J. Farm Sci., 30(3): (382-386) 2017

RESEARCH PAPER

Evaluation of rice genotypes for leaf blast reaction, yield and yield attributing traits

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(Received: August,2017 ; Accepted: September, 2017)

Abstract: Fifty rice genotypes were evaluated for leaf blast disease reaction, mean performance, variability, and other genetic parametersof yield and yield attributing traits. The genotypes were scored for disease reaction under field condition and data on eight quantitative traits were recorded on five randomly selected plants from each plot.Results showed that none of the genotypes was found to be highly resistant or resistant to leaf blast while 26 entries showed moderately resistant reaction. The promising line IET-23594 produced maximum grain yield (5667 kg/ha) followed by existing cultivar KPR-1 (5607 kg/ha). Analysis of variance revealed highly significant sum of squares due to genotypes for all the characters indicating existence of ample variability among the genotypes. The estimates of PCV were higher than the GCV indicating high influence of environment on the expression of the traits. The characters such as straw yield (96.04, 67.18), 100 seed weight (95.68, 37.34) and number of spikeletsper panicle(89.71, 45.48) showed high heritability coupled with high to moderate genetic advance as percent of mean, suggesting that selection of these traits would be effective for their improvement.

Keywords: Genetic advance, Heritability, Leaf blast, Rice

Introduction

Rice (*Oryza sativa* L.) is major staple crop in India as well as world. It is widely cultivated under diverse agro-ecosystems ranging from low land rainfedsituation to upland irrigated situation. More than 70 % of the population in south East Asia depends on rice for their energy requirements. Globally rice was grown on 159.19 million hectare area during 2015-16 producing 472.25 million tonswith average productivity of 4.42 t/ha, while in India 104.41mt rice production was recorded from 43.5 m. ha.area with the productivity of 3.6 q/ha (Anon, 2017). Although India has maximum acreage under cultivation among the rice growing countries, it lags behind with respect to productivity level. Low rice productivity is attributed to the lack of high yielding varieties, various biotic and abiotic stresses and several other constraints. Among various biotic stresses, leaf blast caused by *Pyricularia grisea* is one of the major diseases of rice causing substantial yield losses. Therefore, screening of advanced breeding lines for disease reaction helps in earlyidentification and subsequent release of blast resistant varieties for commercial cultivation.

The development of high yielding rice varieties depends on availability of genetic variability for yield and its component traitsin the genetic material. Phenotypic variation observedin organisms is the result of combination of bothgenetic and environmental causes. Out of these two, onlygenetic cause is heritable and the extent of genetic improvement depends on magnitude of heritable variation. Moreover, knowledge of heritability is essential for selection basedimprovement, as it indicates the extent of transmissibility of a character from generation to generation. Therefore, to get complete expectation ofplant response to selection, only heritability estimate is notenough. Genetic parameters such as genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) are useful in assessment of amount of variability for different characters present in the germplasm. Heritability estimatesalong with high geneticadvance would be more useful tool inpredicting the resultant effect in selection ofthe best genotypes for yield and its attributing traits.

Material and methods

The present experiment was carried out at Agricultural and Horticultural Research Station, Ponnampet, University of Agricultural and Horticultural Sciences,Shivamogga. Fifty genotypes of rice comprising breeding lines and existing varieties were evaluated in randomized complete block design with two replications during *Kharif* 2014. Initially the seedlings were raised by adopting Uniform Blast Nursery (UBN) pattern for evaluation of leaf blast disease reaction. Later 25 to 30 days old seedlings were transplanted in a plot of 6.75 m^2size for each genotypeby maintaining 15 × 15cm spacing. All the recommended agronomic practices were followed to raise a good and healthy crop. The observations were recorded on five randomly selected plants from each plot for quantitative traits namely plant height, number of tillers/plant, panicle lengthand spikelet per panicle on per plant basis while for 100-grain weight, grain yield and straw yield on plot basis. Further the grain and straw yield values recorded from the net plot (kg/plot) were converted into hectare (kg/ha).The AHRS, Ponnampet is considered as one of the hot spot for leaf blast disease hence genotypes were also evaluated for disease reaction under field condition and the genotypes were scored based on leaf blast severity following SES scale of IRRI (Anon., 1996).

The mean data aftercomputing for each character was subjected tostandard method of analysis of variance followingPanse and Sukhatme (1967), phenotypic andgenotypic coefficient of variation were estimated by the formula as suggested by Burton (1952), heritability (broadsense) and genetic advance as per cent of mean werecalculated by the formula given by Johanson *et al.* (1955).

Results and discussion

Performance of genotypes

Perusal of Table 1 indicates disease reaction of various genotypes and their mean performance for various characters. Results on field screening of genotypes for leaf blast reaction revealed that out of fifty entries, none of the genotypes was found to behighly resistant or resistant while 26 entries showed moderately resistant reaction. On the other hand, moderately susceptible reaction was showed by 23 genotypes and one genotype (Intan) was found highly susceptible.

The mean performance of individual rice genotypes revealed that the plant height found to vary from 62.17 cm to 120.17 cm with average of 90.18 cm. Short plant height is considered as desirable, therefore, genotype IET-23203 (62.17 cm) was found shortest while Jeeragisanna (120.17 cm) found to be the tallest. Other genotypes with desirable plant height were KPR-2 (66.00 cm), Jyoti (71.50 cm) and IR-64 (72.50). Number of tillers per plant ranged from 5.00 (IET-23594) to 13.67 (Tetep) with mean of 7.45 tillers per plant. The mean value for panicle length among the genotypes ranged from 17.00 cm to 24.00 cm with average of 20.33 cm. The maximum panicle length was observed in IET-23582 (24.00 cm) while IET-23422 (17.00 cm) showed minimum panicle length.The number of spikelets per panicle varied from 94.00 to 236.5 with average number of 147.48. The promising line IET-23550 recorded highest number of spikelets per panicle (236.5) followed by IET-23422 (236) whereas lowest spikeletnumber per panicle was noted in Tetep (94.00). Regarding the mean performance of rice genotypes for yield parameters, 100 grain weight was found to vary from 1.24 g in Jeeragisanna to 3.50 g in IET-23574 with an average weight of 2.54 g. The rice genotypes in present study differed significantly for grain yield. IET-23594 produced maximum grain yield (5667 kg/ha) followed by KPR-1 (5607 kg/ha) whereas IET-23901 recorded lowest grain yield (2562.96 kg/ha). The estimation of straw yield revealed that the genotype IET-23914 recorded highest yield (14814.81 kg/ha) followed by IET-23967 (12592.59 kg/ha). Similar findings on mean performance of rice genotypes for various traits were also reported by Hammound, (2005); Sedeek *et al.* (2009) and Anis *et al.* (2016).

Analysis of variance

The analysis of variance (Table 2) revealed that sum of squares due to treatment were highly significant for all the characters under study which indicated enough variability existed among the genotypes. The observed differences among the genotypes may be attributed to their different geographical origin. Similar reports on phenotypic variation among rice genotypes were observed by Elayaraja *et al.* (2005) and Pandey *et al.* (2009).

Genetic parameters of rice

The estimation of genetic parameters indicated that phenotypic variance was higher than genotypic variance for all the traits which revealed considerable effect of environment on the expression of these traits (Table 3). Consequently phenotypic coefficient of variation (PCV) was higher than genotypic coefficient of variation (GCV) for all the characters. The estimates of PCV were highest for straw yield (33.96%) followed by number of spikelets per panicle (24.61 %), number of tillers per plant (21.49%), grain yield (19.98%) and 100 seed weight (18.95%) while leastPCV value was observed for panicle length (8.90 %).Similarly, maximum percent GCV value was recorded for straw yield GCV (33.28%) followed by number of spikelets per panicle (23.31%) and 100 seed weight (18.53%) whereas minimum GCV value was observed for panicle length (6.06 %). Similar findings were reported by Jayasudha and Sharma (2010) studies on genetic variability, character association and path-coefficient analysis were conducted on forty seven (47) rice genotypes including thirty three hybrids and fourteen parents for grain yield and some physiological traits. Analysis of variance revealed considerable variability among the genotypes for all the characters. A high genotypic and phenotypic coefficient ofvariation was observed for grain yield per plant, harvest index, pollen fertility (%) and spikelet fertility (%). Characters likepollen fertility (%), spikelet fertility (%), days to 50% flowering and grain yield per plant showed high value of heritabilitycoupled with high genetic advance (Table 3).

The large difference between PCV and GCV values observed for grain yield followed by number of tillers per plantand panicle length indicated large effect of environment on the expression of these traits. On the contrary, 100 seed weight and straw yield were least affected by environment as indicated by less difference between PCV and GCV values. Ramanjaneyulu *et al.* (2014) also reported less difference between PCV and GCV for 1000 seed weight, however, his findings on straw yield were contradictory to the results in the present study.

The estimates of PCV andGCV clearly indicate the presence of degree of genetic variation; however, it is the estimates of heritability andgenetic advancewhich determine the amount of heritable portion of variation. Heritability (broad sense) is the ratio ofgenotypic variance to phenotypic variance, expressed in percentage.The estimates of heritability are more advantageous when expressed interms of genetic advance.

Heritability is classified as high (above 60%), medium (30%-60%) and low (below 30%). High to moderate estimatesof heritability were exhibited for all the character under study (Table 3). The estimates of heritability (broad sense) ranged from 46.28 percent to 96.04 percent. Straw yield (96.04%) showed highest heritability followed by 100 seed weight (95.68%) and plant height (91.94%) whereas moderate heritability was noted for panicle length (46.28%), grain yield (57.83%) and number of tillers per plant (67.23%). Similar findings for 100 seed weight was reported by Paikomba *et al.* (2014) whereas high heritability for grain yield was reported by Panwar (2005), Kumar *et al.* (2007) and Chaurasia *et al.* (2012).

High heritability values of a trait indicate less effect of environment on theirexpression. The plant breeder, therefore adopt simple selectionmethod on the basis of the phenotype of the characters which ultimately improves the genetic background of these traits.

Table 1. Disease reaction and mean performance of various genotypes

Sl. No.	Designation IET No.	Reaction (SES 0-9 Scale) Leaf Blast	Growth parameters: Plant height (cm)	Growth parameters: No. of Tillers/ plant	Growth parameters: Panicle length (cm)	Growth parameters: Spikelet/pl.	Yield parameters: Test weight (g)	Yield parameters: Grain yield (kg/ha)	Yield parameters: Straw yield (kg/ha)
1	23203	3	62.17	8.50	17.83	109.00	1.75	4451.85	5229.63
2	23275	3	83.83	6.17	22.67	148.50	2.96	5548.15	8637.04
3	22598	4	87.83	6.67	21.00	106.00	3.17	4237.04	7777.78
4	23422	3	85.50	5.50	17.00	236.00	2.22	5437.04	7155.56
5	Badshabhog	4	86.33	7.50	19.67	155.50	1.76	3511.11	4355.56
6	23471	3	82.00	5.67	19.83	148.50	2.83	4066.67	5274.07
7	22731	3	81.83	8.00	20.50	191.00	2.40	3103.70	4088.89
8	22704	4	79.67	5.83	18.17	191.50	2.64	4200.00	4992.59
9	MTU-1010	4	81.67	8.17	22.17	116.00	2.79	3222.22	4170.37
10	Tetep	3	100.83	13.67	18.00	94.00	2.08	5577.78	11525.93
11	23901	5	82.83	7.50	18.83	166.00	2.49	2562.96	10118.52
12	23902	5	102.83	5.83	20.83	138.00	2.31	4251.85	6000.00
13	23903	4	114.17	6.67	19.33	189.50	3.23	4059.26	12251.85
14	23904	4	83.33	7.00	21.17	162.50	2.12	2837.04	11407.41
15	23906	3	103.17	7.83	21.33	175.50	2.24	5059.26	8235.56
16	23914	5	115.83	5.17	18.33	105.00	3.04	3540.74	14814.81
17	23624	4	87.33	7.00	20.17	162.50	2.53	3829.63	4651.85
18	23634	3	96.50	6.33	22.00	167.00	1.92	3992.59	5222.22
19	23642	3	87.83	6.50	21.67	194.00	2.51	4733.33	8948.15
20	23656	3	87.50	8.00	20.67	147.50	2.58	5044.44	7955.56
21	23765	3	78.83	7.67	20.00	109.00	2.88	5088.89	7407.41
22	23594	3	113.67	5.00	19.67	147.00	2.95	5666.67	12474.07
23	23601	4	109.67	5.33	20.33	138.00	2.91	5385.19	10103.70
24	23139	3	99.17	8.50	19.50	157.00	2.22	4837.04	11185.19
25	23175	5	110.00	5.83	20.17	166.00	2.99	4718.52	10874.07
26	23550	4	84.33	8.33	20.50	236.50	2.19	3585.19	9866.67
27	23560	3	89.33	8.83	21.17	139.50	1.69	4725.93	7274.07
28	23562	3	85.83	7.00	22.67	147.50	2.10	3200.00	5051.85
29	23574	3	118.33	5.67	19.17	106.00	3.50	5474.07	10044.44
30	23575	4	84.83	9.00	20.83	156.50	2.62	4792.59	5200.00
31	23582	4	96.67	7.50	24.00	152.00	2.69	4274.07	9911.11
32	23954	3	91.83	6.50	21.17	183.50	2.87	4918.52	7259.26
33	23967	3	85.17	8.17	20.17	166.50	2.15	3111.11	12592.59
34	23987	6	96.50	7.00	22.67	131.50	2.83	4762.96	8474.07
35	CSR-36	3	78.50	8.50	19.50	119.00	2.86	4585.19	10607.41
36	23789	3	79.33	7.33	23.17	138.00	2.46	4637.04	9481.48
37	23791	4	79.33	7.17	19.00	128.50	2.46	4148.15	5629.63
38	23793	3	79.17	9.33	20.00	98.00	2.69	4074.07	7555.56
39	Intan	8	100.17	6.33	18.83	205.00	2.72	5118.52	9481.48
40	CTH-3	3	102.33	9.50	18.33	116.50	2.11	3925.93	6459.26
41	Athira	3	89.83	8.33	20.67	94.00	3.16	4496.30	6192.59
42	Thanu	5	88.67	7.50	18.50	157.00	1.92	4377.78	9200.00
43	MTU-1001	4	74.00	7.50	21.33	116.50	2.68	4622.22	8622.22
44	IR-64	4	72.50	8.67	22.00	94.50	3.14	4237.04	4660.74
45	Jaya	3	86.50	9.00	22.00	141.50	2.71	5333.33	6844.44
46	Jyoti	5	71.50	8.17	21.00	101.00	3.14	4118.52	4118.52
47	KPR-1	3	88.67	7.50	21.00	133.00	2.63	5607.41	6962.96
48	KPR-2	3	66.00	7.33	19.00	148.50	1.85	3577.78	4074.07
49	Tunga	4	95.17	8.00	17.67	135.00	3.09	5377.78	7585.19
50	Jeeragisanna	4	120.17	8.50	21.17	208.00	1.24	4592.59	7940.74
	Mean	90.18	7.45	20.33	147.48	2.54	4412.74	7918.96	
	CV (%)	4.29	12.30	6.52	7.89	4.33	12.98	6.75	
	C.D. (0.05)	7.77	1.84	2.66	23.39	0.221	1150.63	1074.71	

Table 2. Analysis of variance for different characters in rice genotypes evaluated (IET)

Source	df	Plant height (cm)	No. of tillers/ plant	Panicle length (cm)	No. of Spikelet/	100 seed weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
		Mean sum of squares						
Replication	1	72.82	2.67	3.48	1900.96	0.09	8362806.49	686320.20
Treatment	49	356.47**	4.29**	4.79**	2498.81**	0.46**	1226895.23**	14175356.12**
Error	49	14.97	0.84	1.76	135.51	0.01	327842.83	286007.78
S.Em±		2.736	0.648	0.938	8.231	0.078	404.87	378.15

* &** indicates significant at 5 % and 1 % level respectively

Table 3. Estimates of genetic parameters for different characters in rice genotypes evaluated

Genetic parameter	Plant height (cm)	No. of tillers/plant	Panicle length (cm)	No. of Spikelet/panicle	100 seed weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
Mean	90.18	7.45	20.33	147.48	2.54	4412.74	7918.96
ó^{2}p	185.72	2.56	3.28	1317.16	0.23	777369.03	7230681.95
ó^{2}g	170.75	1.72	1.52	1181.65	0.22	449526.20	6944674.17
PCV (%)	15.11	21.49	8.90	24.61	18.95	19.98	33.96
GCV (%)	14.49	17.62	6.06	23.31	18.53	15.19	33.28
h^{2}bs	91.94	67.23	46.28	89.71	95.68	57.83	96.04
GA as % of mean	28.62	29.76	8.49	45.48	37.34	23.80	67.18

Where ó^{2}p = phenotypic variance; ó^{2}g = genotypic variance; PCV = phenotypic coefficient of variation; GCV = genotypic coefficient of variation; h^{2}bs = heritability in broad sense; GA as % of mean = genetic advance as per cent of mean

The estimates of genetic advance as per cent of mean provide more reliable information regarding the effectiveness of selection in improving the traits. Genetic advance denotes the improvement in the mean performance of the selected individuals over the base population. Perusal of table 2 revealed moderate to low estimates of genetic advance for the traits under study. The genetic advance as per cent of mean was found to be highest for straw yield (67.18%) followed by number of spikelets per panicle (45.48%) and 100 seed weight (37.34) while lowest value was recorded for panicle length (8.49%).

Since the broad sense heritability includes both additive and non-additive components of genetic variance, heritability alone will not be of muchpractical value hence the concurrent use of genetic advancealong with heritabilitywould be more usefulin predicting the resultant effect of selection on phenotypic expression (Johnson *et al.,* 1955). In the present study, only straw yield showed high genotypic variance, high heritability and high genetic advance whereas high heritability along with moderate and low genetic advance was observed for number of spikelets per panicle, 100 seed weight, plant heightand number of tillers per plant. These findings were in accordance with the results of Dhanwani *et al.* (2013) studied the higher magnitude of PCV and GCV was recorded for number of grains per panicle (23.85%; 23.10%) and grain yield per plant (23.17%; 22.04%).

The additive gene action is involved in the expression of those characters which showhigh genotypic variance coupled with high heritability and genetic advance (Panse, 1957) thus can be improved through simple or progeny selectionmethods while the characters with high heritabilitycoupled with moderate or low genetic advance can beimproved by inter-mating superior individuals from segregatingpopulation of a cross (Samadhia, 2005).

Conclusion

From the present investigation it has been concluded that the none of the genotypes was found to be highly resistant or resistant while 26 entries showed moderately resistant reaction to leaf blast. The mean performance of individual rice genotypes revealed that the plant height found to vary from 62.17 cm to 120.17 cm. Number of tillers per plant ranged from 5.00 (IET-23594) to 13.67 (Tetep). The mean value for panicle length among the genotypes ranged from 17.00 cm to 24.00 cm.The number of spikelets per panicle varied from 94.00 to 236.5. Regarding the mean performance of rice genotypes for yield parameters, 100 grain weight was found to vary from 1.24 g in Jeeragisanna to 3.50 g in IET-23574. IET-23594 produced maximum grain yield (5667 kg/ha) followed by KPR-1 (5607 kg/ ha). The estimation of straw yield revealed that the genotype IET-23914 recorded highest yield (14814.81 kg/ha) followed by IET-23967 (12592.59 kg/ha). Analysis of variance revealed highly significant sum of squares due to genotypes for all the characters indicating existence of ample variability among the genotypes. The estimates of PCV were higher than the GCV indicating high influence of environment on the expression of the traits.

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