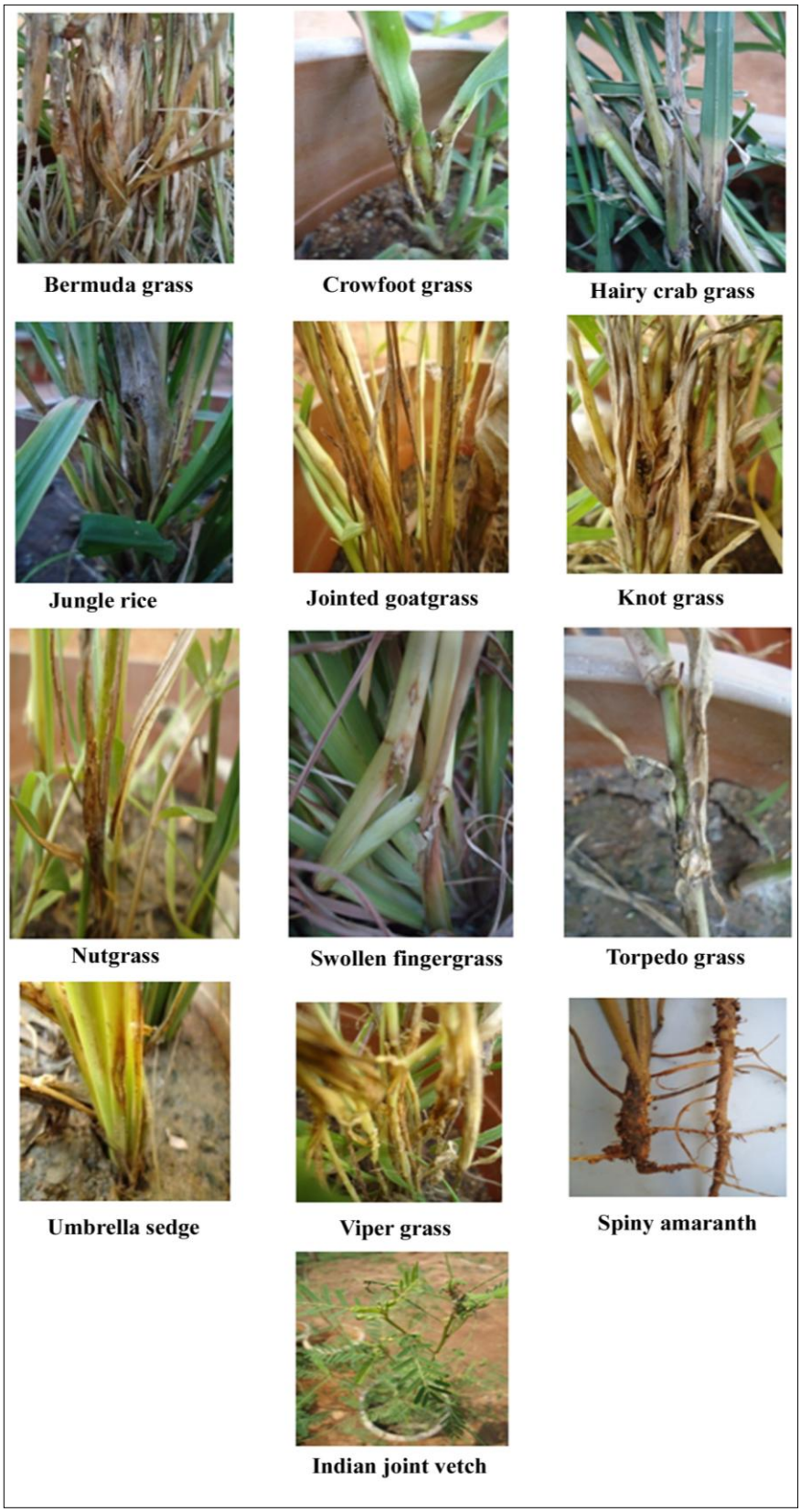

Fig.3 Survival of *Rhizoctonia solani* on different weeds hosts found during sheath blight survey

Table.1 Host range of *Rhizoctonia solani* and its cross infectivity with other cultivated crops and weeds

Sl. No.	Common name	Botanical name	Family	Infection
Cereal / Millets				
1.	Maize	*Zea mays*	Graminaceae	+
2.	Wheat	*Triticum aestivum*	Graminaceae	+
3.	Jowar	*Sorghum bicolor*	Graminaceae	+
4.	Bajra	*Pennisetum typhoides*	Graminaceae	+
5.	Ragi	*Eleusine coracana*	Graminaceae	+
Pulses				
6.	Redgram	*Cajanus cajan*	Leguminaceae	+
7.	Greengram	*Vigna radiata*	Leguminaceae	+
8.	Blackgram	*V. mungo*	Leguminaceae	+
9.	Cowpea	*V. unguiculata*	Leguminaceae	+
10.	Bengalgram	*Cicer arietinum*	Leguminaceae	+
		Commercial crops		
11.	Cotton (Bt, Non Bt)	*Gossypium hirsutum*	Malvaceae	+
Oilseed crops				
12.	Groundnut	*Arachis hypogaea*	Leguminaceae	+
13.	Soybean	*Glycine max*	Leguminaceae	+
Weeds				
14.	Torpedo grass	*Panicum repens*	Graminaceae	+
15.	Crowfoot grass	*Dactyloctenium aegyptium*	Graminaceae	+
16.	Swollen fingergrass	*Chloris barbata*	Graminaceae	+
17.	Jungle rice	*Echinochloa colona*	Graminaceae	+
18.	Umbrella sedge	*Cyperus difformis*	Cyperaceae	+
19.	Jointed goatgrass	*Aegilops cylindrica*	Graminaceae	+
20.	Viper grass	*Dinebra retroflexa*	Graminaceae	+
21.	Nutgrass	*Cyperus rotundus*	Cyperaceae	+
22.	Knot grass	*Paspalum scorbiculata*	Graminaceae	+
23.	Spiny amaranth	*Amaranthus spinosus*	Amaranthaceae	+
24.	Bermuda grass	*Cynodon dactylon*	Graminaceae	+
25.	Hairy crab grass	*Digitaria sanguinalis*	Graminaceae	+
26.	Indian joint vetch	*Aeschynomene indica*	Fabaceae	-

+: Presence
- : Absence

The fungus produced typical root rot and bark peeling symptoms in plant species belongs to family, Leguminaceae (Redgram, Green gram, Black gram, Cowpea, Bengalgram, Groundnut, Fabaceae (Soybean), Malvaceae (Cotton), Amaranthaceae (*Spiny amaranthus*). The fungus could not infect one weed species which belongs to family Fabaceae, Indian joint vetch (*Aeschynomene indica*) (Fig. 1 and 2). The fungus was re-isolated from all the infected plant species and produced typical *R. solani* characters on PDA. This proves that weeds and plants serve as collateral hosts and helped in the spread of the disease in next season. Survival of *R. solani* on weeds as a source of primary inoculum found during

sheath blight survey is depicted in Figure 3.

The pathogen, *R. solani* has a wide host range infecting crops and weed plants. Typical sheath blight, root rot and bark peeling symptoms were started appearing 7 days after inoculation. Multinucleate *Rhizoctonia* sp. AG-1 IA causes symptoms *viz*., sheath blight, foliar blight, leaf blight, web-blight, head rot, bottom rot, and brown patch on different crops like rice (*Oryza sativa* L.), corn (*Zea mays* L.), barley (*Hordeum vulgare* L.), sorghum (*Sorghum vulgare* Pes.), potato (*Solanum tuberosum* L.), barnyard millet, common millet, soybean, peanut (*Arachis hypogaea* L.), lima bean, cabbage, leaf lettuce, stevia, orchard grass, crimson clover, tall fescue (*Festuca arundiacea* Schreb), turfgrass, creeping bentgrass, perennial ryegrass, gentian (*Gentiana scabra*), and camphor (Li and Yan, 1990; Sneh *et al.*, 1998; Fenille *et al.*, 2002 and Naito, 2004)

Host range studies indicated that pathogen (*R. solani*) successfully infected almost all the species. Twenty five plant species belonging to five families were found infected and one plant species devoid of infection. Goswami *et al.*, (2010) found that thirty five crop species, namely wheat, rice, maize, prosomillet, foxtail millet, barley, sorghum, groundnut, soybean, sunflower, mustard, sesame, niger, safflower, chickpea. blackgram, lentil, grasspea, mungbean, cabbage, cauliflower, radish, stringbean, spinach, Indian spinach, Lady's finger, country bean, carrot, cucumber, white gourd, ribgourd, tomato, brinjal, potato and kangkon were tested against the isolates of *Rhizoctnia solani* under field and laboratory conditions and all were found infected by the fungus.

Srinivas *et al.*, (2014) reported that rice isolate of *R. solani* infected 14 species belonging to three different families *i.e.*, Amaranthaceae, Graminaceae and Leguminaceae. Variability in disease symptoms, host range, and geographical location of *R. solani* isolates suggest that there are several strains of the species (Burpee and Martin, 1992). *Rhizoctonia* spp. has been classified according to 14 anastomosis groups (AGs, AG-1 to AG13 and AG-BI) (Carling *et al.*, 2002). AG is a genetic feature that results in exchange of nuclei and the combining of different genotypes (Kataria *et al.*, 1991 and Burpee and Martin, 1992).

The rice fungus *R. solani* infected 20 species which are from 11 families and observed that the sclerotia from diseased tissue of weed hosts produced typical symptoms of sheath blight on paddy plants (Kozaka, 1965 and Tsai, 1974). Kannaiyan and Prasad (1980) have listed 30 monocot weed species as host of *Thanatephorus cucumeries* (*Rhizoctonia solani*). This proves that weeds and plants serve as collateral hosts and helped in the spread of the disease in next season. Hence, keeping bunds clean of weeds will help in checking the disease spread from primary sources.

So, it is better recommended that weeding at timely intervals during crop season and selection of non-suitable crop helps in minimizing the disease in the next crop season. This was supported by (Tsai, 1974; Singh and Saksena 1980 and Goswami *et al.*, 2010).

The management of this disease is possible only after the detailed study of different aspect of the pathogen. Recognizing the importance of the problem, the mode of survival of the pathogen on collateral hosts was studied in the conditions where crop is not sown for a season. This article represents the importance of weed management practices for minimizing the off season survival of the pathogen.

References

Acharya, S., and Sengupta, P. K. 1998. Collateral hosts of rice sheath blight fungus *Rhizoctonia solani*. Oryza, 35: 89-90.

Adhipathi, P., Singh, V., and Meena, S. C. 2013. Virulence diversity of *Rhizoctonia solani* causing sheath blight disease in rice and its host pathogen Interaction. The Bioscan, 8(3): 949-952.

Anderson, N. A., 1982. The genetics and pathology of *Rhizoctonia solani*. Annu. Rev. Phytopathol. 20: 329-347.

Baker, K. F., 1970. *Types of Rhizoctonia diseases and their occurrence*. In: Parmeter JR, Jr, editor. *Rhizoctonia solani*: biology and pathology. Berkeley, CA: California University Press, pp.124-148.

Brown, E. A., and McCarter, S. M. 1976. Effect of a seedling disease caused by *Rhizoctonia solani* on subsequent growth and yield of cotton. Phytopathology. 66: 111-15.

Burpee, L. L., and Martin, B. 1992. Biology of *Rhizoctonia* species associated with Turfgrasses, Plant Dis., 76: 112-117.

Carling, D. E., Baird, R. E., Gitaitis, R. D., Brainard, K. A., and Kuninaga, S. 2002. Characterization of AG-13, a newly reported anastomosis group of *Rhizoctonia solani*. Phytopathology. 92: 893-899.

Carling, D. E., Leiner, R. H., and Kebler, K. M. 1987. Characterization of a new anastomosis group (AG-9) of *Rhizoctonia solani*. Phytopathology. 77: 1609-1612.

Conway, K. E., Maness, N. E., and Motes, J. E. 1997. Integration of biological and chemical controls for *Rhizoctonia* aerial blight and root rot of rosemary. Plant Dis. 81: 795-798.

Couch, H. B., 1995. Diseases of Turfgrasses Caused by Fungi. In: Couch HB, editor. Diseases of Turfgrasses. 3rd ed. Malabar, FL: Krieger Publishing Company, pp. 21-199.

Escande, A. R., and Echandi, E. 1991. Protection of potato from *Rhizoctonia* canker with binucleate *Rhizoctonia* fungi. Plant Pathol. 40: 197-202.

Fenille, R. C., Luizde, S. N., and Kuramae, E. E. 2002. Characterization of *Rhizoctonia solani* associated with soybean in Brazil. Eur. J. of Plant Pathol. 108(8): 783-792.

Goswami, B. K., Bhuiyan, K. A. and Mian, I. H. 2010. Morphological and pathogenic variations in the isolates of *Rhizoctonia solani* in Bangladesh. Bangladesh J. Agril. Res. 35(3): 375-380.

Kataria, H. R., Verma, P. R., and Gisi, U. 1991. Variability in the sensitivity of *Rhizoctonia solani* anastomosis groups to fungicides. Phytopathology. 153: 121-133.

Kozaka, T., 1961. Ecological studies on sheath blight of rice of rice caused *Pellicularia sasakii* (Shirai) and its chemical control. Chugoko agric. Res. 20: 1-133.

Li, H. R., and Yan, S. Q. 1990. Studies on the strains of pathogens of sheath blight of rice in the east and south of Sichuan Province. Acta. Mycologica. Sinica. 9: 41-9.

Liu, Z., and Sinclair, J. B. 1991. Isolates of *Rhizoctonia solani* anastomosis group 2-2 pathogenic to soybean. Plant Dis. 75:682-687.

Naito, S., 2004. *Rhizoctonia* diseases: Taxonomy and population biology. Proceeding of the International Seminar on Biological Control of Soilborne Plant Diseases, Japan- Argentina Joint Study, Buenos Aires, Argentina, pp.18-31.

Ogoshi, A., 1987. Ecology and pathogenicity of anastomosis and intraspecific groups of *Rhizoctonia solani* Kuhn. Annual

Review of Phytopathology. 25: 125-43.

Ou, S. H., 1972. *Rice diseases*. First edition. The common wealth Mycological Institute, Kew Survey, England. 368pp.

Singh, A., Singh, U. S., Willocquet, L., and Savary, S. 1999. Relationship among cultural/ morphological characteristics, anastomosis behaviour and pathogenecity of *Rhizoctonia solani* Kühn on rice. J. Mycol. Pl. Pathol. 29: 306-316.

Sneh, B., Burpee, L., and Ogoshi, A. 1998. Identification of *Rhizoctonia* species. The APS, St. Paul, Minesota.

Srinivas, P., Ramesh Babu, S. and Ratan, V., 2014, Role of sclerotia, plant debris and different hosts on survival of rice sheath blight pathogen, *Rhizoctonia solani.* Int. J. Appl Biol. Pharm. 5(2): 29-33.

Tangonan, N. G., and Quebral, F. C. 1992. Host Index of Plant Diseases in the Philippines, 2nd edn. Los Banos, Philippines: University of the Philippines at Los Banos.

Wiseman, B. M., Neate, S. M., Keller, K. O., and Smith, S. E. 1995. Suppression of *Rhizoctonia solani* anastomosis group 8 in Australia and its biological nature. Soil. Biol. Biochem. 28: 727-732.

Yitbarek, S. M., Verma, P. R., and Morrall, R. A. A. 1987. Anastomosis groups, pathogenicity, and specificity of *Rhizoctonia solani* isolates from seedling and adult rapeseed/canola plants and soils in Saskatchewan. Can. J. Plant. Pathol. 9: 6-13.

How to cite this article:

Nagaraj, B.T., Gururaj Sunkad, D. Pramesh, M.K. Naik and Patil, M.B. 2017. Host Range Studies of Rice Sheath Blight Fungus *Rhizoctonia solani* (Kuhn). *Int.J.Curr.Microbiol.App.Sci.* 6(11): 3856-3864. doi: https://doi.org/10.20546/ijcmas.2017.611.452