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Identification of promising high yielding blast resistant rice genotype for hilly conditions of Karnataka

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ABSTRACT

Rice (Oryza sativa L.) is one of the most important food crops from which nearly one third of world's population derives its principal source of calories. The experiment was conducted to discover the impending genotypes suitable for hilly situation of Karnataka. The experimental materials were chosen or selected based on significant superiority or on par yield over the local check variety, i.e., Tunga in the AICRIP investigational trials of paddy. The chosen entries were evaluated for the three years in the station trial at the Agricultural and Horticultural Research Station, Ponnampet in randomized complete block design with two replications during 2016, 2017 and 2018 kharif seasons. Third year Multi Location Trial (MLT) was also conducted at AHRS, Ponnampet and ZAHRS, Mudigere. The pooled data across the years in the station trial revealed that the entry IET-24451 recorded the utmost grain yield (6196 kg/ha) among the entries and gave up 36 per cent increased grain yield over the Tunga and 17 per cent increased grain yield over the KPR-1. The pooled data of MLT across the locations revealed that the entry IET-25281 recorded the utmost grain yield of 6076 kg/ha with 11 per cent increased grain yield over the Tunga and 13 per cent increased grain yield over the KPR-1. The combined pooled data of station trial across the years and MLT trial across locations revealed that the entry, IET-24451 of 6135 kg/ha recorded the maximum grain yield followed by IET-25281 (5970 kg/ha) among the entries. The entry IET-24451 recorded 22 per cent increased grain yield over the Tunga and 15 per cent increased grain yield over the KPR-1, whereas the entry IET-25281 recorded 19 per cent increased grain yield over the Tunga and 12 per cent increased grain yield over the KPR-1 and both the entries IET-24451 and IET-25281 recorded the leaf and neck blast resistance reaction in the Uniform Blast Nursery Screening Pattern. Hence, the entry IET-24451 was recommended for on-farm trial due to its blast resistance trait and yield superiority across the years and the locations.

Key words: *Blast, genotypes, grain yield, resistant and rice*

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important food crops from which nearly one third of world's population derives its principal source of calories. It is widely cultivated under diverse agro-ecosystems ranging from rainfed low land situation to upland irrigated situation. More than 70 % of the population in south East-Asia depends on rice for their energy requirements. Rice is cultivated globally in an area of about 161.40 million hectares with production of about 506.30 million tonnes and productivity of 3.14 tonnes per hectare. India is an important center of rice cultivation covering an area of 44.11 million hectare with an annual production of 105.48 million tonnes and an average productivity of 2.39 tonnes per hectare. In India, rice is grown in almost all the states. In Karnataka, it occupies 13.26 lakh hectares with annual production of 3.54 million tons with average productivity of 2.67 tonnes per hectare (Anon, 2016). Based on the trend of consumption in our country, it is estimated that requirement of rice will be 137.30 million tonnes by 2050 (Anon, 2013).

Due to the green revolution in 1960's, world's rice production increased. On the contrary, production potential of modern cultivars of rice is currently declining, because of several biotic, abiotic stresses (Keneni et al., 2012) and narrow genetic base in modern cultivars of rice (Wouw et al., 2010). In order to fulfill the requirement of rice there is an urgent need to identify potential high yielding and disease resistant rice genotypes over the existing cultivated varieties. Hence, an experiment was conducted to identify the potential genotypes suitable for hilly conditions of Karnataka.

MATERIALS AND METHODS

The experimental materials were selected based on significant superiority or on par yield over the local check variety i.e., Tunga in the All India Coordinated Rice Improvement Project (AICRIP) trials. Every year, 40 rice genotypes comprising of selected entries from AICRIP trials and existing varieties were evaluated at Agricultural and Horticultural Research Station, Ponnampet, Karnataka in randomized complete block design with two replications during kahrif, 2016, 2017 and 2018.

The seeds were sown in nursery bed to raise the seedlings of paddy genotypes and 25 days old seedlings were transplanted with a spacing of 15 × 15 cm in a plot 6.75 m^2 sizes for each genotype. All agronomic practices were followed based on the zonal recommendations to raise a good crop. The observations on plant height and panicle number per plant were recorded on five randomly selected plants from each plot. Observations on days to 50 per cent flowering and yield were taken on plot basis. The grain yield values recorded from the net plot (kg/plot) were converted into hectare (kg/ha). The genotypes were also evaluated for disease reaction especially leaf and neck blast reaction because AHRS, Ponnampet is considered as one of the hot spot for rice blast disease hence the genotypes were scored by following SES scale of IRRI (1996) in the nursery and field condition for leaf and neck blast incidence, respectively. The rice blast disease reactions were recorded by using 0-9 scale given below

Based on the two years performance in the station trial, Multi-Location Trial (MLT) was conducted in the third year with seven genotypes including two checks at ZAHRS Mudigere and AHRS, Ponnampet. The pooled analyses were performed across the years in the station and across the locations in MLT. The percent increase in grain yield over check varieties were calculated by using the formula

Per cent grain yield increased over check verity

$$= \frac{(\text{Mean grain yield of selected entry - Mean grain yield of check verity})}{\text{Mean grain yield of check verity}} \times 100$$

Disease scale	Disease symptoms	Host response
0	No lesions observed	Highly resistant
1	Small brown specks of pin-point size or larger brown specks without sporulating center	Highly resistant
2	Small roundish to slightly elongated, necrotic grey spots, about 1-2 mm in diameter, with a distinct brown margin	Resistant
3	Lesion type is the same as in scale 2, but a significant number of lesions are on the upper leaves	Moderately resistant
4	Typical susceptible blast lesions 3 mm or longer, infecting less than 4 per cent of the leaf area	Moderately resistant
5	Typical blast lesions infecting 4-10 per cent of the leaf area	Moderately susceptible
6	Typical blast lesions infection 11-25 per cent of the leaf area	Moderately susceptible
7	Typical blast lesions infection 26-50 per cent of the leaf area	Susceptible
8	Typical blast lesions infection 51-75 per cent of the leaf area and many leaves are dead	Highly susceptible
9	More than 75 per cent leaf area affected	Highly susceptible

Standard scale given by IRRI (1996) for neck blast reaction was done at after maturity stage.

Disease scale	Disease symptoms	Host response
0	No lesions observed	Highly resistant
1	Less than 5 per cent infected panicles	Resistant
3	5-10 per cent infected panicles	Moderately resistant
5	11-25 per cent infected panicles	Moderately susceptible
7	26-50 per cent infected panicles	Susceptible
9	More than 50 per cent infected panicles	Highly susceptible

RESULTS AND DISCUSSION

The pooled data of top five performing rice genotypes across the years are presented in Table 1. The average days to fifty percent flowering, plant height and productive tillers per plant of rice genotypes were recorded to be 111 days, 80.14 cm and 9.21 numbers respectively. The pooled data across the years in the station trial revealed that the entry IET-24451 recorded the highest grain yield (6196 kg/ha) among the entries and showed 36 per cent increased grain yield over the Tunga and 17 per cent increased grain yield over the KPR-1. Similarly, Kirubakaran Soundararaj et al. (2015) found a superiority of rice genotype, TPS 5 (TP 08010 culture) and it recorded a mean grain yield of 6377 Kg/ha over four years of station trials conducted during 2007 to 2011 at Agricultural Research Station, Thirupathisaram with 14.70 per cent yield improvement over ASD 16. Besides yield advantage of IET-12445, both leaf and neck blast resistance also recorded and it is on par with the KPR-1 (check entry), where as other ckeck entry Tunga recorded moderately resistant reaction for both the types of blast.

The pooled data of Multi Location Trials across the locations are presented in Table 2. The average days to fifty percent flowering, plant height and productive tillers per plant recorded rice genotypes were of 111 days, 83.57 cm and 10.71 numbers respectively. The pooled data of Multi Location Trials across the locations revealed that the entry IET-25281 recorded the highest grain yield of 6076 kg/ha among the entries and showed 11 per cent increased grain yield over the Tunga and 13 per cent increased grain yield over the KPR-1. Similarly Dushyanthakumar and Shadakshari (2011) found most promising entry (KHP-10) in multi Location Trials conducted during 2002 to 2006 at ZARS-Mudigere, ARS-Sirsi, Ponnampet and Madikeri. It recorded 25 % and 23 % increased grain yield over recommended checks KHP-2 and IET-7191 respectively. Besides yield advantage of IET-25281, both leaf and neck blast resistance also recorded and it is on par with the KPR-1 (check entry), where as other ckeck entry Tunga recorded moderately resistant reaction for both the types of blast.

The combined pooled data of station trials and MLT trials are presented in Table 3. The average days to fifty percent flowering, plant height and productive

Table 1. Pooled data of top performing genotypes in station trials conducted at AHRS, Ponnampet, Karnataka during 2016, 2017 and 2018.

Entries	Days to 50 % flowering				Plant height (cm)				Number of tiller per plant				Grain yield (Kg/ha)				% yield incr-ease over Tunga	% yield incr-ease over KP R-1	Leaf blast scores	Neck blast scores
	2016	2017	2018	Mean	2016	2017	2018	Mean	2016	2017	2018	Mean	2016	2017	2018	Mean				
IET-24451	110	111	108	110	84	92	84	87	8	8	8	8	6881	4986	6722	6196	36	17	2	1
IET-25281	112	121	109	114	77	84	76	79	10	9	10	10	5824	5231	6537	5864	29	11	2	1
IET-24395	121	110	106	112	94	89	86	89	8	6	8	7	5467	5058	6005	5510	21	4	4	3
IR-10A155	110	117	123	116	87	79	75	80	9	10	10	9	6022	4899	5523	5481	20	4	3	3
IET-2449	106	112	103	107	74	74	70	73	8	10	7	9	5914	4538	5597	5350	17	1	2	3
Tunga	125	124	124	124	85	95	93	91	8	7	8	7	4308	4101	5259	4556	0	-14	3	3
KPR-1	100	112	105	106	84	91	85	87	11	8	8	9	6385	4134	5306	5275	16	0	2	1
Exptl. mean	112.54	111.08	109.70	111.11	79.31	81.08	80.03	80.14	10.54	8.74	8.34	9.21	4986	3683	5072	4580				
LSD @5%	2.21	2.88	1.77	2.29	8.42	8.40	8.09	8.30	1.66	2.48	2.50	2.21	1069.98	939.96	1077.65	1029.20				
C.V.	1.42	1.27	0.80	1.16	5.23	5.11	5.00	5.11	7.76	14.01	14.85	12.21	10.57	12.60	10.51	11.23				

Table 2. Pooled data of top performing genotypes in MLT-2018-19 conducted at Mudigere and Ponnampet, Karnataka.

Entries	Days to 50% flowering			Plant height (cm)			Number of tiller per plant			Grain yield (Kg/ha)			% yield increase over Tunga	% yield increase over KPR-1	Leaf blast scores	Neck blast scores
	MDG	PNP	Mean	MDG	PNP	Mean	MDG	PNP	Mean	MDG	PNP	Mean				
IET-25281	116	108	112	85	76	80	13	11	12	5584	6568	6076	11	13	2	1
IET-24451	111	108	110	86	84	85	13	9	11	5390	6756	6073	11	12	2	1
IET-24395	111	105	108	83	85	84	13	7	10	6007	6032	6020	10	11	4	3
IR-10A155	118	122	120	86	75	80	14	10	12	5540	5551	5545	1	3	2	1
IET-24491	103	102	103	74	70	72	13	7	10	4937	5628	5283	-4	-2	3	3
Tunga	125	123	124	106	93	99	13	7	10	5654	5309	5481	0	2	3	3
KPR-1	101	105	103	86	85	85	13	7	10	5467	5333	5400	-1	0	2	1
Exptl. mean	112.14	110.43	111.43	86.57	81.14	83.57	13.14	8.29	10.71	5511	5882	5697				
LSD @ 5%	1.13	1.28	0.93	8.06	7.47	6.41	0.75	1.42	0.91	1154.21	907.89	769.66				
C.V.	0.57	0.65	0.47	5.23	5.18	4.29	3.22	9.60	4.78	11.77	8.68	7.59				

Table 3. Combined pooled data of station trials and MLT conducted at Mudigere and Ponnampet, Karnataka.

Entries	Days to 50% flowering			Plant height (cm)			Number of tiller per plant			Grain Yield (Kg/ha)			% yield increase over Tunga	% yield increase over KPR-1	Leaf blast scores	Neck blast scores
	Station trial mean	MLT mean	Pooled mean	Station trial mean	MLT mean	Pooled mean	Station trial mean	MLT mean	Pooled mean	Station trial mean	MLT mean	Pooled mean				
IET-24451	110	110	110	87	85	86	8	11	9	6196	6073	6135	22	15	2	1
IET-25281	114	112	113	79	80	80	10	12	11	5864	6076	5970	19	12	2	1
IET-24395	112	108	110	89	84	87	7	10	9	5510	6020	5765	15	8	4	3
IR-10A155	116	120	118	80	80	80	9	12	11	5481	5545	5513	10	3	3	3
IET-2449	107	103	105	73	72	73	9	10	9	5350	5283	5317	6	0	2	3
Tunga	124	124	124	91	99	95	7	10	9	4556	5481	5019	0	-6	3	3
KPR-1	106	103	105	87	85	86	9	10	9	5275	5400	5338	6	0	2	1
Exptl. mean	111.11	111.43	111.27	80.14	83.57	81.855	9.21	10.71	9.96	4580	5697	5138				
C.D.@ 5%	2.29	0.93	1.61	8.30	6.41	7.355	2.21	0.91	1.56	1029.20	769.66	899.43				
C.V.	1.16	0.47	0.82	5.11	4.29	4.7	12.21	4.78	8.495	11.23	7.59	9.41				

tillers per plant recorded rice genotypes were of 111 days, 81.86 cm and 9.96 numbers respectively. The combined pooled data of station trials and MLT trials across the years and across locations revealed that the entry, IET-24451 with 6135 kg/ha recorded the highest grain yield followed by IET-25281 with 5970 kg/ha among the entries. The entry IET-24451 recorded 22 per cent increased grain yield over the Tunga and 15 per cent increased grain yield over the KPR-1, whereas the entry IET-25281 recorded 19 per cent increased grain yield over the Tunga and 12 per cent increased grain yield over the KPR-1. Thirumeni et al. (2015) considering the overall performance of KR 99001 in different trials of station trials, Multilocation trials, Adaptive Research Trials (ART) and On Farm Trials (OFT), reported that the proposed culture recorded an average grain yield of 5.5 t/ha with an increase of 4.58 per cent over CR 1009 (5.2 t/ha) and 5.97 per cent over ADT 44 (5.2 t/ha) and KR 99001 was recommended and approved for release after confirming its performance in agronomic experiment.

These two entries IET-24451 and IET-25281 were found promising as evidenced by increased grain yield which is one of the most important parameter in determining the potentiality of a variety. The maximum grain yield is associated with higher dry matter, heavier panicle and number of total grains per panicle reported by Rao et al. (2000). Pradhan et al. (2014) also revealed that increased grain yield was due to positive correlation with panicles per square meter, number of grains per panicle and panicle length and Jamir and Gohain (2017) also agreed with Pradhan et al. (2014). The high yielding entries IET-24451 and IET-25281 also recorded resistance to leaf and neck blast reaction both in station trial and Multi Location Trials. The entry IET-24451 was already promoted to the AVT-2-RSL in AICRIP during 2015 which recorded 11 % increased yield over the best check variety in the Karnataka as well as in southern zone (Zone VII) of India (Progress Report, 2015)

The entry IET-24451 is medium duration, high yielding, blast resistant genotype with long bold seeds. Considering the overall performance of IET-24451 in different trials of AICRIP, station and Multilocation trial, the entry IET-24451 is suggested for the conduct of on- farm trial.

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