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Research Article

SELECTION OF HOST PLANT RESISTANCE GENOTYPES IN PADDY FOR BLAST AND BROWN SPOT DISEASES IN HILLY ZONE OF KARNATAKA

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ABSTRACT

Rice belongs to the genus Oryza and has two cultivated and 22 wild species. The cultivated species are Oryza sativa and Oryzaglaberrima. Oryza sativa is grown all over the world. Rice is known to suffer from number of diseases caused by fungal, bacterial and viral origins. Identification of resistant genotypes is again an essential continuous process either to recommend for cultivation in endemic area or to use as donors of the resistant genes. In view of these, the present investigation of evaluation of 102 rice varieties/genotypes against blast and brown spot diseases were carried out during Kharif 2014 to identify the sources of resistance under field conditions. 102 entries were tested in Uniform blast screening nursery for leaf blast and transplanted field of screening for neck blast and brown spot diseases resistance of paddy, out of which none of varieties /genotypes found highly resistant to resistant reaction of leaf blast disease of paddy and 7 entries i.e. T(N)1, IR-64, IET- 24212, 24214, Vivekdhan 62(NC), 23534, Rasishowed moderately resistant reactions to the leaf blast disease and remaining entries were found moderately susceptible to highly susceptible reaction to leaf blast disease. The same varieties/genotypes were also screened for neck blast disease out of which none of varieties /genotypes found highly resistant reaction of neck blast disease of paddy and 13 entries i.e., IET-24205, 24188, 24227, 24231, 23542, 23543, 23541, 22979, 22957, 23528, Benibhog, RP-Bio-226, CO-39 were found resistant reaction to neck blast disease and remaining entries were found moderately resistant to susceptible reaction to neck blast disease. Similarly, the same varieties / genotypes were also screened for brown spot disease out of which none of the entries found highly resistance and 2 entries i.e., IET-24216, IR-50 were found resistant reaction to brown spot disease. The remaining entries were found moderately resistant to highly susceptible reaction to brown spot disease.

INTRODUCTION

Rice (*Oryzasativa*L.) is an important cereal crop belonging to the family *Poaceae*. Rice is the most important staple food crop and grown in India providing of 43 per cent of calorie requirement for 70 per cent of the Indian population. India is the largest rice growing country accounting for about one third of the world acreage under the crop. In India, annual rice production is 103.6 mt during 2016 (Anon, 2016). The major rice growing states of India are West Bengal, Bihar, Madhya Pradesh, Orissa, Andhra Pradesh, Karnataka and Uttar Pradesh, which accounts 69.80 per cent of the total area.

Rice suffers from many biotic and abiotic factors which result in the lower productivity. Among the biotic factor it suffer from fungal diseases *viz.,* blast (*Pyriculariaoryzae*), brown leaf spot (*Bipolarisoryzae / Helminthosporiumoryzae*), stem rot (*Sclerotiumoryzae*), sheath blight (*Rhizoctoniasolani*), sheath rot (*Sarocladiumoryzae*), bacterial disease such as bacterial blight (*Xanthomonasoryzae*pv. *oryzae*) and viral disease such as (rice tungro virus) nematode disease such as rice root knot (*Meloidogynegraminicola*) are important. Among fungal diseases blast and brown spot disease is of economic importance.

In India, the disease was first recorded in Thanjavore delta of south India in 1918 by Mc Rae (1922). However, it attracted the attention only when a devastating epidemic occurred in 1919 (Padmanabhan, 1965).

Among the fungal disease, brown leaf spot of rice incited by*Helminthosporiumoryzae* is a major disease occurring in almost all the rice growing areas of the world causing 5 per

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cent yield loss across all lowland rice production situations in south and Southeast Asia (Savary , 2000).

The pathogen attacks all the aerial parts of plants at any stage of crop growth right from germination to harvest. The disease occurs as seedling blight, leaf blast, node blast, neck or panicle blast and grain spot. Seed and soil borne infection during germination and thereafter on tender seedling cause, seedling blight leading to death of seedling. Leaf blast is characterized by production of large spindle shaped lesions with ashy grey centres with brown margins drastically reduce crop growth and tillering. The infected node or neck tissues became soft and rotted. The node or neck blast is considered as the most destructive phase of the disease attacking prior or after flowering and grain formation, causing drastic reduction in grain quality and quantity of produce. The infection on grain produced dark brownish black spot.

Blast disease commonly occurs in few paddy growing areas like Mandya, Kodagu, Shivamogga, Uttara Kannada, Dakshina Kannada, Mysore and Chickmagaluru districts (Anon., 1981). The occurrence of disease in moderate to severe form in hilly areas of Karnataka is mainly due to indiscriminate use of nitrogenous fertilizers, heavy rainfall, mono-cropping and repeated cultivation of the crop. This leads to severe losses in grain yield of the crop. Moreover, repeated cultivation of paddy would not only make the higher inoculum build up but also aggravate the disease problem.

Cultivation of resistant genotypes is the effective and cheaper method to combat the disease as compared to the chemical control. Hence, several genotypes should be screened to identify the resistant genotypes. In view of these, the present investigation of evaluation of 102 rice varieties/genotypes against blast and brown spot diseases were carried out during *Kharif* 2014 at AHRS, Ponnampet to identify the sources of resistance under field conditions.

MATERIAL METHODS

Screening of rice genotypes against leaf blast disease in Uniform Blast Nursery (UBN) pattern: The experiment was conducted during *Kharif*2014 at AHRS, Ponnampet. Screening of rice against *P. oryzae*was carried out to know the source of resistance against leaf blast disease under natural epiphytotic condition. 102 rice germplasm lines were evaluated against leaf blast disease. These germplasm lines were sown on 07-07-2014 in UBN (Uniform Blast Nursery) pattern. It is an identification of naturally existing blast strains in the hotspot locality. In this technique, nursery beds of 0.5 m width and length of 50 m were raised using spade, all around the bed the most susceptible checks were sown to serve as a source of inoculums for spreading the disease. The susceptible and resistant checks were sown initially and each test entry were sown at 10 cm apart in one line and after every 20 test entries again susceptible and resistant checks were sown. Disease reactions were recorded by using 0-9 scale given below.

Scoring for Leaf blast was done at Nursery Stage by Using Following Scale given by IRRI (1996)

Rating scale	Disease severity	Host response
0	No lesion observed	Highly Resistant
1	Small brown specks of pin point size	Resistant
2	Small roundish to slightly elongated, necrotic grey spots, about 1-2 mm in diameter, with a distinct brown margin. Lesions are mostly found on the lower leaves	Moderately Resistant
3	Lesion type same as in 2, but significant number of lesions on the upper leaves	Moderately Resistant
4	Typical susceptible blast lesions, 3 mm or longer infecting less than 4% of leaf area	Moderately Susceptible
5	Typical susceptible blast lesions of 3mm or longer infecting 4-10% of the leaf area	Moderately Susceptible
6	Typical susceptible blast lesions of 3 mm or longer infecting 11-25% of the leaf area	Moderately Susceptible
7	Typical susceptible blast lesions of 3 mm or longer infecting 26-50% of the leaf area	Susceptible
8	Typical susceptible blast lesions of 3 mm or longer infecting 51-75% of the leaf area many leaves are dead	Highly Susceptible
9	Typical susceptible blast lesions of 3 mm or longer infecting more than 75% leaf area affected	Highly Susceptible

Screening of rice Genotypes Against neck Blast and Brown spot diseases in Field Nursery Pattern: Another experiment was conducted during *Kharif*2014 at AHRS, Ponnampet. Screening of rice against *P. oryzae* and *Helminthosporiumoryzae* was carried out to know the source of resistance against neck blast and brown spot diseases under natural epiphytotic condition. 102 rice germplasm lines were evaluated against neck blast and brown spot diseases. These germplasm lines were sown on 01-07-2014 in field nursery pattern. Intan and IR-64 serve as susceptible and resistant check respectively. One line of 25 days old seedlings were uprooted from the nursery bed and planted in the main field over a length of 1.5 meters in two lines with a spacing of 15 x 15 cm. Fertilizers were applied at the rate of 75:75:90 Kg/ha *i.e*basal application at the rate of 37.5:75:45 Kg/ha and top dressing of 37.5:0:45 Kg/ ha respectively. The screening against neck blast and brown spot resistance and disease reactions were recorded using 0-9 scale given below.

Scoring for Neck Blast was Done at Harvesting Stage by Using Following Scale Given by IRRI (1996)

Rating scale	Disease Reaction	Description
0	HR	No incidence
1	R	Less than 5 % infected panicles
3	MR	5-10 % infected panicles
5	MS	11-25 % infected panicles
7	S	26-50 % infected panicles
9	HS	More than 50 % infected panicles

Scoring for Brown spot by Using Following Scale given by IRRI (1996)

Rating scale	Disease severity in per cent leaf area coverage	Host response
0	No incidence	Highly Resistant
1	Less than 1%	Resistant
2	1-3%	Moderately Resistant
3	4-5%	Moderately Resistant
4	6-10%	Moderately Susceptible
5	11-15%	Moderately Susceptible
6	16-25%	Moderately Susceptible
7	26-50%	Susceptible
8	51-75%	Highly Susceptible
9	76-100 %	Highly Susceptible

RESULTS AND DISCUSSION

Screening of rice Genotypes Against blast and brown spot Diseases in Nurseries: In order to identify the resistant sources, 102 rice genotypes were screened by using 0-9 scale against leaf and neck blast caused by *P. oryzae*under natural epiphytotic condition at AHRS, Ponnampet. The genotypes were grouped into six classes based on degree of reaction and the number of genotypes falling in particular group and results are presented in Table -1 and Plate-1 respectively.

Among 102 genotypes screened against leaf blast, out of which none of the entries found highly resistant and resistant reaction to leaf blast disease of paddy,7 entries *i.e.,*T(N)1, IR-64, IET-24212, 24214, Vivekdhan 62(NC), 23534 andRasishowed resistant reactions to the leaf blast.81 entries *i.e.,*IET-24198, 24207, 24213, 24215, 24216, 24180, 24186, 24189, 24196, 24197, 23544,23538, 22967, 22970, 22957, 23528, Nidhi, Ajaya, IR-50, CO-39, IET-24203, 24205, 24206, 24208, 24181, 24185, 24188,24192, 24193, 24195, 24217, 24220, 24222, 24223, 24225, 24229, 24231, Sukaradhan 1(NC), 23542, 23543, 23548, 23540,23547, 23539, 22976, 3304, 22969, 23523, Sukaradhan 1(NC), 22984, 22958, 23536, Vikramarya, IET-24200, 24209, 24210, 24211, 24179, 24182, 24187, 24194, 24218, 24219, 24221,24224, 24227, 24228, 24230, 23546, 23541, 22974, 23524, 23518, 23525, 22980,22979, Shalimar Rice (RC), 22952, 23529, Ch-45, Benibhog, Swarnadhan, RP-Bio-226 showed moderately susceptible reactions to the leaf blast. 9 entries *i.e.,*IET-24199, 24201, 24202, 24184, 24190, 24191, 24226, 22982, Vivekdhan 62 (NC), showed susceptible reactions to the leaf blast. 3 entries *i.e.,*IET-24204, 22978, HR-12showed highly susceptible reaction to leaf blast respectively (Table 1).

Among 102 genotypes screened against neck blast,out of which none of the entries found highly resistant reaction to neck blast disease of paddy,13 entries *i.e.,*IET-24205, 24188, 24227, 24231, 23542, 23543, 23541, 22979, 22957,23528, Benibhog, RP-Bio-226, CO-39 found resistant reaction to neck blast disease of paddy,58 entries *i.e.,*IET-24198, 24199, 24203, 24204, 24207, 24209, 24212, 24213, 24214,24215, 24180, 24184, 24186, 24187, 24190, 24191, 24193, 24194,24196, 24217, 24218, 24219, 24220, 24221, 24222, 24224, 24228,24229, 24230, Sukaradhan 1(NC), 23544, 23546, 23548, 23540, 23547, 23538,23539, 22976, 3304, 22969, 23524, 23525, Sukaradhan 1 (NC), 22980, 22982,22978, 22984, Shalimar Rice 3(RC), 22952, 23534, T(N)1, Rasi, Vikramarya, Ch-45, Swarnadhan, Ajaya, IR-50showed moderatelyresistant reactions to the neck blast,23 entries *i.e.,*IET-24200, 24201, 24202, 24206, 24208, 24210, 24211, 24179, 24181,24182, 24189, 24192, 24197, 24223, 24225, 24226, 22967, 23518,22958, Vivekdhan 86 (NC), 23529, 23536, Nidhi showed moderately susceptible reactions to the neck blast. 8 entries *i.e.,*IET-24216, 24185, 24195, 22974, 22970, 23523, Vivekdhan 62 (NC), HR-12 showed susceptible reactions to the neck blastrespectively (Table 2 and Plate 2). Intan served as susceptible check showed highly susceptible and susceptible reaction to leaf and neck blast respectively. IR-64 served as resistant check showed moderately resistant reactions against leaf and neck blast respectively. To identify the resistant sources against the any disease in order to breed resistant varieties is of primary importance. Wide response of rice genotypes against *P. oryzae*has been earlier observed by various workers (Nagaraju*et al.,* 1991, Saifulla and Manjunath., 1995 and Ghazanfar*et al.,* 2009). Saha (2004) reported that HR-12 showed susceptibility to *P. oryzae* as observed in the present study. Ravi *et al.* (1989) reported that Jaya variety showed high degree of resistant to the blast of rice. The results obtained in the present study are supported b y Naik*et al.* (2016) who reported that Intan and HR-12 showed highly susceptible reaction to blast of rice, while Rasi and IR-64 recorded moderately susceptible reaction to the blast of rice. Barnwal *et al*. (2012) reported and used C0-39 as susceptible variety to blast of rice in experiment to evaluate fungicides.

Among 102 genotypes screened against brown spot, out of which none of the entries found highly resistant to brown spot disease of paddy,2 entries *i.e.,*IET-24216, IR-50showed resistant reactions to the leaf blast,54entries *i.e.,*IET-24199, 24203, 24212, 24214, 24180, 24186, 24217, 24222, 24231, 23544, 23542, 23546, 22974, 22980, 22952, 23534, 23536, T (N)1, IR-64, Rasi, Ch-45, IET-24198, 24202, 24204, 24207, 24213, 24215, 24182, 24189, 24192, 24197, 24223, 24224, 24225, 24227, Sukaradhan 1(NC), 23543, 23541, 23540, 23547, 22969, 22969, 23523, 22982, 22978, Shalimar Rice 3 (RC), 22958, Vivekdhan 86 (NC), 22957, Vivekdhan 62 (NC), 23528, Benibhog, Ajaya, CO-39showed moderately resistant reactions to the brown spot disease. 44 entries *i.e.,*IET-24201, 24208, 24209, 24211, 24184, 24185, 24187, 24188, 24190, 24191, 24193, 24194, 24195, 24196, 24218, 24219, 24220, 24221, 24226, 24228, 24230, 23548, 23539, 23539, 22976, 22967, 22970, 23524, Sukaradhan 1 (NC), 23529, HR-12, RP-Bio-226, IET-24200, 24205, 24181, 23525, 22979, 22984, Nidhi, IET-24210, 24179, 24229, 23518, Swarnadhan showed moderately susceptible reactions to the brown spot disease. 2 entries *i.e.,*IET-24206, Vikramarya showed susceptible reactions to the brown spot diseaserespectively (Table 2 and Plate 2).

Wide response of rice genotypes against *Helminthosporiumoryzae* has been earlier observed by various workers Arshad *et al*. (2008) were evaluated seventy genotypes/entries/varieties, among that only one Basmati entry, PK-3699-43 of PARC was found resistant, while all other remaining varieties/entries were found moderately resistant to highly susceptible.

Mother *et al.* (2013) screened five rice cultivars, one hybrid (WR96), three modern (BR16, BR26, and BRRI Dhan27) and one local (Pari) were screened for their reaction to brown leaf spot disease caused by *Cochliobolus miyabeanus* and their

performance on yield-related characters. The severity of brown leaf spot varied with growth stages of rice plant as well as different cultivars tested under field condition. Low disease severity was observed at maximum tillering stage compared to moderate to high at dough stage, with hybrid cultivar WR96 showing highest disease, while local cultivar Pari had the lowest.

Table 1 Grouping of Paddy genotypes based on their reaction to Leaf blast under Nursery (NSN-Hills) conditions

Reaction (SES 0-9 Scale)	Entry No. (IET)
0 (HR)	-
1 (R)	-
2 (MR)	(2) T(N)1, IR-64
3 (MR)	(5) IET-24212, 24214, Vivekdhan 62(NC), 23534, Rasi
4 (MS)	(20) IET-24198, 24207, 24213, 24215, 24216, 24180, 24186, 24189, 24196, 24197, 23544,23538, 22967, 22970, 22957, 23528, Nidhi, Ajaya, IR-50, CO-39
5 (MS)	(32)IET-24203, 24205, 24206, 24208, 24181, 24185, 24188,24192, 24193, 24195, 24217, 24220, 24222, 24223, 24225, 24229, 24231, Sukaradhan 1(NC), 23542, 23543, 23548, 23540,23547, 23539, 22976, 22969, 22969, 23523, Sukaradhan 1(NC), 22984, 22958, 23536, Vikramarya
6 (MS)	(29)IET-24200, 24209, 24210, 24211, 24179, 24182, 24187, 24194, 24218, 24219, 24221,24224, 24227, 24228, 24230, 23546, 23541, 22974, 23524, 23518, 23525, 22980,22979, Shalimar Rice (RC), 22952, 23529, Ch-45, Benibhog, Swarnadhan, RP-Bio-226.
7 (S)	(9) IET-24199, 24201, 24202, 24184, 24190, 24191, 24226, 22982, Vivekdhan 62 (NC),
8 (HS)	(3) IET-24204, 22978, HR-12
9 (HS)	-

Plate 1 screening of rice genotypes against leaf blast disease in Uniform Blast Nursery (UBN) pattern

Table 2 Grouping of Paddy genotypes based on their reaction to Leaf blast under Nursery (NSN-Hills) conditions.

Reaction (SES 0-9 Scale)	Entry No. (IET)	
	Neck blast	Brown spot
0 (HR)	-	-
1 (R)	(13)IET-24205, 24188, 24227, 24231, 23542, 23543, 23541, 22979, 22957,23528, Benibhog, RP-Bio-226, CO-39.	(2)IET-24216, IR-50
2 (MR)		(21)IET-24199, 24203, 24212, 24214, 24180, 24186, 24217, 24222, 24231, 23544, 23542, 23546, 22974, 22980, 22952, 23534, 23536, T (N)1, IR-64, Rasi, Ch-45.
3 (MR)	(58)IET-24198, 24199, 24203, 24204, 24207, 24209, 24212, 24213, 24214,24215, 24180, 24184, 24186, 24187, 24190, 24191, 24193, 24194,24196, 24217, 24218, 24219, 24220, 24221, 24222, 24224, 24228,24229, 24230, Sukaradhan 1(NC), 23544, 23546, 23548, 23540, 23547, 23538,23539, 22976, 3304, 22969, 23524, 23525, Sukaradhan 1 (NC), 22980, 22982,22978, 22984, Shalimar Rice 3(RC), 22952, 23534, T(N)1, Rasi, Vikramarya, Ch-45, Swarnadhan, Ajaya, IR-50	(33)IET-24198, 24202, 24204, 24207, 24213, 24215, 24182, 24189, 24192, 24197, 24223, 24224, 24225, 24227, Sukaradhan 1(NC), 23543, 23541, 23540, 23547, 22969, 22969, 23523, 22982, 22978, Shalimar Rice 3 (RC), 22958, Vivekdhan 86 (NC), 22957, Vivekdhan 62 (NC), 23528, Benibhog, Ajaya, CO-39.
4 (MS)		(32)IET-24201, 24208, 24209, 24211, 24184, 24185, 24187, 24188, 24190, 24191, 24193, 24194, 24195, 24196, 24218, 24219, 24220, 24221, 24226, 24228, 24230, 23548, 23539, 23539, 22976, 22967, 22970, 23524, Sukaradhan 1 (NC), 23529, HR-12, RP-Bio-226.
5 (MS)	(23)IET-24200, 24201, 24202, 24206, 24208, 24210, 24211, 24179, 24181,24182, 24189, 24192, 24197, 24223, 24225, 24226, 22967, 23518,22958, Vivekdhan 86 (NC), 23529, 23536, Nidhi	(7)IET-24200, 24205, 24181, 23525, 22979, 22984,Nidhi
6 (MS)		(5)IET-24210, 24179, 24229, 23518, Swarnadhan.
7 (S)	(8)IET-24216, 24185, 24195, 22974, 22970, 23523, Vivekdhan 62 (NC), HR-12,	(2)IET-24206, Vikramarya
8 (HS)		-
9 (HS)	-	-

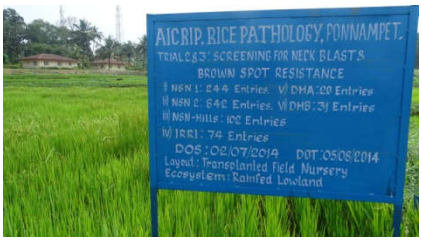

Plate 2 screening of rice genotypes against neck blast and brown spot diseases in field nursery.

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