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Toorray Nitin Kumar
Assistant Professor, College of Agriculture and Research Station, Marra, IGKV, Durg, Chhattisgarh, India

Tiwari Pradeep Kumar
Professor, Department of Plant Pathology, IGKV, Raipur, Chhattisgarh, India

Corresponding Author:
Toorray Nitin Kumar
Assistant Professor, College of Agriculture and Research Station, Marra, IGKV, Durg, Chhattisgarh, India

Identification of the slow disease developing varieties for sheath blight disease of rice

Toorray Nitin Kumar and Tiwari Pradeep Kumar

Abstract
A set of nineteen rice entries were tested to identify the slow disease developing varieties against sheath blight disease. Among them, IET No. RP-Patho-23 and IET No. 25916 showed a resistant reaction against sheath blight disease, while IET No. 22240, IET No. 545191, IET No. 463893, IET No. 22017, IET No. R-2138-1037 -1-415-1, IET No. 24451, IET No. 25033, IET No. 25520, IET No. 26351, IET No. 25991, IET No. 26103, IET No. 25979, IET No. 25924, IET No. 26267 and IET No. 26394 and IET No. 24367 were recorded as moderately resistant as compared to the susceptible check Rasi.

Keywords: Identification, slow disease developing rice varieties, sheath blight

Introduction
Rice (*Oryzae sativa* L.) is the staple food crop of over half of the world's population, and is also widely cultivated across the world, making it possibly the most valuable plant on earth (Shimamoto, 1995; Goff, 1999) [14, 5]. It provides 20 percent of the world's supply of dietary energy followed by maize and wheat. Of the several factors known to destabilize rice yields, pests and diseases account for 30-40 percent crop losses. Most parts of the country regularly encounter complete crop failure due to epidemics of pests and diseases. In Chhattisgarh, rice production is comparatively smaller than the national average production. A lot of fungal, bacterial, nematode, and viral diseases are attacked on rice. Serious incidences of diseases such as blast, sheath blight and bacterial blight have been reported from rice growing areas in Chhattisgarh regions.

Sheath blight is one of India's widespread and harmful rice diseases. Rice sheath blight disease is causing significant loss, particularly in areas where high yielding varieties are cultivated. *Rhizoctonia solani* (Perfect stage-*Thanatephorus cucumeris*) which causes rice sheath blight in both soil and water borne.

The shortage of suitable field-resistant varieties was primarily responsible for the cultivation of high yielding but susceptible varieties to this disease in most areas of the country and also in Chhattisgarh State. Since, sheath blight disease is the most prevalent in this state, and its recurrence is rising year after year, efforts to control this disease are focused. There is little scope for breeding for sheath blight resistance as no commercial rice cultivar was found to have resistant donor rates (Roy, 1993) [12]. Most of the prominent varieties under cultivation are susceptible in most parts of the country, particularly in the Chhattisgarh region. Saha *et al*. (2002) [13] screened 149 entries of NSN-1 during the 2000 Kharif (wet) season, at Bankura and Chinsurah, West Bengal, India; and reported the same finding *i.e.*, none of the test entries recorded resistant reaction to sheath blight disease either at Bankura or at Chinsurah. However, 11 and 17 entries showed moderate resistance to this disease at Bankura and Chinsurah, respectively. Chahal *et al*. (2003) [1] reported that sheath blight reduced grain filling by 32.30% in rice when diseased area of top three leaves was 54.30%. They found yield recorded was 18 gram per plant as compared to 35.9 gram per plant in well control, when all the leaves were infected and on artificial inoculations of rice cultivars, maximum disease severity was recorded in PR 103 (97%) with yield loss of 43.4%. Goel and Lore (2004) [4] studied on one hundred elite advanced breeding lines of rice in Hyderabad, Andhra Pradesh, India that were screened for resistant reactions to different rice diseases including sheath blight (*Rhizoctonia solani*); Only 4 lines (IET-14277, -16958, -17048 and -17159) were found to be moderately resistant toward sheath blight.

Material and Methods

The experiment of identification of the resistant entries was conducted under field condition in bunded rice field under irrigated conditions during kharif 2016 and kharif 2017. One set of nineteen rice varieties were used for the identification of slow disease developing varieties against sheath blight disease. Nineteen rice varieties/ entries were transplanted in two rows and in one row ten plants were maintained. IET No.RP-Patho-23, IET No. 25916, IET No. 22240, IET No. 545191, IET No. 463893, IET No. 22017, IET No. R-2138-10371-415-1, IET No. 24367, IET No. 24451, IET No. 25033, IET No. 25520, IET No. 26351, IET No. 25991, IET No. 26103, IET No. 25979, IET No. 25924, IET No. 26267, IET No. 26394 and Rasi were grown in I.G.K.V., Raipur research field.

To conduct this experiment, twenty one day old seedlings of each entries were transplanted in 2 rows of 2 meter length. 10 plants were transplanted in each row. Row to row and plant to plant spacing was 20 × 15 cm. Fertilizer was applied @ N120: P50: K0 ha-1. Fifty percent of N and total P were given as basal dose and remaining N applied in two split doses as top dressing at tillering and panicle initiation stage. Artificial inoculation was done at the maximum rice tillering stage by using mycelial block of 5-day-old culture of *R. solani*. Five plants were inoculated in each row. The disease development was recorded in each variety and percent disease severity was calculated as Standard Evaluation System (SES), IRRI (2014) [8]. Observations were recorded 30 days after inoculation and graded as per 0-9 SES scale. The sheath blight scale was as follows:

Table 1: Standard Evaluation System (SES), IRRI (2014) [8]

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

The disease development was recorded in each variety and Percent Disease severity and Percent Disease Index was calculated as:

$$\text{Disease severity \%} = \frac{Total\ lession\ length}{Total\ length\ of\ sheath} \times 100$$

Results and Discussion

To find out the slow disease developing varieties, nineteen rice entries were evaluated for their reaction against *R. solani* under natural field condition

Fig 1: Identification of the slow disease developing varieties for sheath blight

During the year 2016 the data presented in table 2 and fig 1 that the nineteen entries were screened against sheath blight of rice under artificial inoculation. No entry was recorded for highly resistance reaction. The two entries designated as RP-Patho-23 and IET No.-25916 were showed resistant reaction (Score-3). While the sixteen entries designated IET No.- 22240, IET No.- 545191, IET No.- 463893, IET No.- 22017, IET No.- R-2138-1037-1-415-1, IET No.- 24451, IET No.- 25033, IET No.- 25520, IET No.- 26351, IET No.- 25991, IET No.- 26103, IET No.- 25979, IET No.- 25924, IET No.- 26267, IET No.- 26394 and IET no,-24367 showed moderately resistant reaction (Score-5). Rest of the one entry Rasi was recorded as susceptible (Score-7) in their reactions against the disease.

Table 2: Identification of the slow disease developing varieties for sheath blight (Year 2016)

S. No.	Grade	Varietal Reaction	Frequency Distribution	Varieties/entries (IET No.)
1	0	Immune	0	NIL
2	1	Highly Resistant	0	NIL
3	3	Resistant	02	IET No.-RP-Patho-23 and IET No.- 25916
4	5	Moderately	16	IET No.- 22240, IET No.- 545191, IET No.- 463893, IET No.- 22017, IET No.- R-2138-1037-1-415-1,

		Resistance		IET No.- 24451, IET No.- 25033, IET No.- 25520, IET No.- 26351, IET No.- 25991, IET No.- 26103, IET No.- 25979, IET No.- 25924, IET No.- 26267, IET No.- 26394 and IET No.-24367.
5	7	Susceptible	01	Rasi
6	9	Highly Susceptible	0	NIL

Total entries = 19 LSI = 4.89

During the year 2017 the data presented in table 3 the nineteen were screened against sheath blight of rice under artificial inoculation. no entry was recorded for highly resistance reaction. The three entries designated as IET No.- RP-Patho-23, IET No.- 25916 and IET No.- 24367 were showed resistant reaction (Score-3). While the fifteen entries designated IET No.- 22240, IET No.- 545191, IET No.- 463893, IET No.- 22017, IET No.- R-2138-1037-1-415-1, IET No.- 24451, IET No.- 25033, IET No.- 25520, IET No.- 26351, IET No.- 25991, IET No.- 26103, IET No.- 25979, IET No.- 25924, IET No.- 26267 and IET No.- 26394 showed moderately resistant reaction (Score-5). Rest of the one entry Rasi was recorded as susceptible (Score-7) in their reactions against the disease.

Table 3: Identification of the slow disease developing varieties for sheath blight (Year2017)

S. No.	Grade	Varietal Reaction	Frequency Distribution	Varieties/entries (IET No.)
1	0	Immune	0	NIL
2	1	Highly Resistant	0	NIL
3	3	Resistant	03	IET No.-RP-Patho-23, IET No.- 25916 and IET No.-24367
4	5	Moderately Resistance	15	IET No.- 22240, IET No.- 545191, IET No.- 463893, IET No.- 22017, IET No.- R-2138-1037-1-415-1, IET No.- 24451, IET No.- 25033, IET No.- 25520, IET No.- 26351, IET No.- 25991, IET No.- 26103, IET No.- 25979, IET No.- 25924, IET No.- 26267 and IET No.- 26394.
5	7	Susceptible	01	Rasi
6	9	Highly Susceptible	0	NIL

Total entries = 19 LSI = 4.78

Pooled data of kharif 2016 and kharif 2017 presented in the table 4 indicated that among nineteen entries, no entry was recorded for highly resistance reaction. The two entries designated as RP-Patho-23 and IET No.-25916 were showed resistant reaction (Score-3). While the sixteen entries designated IET No.- 22240, IET No.- 545191, IET No.- 463893, IET No.- 22017, IET No.- R-2138-1037-1-415-1, IET No.- 24451, IET No.- 25033, IET No.- 25520, IET No.- 26351, IET No.- 25991, IET No.- 26103, IET No.- 25979, IET No.- 25924, IET No.- 26267,IET No.- 26394 and IET no,-24367 showed moderately resistant reaction (Score-5). Rest of the one entry Rasi was recorded as susceptible (Score-7) in their reactions against the disease.

Few cultivars lines and wild rice species were reported to be resistant by different workers. Varieties like Kataktara DA-2 (IRRI, 1972), BR-430-51-2, BR-57-49-6 (Manian and Manibhushanr Rao, 1979) [9], KRC346, KRC355, RP1057-3 (Reddy *et al.*, 1981) [11], PTB-33, Sinna Sivappa and CR57-11-2 (Gangopadhyay and Mishra, 1984), IET8748 (Dev and Mary, 1985) [2], IR-8, IR-42, IR-32 (Iboton, 1985) [7], CR-1014 and T141 (Premalatha Dath, 1985) [10] and Tetep, IET-4699, Jawa-14 (Guo *et al.*, 1985) [6] were reported to be resistant. Siani and Raina (1985) [15] also reported 15 varieties as resistant from their evaluation trials.

Table 4: Identification of the slow disease developing varieties for sheath blight (Pooled data of kharif 2016 and 2017)

S. No.	Grade	Varietal Reaction	Frequency Distribution	Varieties/entries (IET No.)
1	0	Immune	0	NIL
2	1	Highly Resistant	0	NIL
3	3	Resistant	02	IET No.-RP-Patho-23 and IET No.- 25916
4	5	Moderately Resistance	16	IET No.- 22240, IET No.- 545191, IET No.- 463893, IET No.- 22017, IET No.- R-2138-1037-1-415-1, IET No.- 24451, IET No.- 25033, IET No.- 25520, IET No.- 26351, IET No.- 25991, IET No.- 26103, IET No.- 25979, IET No.- 25924, IET No.- 26267, IET No.- 26394 and IET No.-24367.
5	7	Susceptible	01	Rasi
6	9	Highly Susceptible	0	NIL

Total entries = 19 LSI = 4.83

Identification of R. genes in the slow resistant developing varieties may be helpful for incorporation or transfer of R genes in susceptible variety by using genetic engineering technique will be able to develop resistant varieties of sheath blight of rice.

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