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Screening/rescreening of rice entries for sheath blight resistant under field condition

Nirmal Prasad, Nohar Singh, Avinash P and Pradeep Kumar Tiwari

Abstract
Rice (*Oryza sativa* L.) is second most important cereal and the staple food for more than half of the world's population. Sheath blight of rice caused by *Rhizoctonia solani*. The disease has been named as "sheath blight" because of primary infection on leaf sheath. The yield loss due to this disease is reported to range from 5.2-50 per cent depending on the environmental conditions, crop stages at which the disease occurs, cultivation practices and cultivars used. Significant grain yield losses were reported due to sheath blight when susceptible varieties were grown. Thirty one entries / cultivars of rice were screened under natural field condition for resistance of for resistance of sheath blight of rice. The 31 different rice entries and cultivars were screened for sheath blight resistant purpose. The thirty one entries were screened against sheath blight of rice under artificial inoculation no entry was recorded for highly resistance reaction. Twenty one entries designated as 22250, 21665, 3305, 545191, 545206, 450294, 463893, 22164, CRHR-32, NDR-359, 23135, 23144, 23174, 23089, 23101, 23114, 22017, 23115, 23652, 23834 were showed resistant reaction (Score-3). While the nine entries designated as R1896-81-2-59-1, R2048- 187-2-128-1, ARR-8, FSVT-MS-18, FSVT-MS-20, 213, 1714, 2717 and the variety IR10F36 showed moderately resistant reaction (Score-5). Rest of the one entry 212 was recorded as susceptible (Score-7) in their reactions against the disease.

Keywords: *Rhizoctonia solani*, resistance, screening, rice

Introduction
Rice (*Oryza sativa* L.) is second most important cereal and the staple food for more than half of the world's population. It provides 20% of the worlds dietary energy supply followed by Maize and Wheat. To meet the global demand, it is estimated that about 114 Mt of additional milled rice needs to be produced by 2035 with an increase of 26% in next 25 years. In the world at present the area of rice is 162.26 Mha. with production of 483.80 million metric ton and productivity of 2.98 Mt ha^{-1} In India the area of rice is 44.50 Mha^{-1} with production of 106.50 million metric ton and productivity 3.59 Mt ha^{-1}. (Anonymous, 2016) [1].

Sheath blight is one major biotic constraints that affects rice production in India and is considered economically important disease of rice in the world The disease is caused by *Rhizoctonia solani* Kuhn (teleomorph: *Thanetophorus cucumeris* (Frank) Donk), a fungal pathogen of both rice and soyabeans. The yield loss due to this disease is reported to range from 5.2-50 per cent depending on the environmental conditions, crop stages at which the disease occurs, cultivation practices and cultivars used. Significant grain yield losses were reported due to sheath blight when susceptible varieties were grown. The disease has been named as "sheath blight" because of primary infection on leaf sheath. The fungus attack the crop from tillering to heading stage and leaf blade symptoms also observed. Initial symptoms are noticed on leaf sheath near water level. As the spot enlarge, the centre become grayish with irregular brown blackish border. The presence of several large lesions on leaf sheath causes death of whole leaf and in several causes all the leaf of a plant blighted. The infection spreads to inner sheath resulting death of entire plant. Older plants are highly susceptible, plants heavily infected by in the only heading and grain filling growth stage produced poorly filled grain. The fungus *Rhizoctonia solani* produced usually long cells of septate mycelium which are hyaline within young, yellowish brown. It produced large number of globose sclerotia which initially turn white, late turn brown to purplish brown. Sclerotia as a major source of primary inoculum. Wide host range of the pathogen *Rhizoctonia solani* makes management of the disease a different tast. Hence the disease is being managed by changing the cultural practices by one of chemical fungicide and limited extend with a biological control and biopesticide. The systematic search of higher plants for antifungal activity has shown that plant extracts have the ability to inhibit spore germination and mycelia growth in many fungal species.

Integrated approaches for the disease management are paying more dividences in terms of sustainability. This approach mainly emphasizes on the host plant resistance, cultural practices, eco-friendly means i.e. through the use of botanicals and bio-pesticides *etc*. with a need based application of chemical molecules for disease management. Integrated disease management (IDM) blending to the traid *viz.*, cultural, biological, Bio-pesticide and use of resistance source in the right manner could be adopted. Looking to the above figure and facts, an attempt was made through this investigation to study the different methods contributing for the effective management of sheath blight of rice. One of most important resistance cultivar for screening rice entries/ varieties for sheath blight resistant. Chandra *et al.* (2016) [2] analyzed that out of 108 germplasm, screened under natural as well as under artificial inoculated condition, none of the entries were found immune or resistant. Shamim *et al*. (2014) [5] screened a wide collection of cultivated rice, wild rice, maize, wheat and barley genotypes were screened against *R. solani* for resistance. Lal *et al*. (2012) [3] tested six cultivars of rice were artificially inoculated with 25 isolates of *R. solani* in glass house.

Material and Method

Experimental site

The field experiment was conducted during *kharif* 2016 at the experimental field of the Department of Plant Pathology situated in the Research farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.).

Rescreening of rice entries/ varieties for sheath blight resistant

The study was conducted in bunded rice field and under irrigated conditions during kharif 2016. Thirty one rice varieties/ entries i.e.CRHR-32, NDR-359, R1896-81-2-59-1, R2048- 187-2-128-1, ARR-8, FSVT-MS-18, FSVT-MS-20, IR10F36, 22250, 21665, 3305, 545191, 545206, 450294, 463893, 22164, 23135, 23144, 23174, 23089, 23101, 23114, 22017, 23115, 23652, 23834, 22240, 213, 1714, 2717, 212 were grown in I.G.K.V., Raipur Research field. The rice entries were shown in a nursery bed by direct sowing in simple two rows design with a spacing of 20 cm from row to row and a single row of check TN-1 was taken. Seed placement was done approximately at a distance of 2 to 3 cm. Fertilizer was applied @ N120: P50: K0 kg ha^{-1}. Fifty percent of N and total P were given as first basal dose and remaining N applied in two split doses. The environment was kept aseptic to ensure that the seedlings were disease and contaminant-free.

R. solani inoculum preparation

Stems of 35-40 days old rice plants were cut in to pieces of about 2 cm size and filled in to 500 ml Erlenmeyer flasks upto one third. Flasks were autoclaved at 15 pound per square inch for 30 minutes. Mycelial discs of 5 mm diameter cut from the margin of 48 hrs old culture of the pathogen were inoculated into the flask and incubated at 27±2 ºC up to fifteen days for full growth of fungus and formation of sclerotia.

Inoculation

In all the field experiments, sclerotia from 7-9 days old culture and rice stem bits (*R. solani* mycelium profusely grown) were used for inoculation of the rice plants at the maximum tillering stage. The primary tillers of each hill were tagged and inoculated gently by punching and pushing single sclerotium or rice stem bit into the sheath just 1 ½ to 2 ½ cm above the water surface level as per the position of the sheath.

Method of inoculation

For artificial inoculation, rice plants at maximum tillering stage were taken for inoculation. The inoculation was done by placing sclerotia of *R. solani* with the help of sterilized forceps in the centre of each hill. For each variety five healthy tillers were inoculated at random. After inoculation, crop was regularly watched for appearance of disease. Rice varieties/entries were screened against sheath blight severity. Each plot was observed in number of infected tiller and each tiller were observed plant height and symptoms length of sheath blight of rice. The disease development was recorded in each variety and percent disease severity was calculated as standard evaluation system (SES), (Anomymous 1988). Observations were recorded 30 days after inoculation and graded as per 0-9 SES scale. The scale was as follows:

The disease development would be recorded in each variety and Percent Disease severity and Percent Disease Index will be calculated as:

$$\text{Disease severity} = \frac{\text{Total lesion lenght}}{\text{Total lenght of sheath}} \text{X } 100$$

$$\text{Percent Disease Index} = \frac{\text{Sum of all individual disease ratings}}{\text{Total no. of plant asseded X maximum rating}} \text{ X } 100$$

Table 1: Disease rating scale Response Description

Disease rating scale	Response	Description
0	Immune	No Infection
1	Highly Resistant	Vertical spread of the lesions up to 20% of plant height
3	Resistant	Vertical spread of the lesions up to 21-30% of plant height
5	Moderately Resistant	Vertical spread of the lesions up to 31-45% of plant height
7	Susceptible	Vertical spread of the lesions up to 46-65% of plant height
9	Highly Susceptible	Vertical spread of the lesions up to 66-100% of plant height

Result

Screening/rescreening of rice entries for sheath blight resistant

The thirty one entries were screened against sheath blight of rice under artificial inoculation no entry was recorded for highly resistance reaction Table 2 twenty one entries designated as 22250, 21665, 3305, 545191, 545206, 450294, 463893, 22164, CRHR-32, NDR-359, 23135, 23144, 23174, 23089, 23101, 23114, 22017, 23115, 23652, 23834 were showed resistant reaction (Score-3). While the nine entries designated as R1896-81-2-59-1, R2048- 187-2-128-1, ARR-8, FSVT-MS-18, FSVT-MS-20, 213, 1714, 2717 and the variety IR10F36 showed moderately resistant reaction (Score-5). Rest of the one entry 212 was recorded as susceptible (Score-7) in their reactions against the disease.

The above results are accordance with the findings of Mosaddeque *et al*. (2008) [4] were screened forty four test entries of parental lines of rice with one susceptible (BR11) and one resistance check (BRR1 dhan 29) against sheath blight (*R. solani*) of rice. Ten lines were resistant, 31 were moderately resistant and 3 showed susceptible reaction at maximum tillering stage.

Table 2: Frequency distribution of rice entries/ varieties for sheath blight resistance

S. N.	Score	Varietal reaction	Frequency Distribution	Varieties/entries (IET No.)
1	0	Immune	0	NIL
2	1	Highly resistance	0	NIL
3	3	Resistant	21	22250, 21665, 3305, 545191, 545206, 450294, 463893, 22164, CRHR-32, NDR-359, 23135, 23144, 23174, 23089, 23101, 23114, 22017, 23115, 23652, 23834
4	5	Moderately Resistance	9	R1896-81-2-59-1, R2048- 187-2-128-1, ARR-8, FSVT-MS-18, FSVT-MS-20, 213, 1714, 2717, IR10F36.
5	7	Susceptible	1	212
6	9	Highly susceptible	0	NIL
Total entries= 31 LSI=3.70				

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