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Evaluation of Advanced Varietal Rice Genotypes for Leaf Blast Reaction, Genotypic Performance and Correlation Studies

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The present study was carried out at Agricultural and Horticultural Research Station, Ponnampet, University of Agricultural and Horticultural Sciences, Shivamogga during 2015. The experimental material comprised of 15 advanced varietal lines including existing variety as check. Mean performance of individual rice genotypes revealed that the days to 50% flowering found to vary from 85.00 days to 114.50. Plant height was found to vary from 59.84 cm to 91.33 cm with average height of 75.42 cm. Number of panicles per m^2 area ranged from 304.52 (IET-1912) to 580.80 (IET-1902) with mean of 432.21 panicles/m^2 area. The genotype IET-1912 produced maximum grain yield (5172.60 kg/ha) and found to be 20.77% superior in grain yield than local check Tunga (3096.09 kg/ha) followed by IET-1914 (5059.61 kg/ha) which found 19.64% superior, whereas IET-1908 was found to be 3.74% inferior in grain yield (2722.42 kg/ha) than local check. 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 traits such as plant height, number of panicles/m^2 and grain yield which showed high heritability coupled with high genetic advance could be used as selection criteria for their improvement since these are governed by additive gene action. The traits like plant height and days to 50% flowering could be used as indirect selection criteria for their simultaneous improvement.

Introduction

Rice (*Oryza sativa* L.) (2n=24) is the world's most important cereal crop and serves as the primary source of staple food for lives of billions of people around the World. The crop belongs to the family *Poaceae* and sub-family *Oryzoidea* and it is one of the very few crop species endowed with rich genetic diversity which accounts for more than 100,000 landraces and improved cultivars. The crop has undoubtedly evolved very high levels of adaptation to various ecological habitats ranging from low land rain-fed situation to upland irrigated situation. Globally rice was grown on 159.19 mha area during 2015-16 producing 472.25 mt with average productivity of 4.42 t/ha, while in India 104.41 mt rice production was recorded from 43.5 mha 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 oryzae* is one of the major diseases of rice causing substantial yield losses.

The progress in breeding for yield and its contributing characters of any crop is polygenically controlled, environmentally influenced and determined by the magnitude and nature of their genetic variability (Wright, 1935 and Fisher, 1981). Genetic variability and character association are pre-requisites for improvement of any crop including rice for selection of superior genotypes and improvement of any trait (Krishnaveni *et al.,* 2006). It is very difficult to judge whether observed variability is highly heritable or not. Moreover, knowledge of heritability is essential for selection based improvement as it indicates the extent of transmissibility of a character into its off springs. Knowledge of correlation between yield and its contributing characters are basic and foremost endeavor to find out guidelines for plant selection. Keeping in view the above facts, the present investigation was undertaken to study the behavior of resistance against *Pyricularia oryzae* and to know the variability and correlation among yield and its contributing characters in 15 rice genotypes under rain fed hilly ecosystem.

Materials and Methods

The experiment comprised of 15 advanced varietal lines and existing varieties of rice grown during *kharif* 2015 at Agricultural and Horticultural Research Station, Ponnampet, University of Agricultural and Horticultural Sciences, Shivamogga. These fifteen genotypes were evaluated in randomized complete block design with two replications. Seedlings were raised by adopting Uniform Blast Nursery (UBN) pattern for evaluation of

leaf blast disease reaction at seedling stage and later 25-30 days old seedlings were transplanted in a plot of 6.43 m^2 for each genotype at a spacing of 15 x 15 cm between and within rows. All the recommended package of practices was followed to raise a good crop. The observations were recorded on five randomly selected plants from each plot for scoring against blast disease and plant height while days to 50% flowering, number of panicles/m^2 area and grain yield/ha were recorded on net plot basis.

The AHRS, Ponnampet is considered as one of the internationally recognised hotspot for leaf blast disease hence genotypes were firstly evaluated for disease reaction under field condition and the genotypes were scored based on leaf blast severity following SES scale of IRRI (1996). The variability was estimated as per procedure for analysis of variance suggested by Panse and Sukhatme (1985), GCV and PCV by Burton and De Vane (1952) and heritability and genetic advance by Johnson *et al.,* (1955). Correlation coefficient was worked as per Al-Jibouri *et al.,* (1958).

Results and Discussion

Results of table 1 indicate 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 fifteen entries 8 entries showed resistant reaction and remaining 7 entries exhibited moderately resistant reaction.

The mean performance of individual rice genotypes revealed that the days to 50% flowering found to vary from 85.00 days to 114.50 days with average of 102.20 days. Genotypes with shorter days to 50% flowering are considered as early genotypes and are considered as desirable; therefore, early genotype IET-1910 (85.00) is preferred over

long duration genotype IET-1902 (114.50). Plant height was found to vary from 59.84 cm to 91.33 cm with average height of 75.42 cm. Number of panicles/m^2 area ranged from 304.52 (IET-1912) to 580.80 (IET-1902) with mean of 432.21 panicles/m^2 area. Based on the mean performance of rice genotypes for yield the genotypes in present study differed significantly. IET-1912 produced maximum grain yield (5172.60 kg/ha) and found to be 20.77% superior in grain yield than local check Tunga (3096.09 kg/ha) followed by IET-1914 (5059.61 kg/ha) which found 19.64% superior, whereas IET-1908 was found to be 3.74% inferior in grain yield than local check (2722.42 kg/ha) the overall average grain yield was 3775.74 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).

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).

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. Consequently phenotypic coefficient of variation (PCV) was higher than genotypic coefficient of variation (GCV) for all the characters. The estimates of PCV was highest for grain yield (22.49%) whereas low to moderate PCV were recorded for Days to 50% flowering (8.19%), plant height (11.88%) and number of panicles/m^2

area (18.77%). Similarly, low to moderate GCV values were recorded for all the characters namely days to 50% flowering (8.03 %), plant height (11.84 %), number of panicles/m^2 area (18.27%) and grain yield (18.00). Similar findings on analysis of variance and genetic variability parameters were reported in 47 rice genotypes by Jayasudha and Sharma (2010).

The large difference between PCV and GCV values observed for grain yield indicated large effect of environment on the expression of these traits. On the contrary, days to 50% flowering, plant height and panicle number/m^2 area are least affected by environment as indicated by less difference between PCV and GCV values. Ramanjaneyulu *et al.,* (2014) also reported similar results of more difference between PCV and GCV for yield.

The estimates of PCV and GCV clearly indicate the presence of degree of genetic variation; however, it is the estimates of heritability and genetic advance which determine the amount of heritable portion of variation. According to Lush (1949), heritability (broad sense) is the ratio of genotypic variance to phenotypic variance, expressed in percentage. The estimates of heritability are more advantageous when expressed in terms of genetic advance.

Heritability is classified as high (above 60%), medium (30%-60%) and low (below 30%). High heritability estimates were exhibited for all the character under study (Table 3). The estimates of heritability (broad sense) ranged from 64.05 percent to 99.20 percent. Plant height (99.20%) showed highest heritability followed by days to 50% flowering (95.96%), panicle number/m^2 area (94.77%) and grain yield (64.05%). Similar findings of high heritability values were reported for grain yield by Panwar (2005), Kumar *et al.,* (2007) and Chaurasia *et al.,* (2012).

Table.1 Disease reaction and mean performance of various genotypes under study

Sl. No.	Designation IET No.	Disease Reaction (SES 0-9 Scale)	Growth Parameters		Yield Parameters		Percent increase over local check
		Leaf Blast	Days to 50% Flowering	Plant height (cm)	No. of Panicles/m^2	Grain yield Kg/ha	
1	1901	2	105.00	59.84	544.50	4473.31	13.77
2	1902	2	114.50	64.00	580.80	3391.46	2.95
3	1903	1	98.00	68.17	500.94	4081.85	9.86
4	1904	2	109.50	74.00	370.26	2836.30	-2.60
5	1905	2	100.50	79.00	392.04	3167.26	0.71
6	1906	3	109.00	77.00	413.82	3137.01	0.41
7	1907	1	109.00	74.00	341.22	3902.14	8.06
8	1908	1	106.00	71.33	508.20	2722.42	-3.74
9	1909	1	100.50	82.00	406.56	3843.42	7.47
10	1910	2	85.00	76.67	406.56	3649.47	5.53
11	1911	2	97.00	76.83	421.08	3535.59	4.39
12	1912	1	94.00	91.33	304.92	5172.60	20.77
13	1913	1	95.50	65.33	508.20	4567.62	14.72
14	1914	1	95.50	81.66	348.48	5059.61	19.64
15	1915/Tunga (LC)	1	114.00	90.16	435.60	3096.09	0.00
	Mean		102.20	75.42	432.21	3,775.74	
	CV (%)		1.65	1.65	1.07	4.29	
	CD (0.05)		3.61	3.61	1.72	39.80	

Table.2 Analysis of variance for different characters under study

	df	Days to 50% Flowering	Plant height (cm)	No. of Panicles/m^2	Grain yield Kg/ha
Source		Mean sum of squares			
Replication	1	3.333	2.511	2,031.00	472,985.02
Treatment	49	137.414**	160.035**	12,813.47**	1,182,991.12**
Error	49	2.833	0.645	344.36	259,265.22
SE±M		1.19	0.57	13.12	360.05

*, ** indicates significant at 5 % and 1 % level, respectively.

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

Genetic parameter	Days to 50% Flowering	Plant height (cm)	No. of Panicles/m^2	Grain yield Kg/ha
Mean	102.20	75.42	432.21	3,775.74
σ^2p	70.12	80.35	6578.91	721128.08
σ^2g	67.29	79.70	6234.56	461862.91
PCV (%)	8.194	11.884	18.766	22.491
GCV (%)	8.026	11.836	18.269	17.999
h^2 bs	95.96	99.197	94.766	64.047
GAM	16.197	24.285	36.635	29.674

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

Table.4 Genotypic and phenotypic correlations matrix

	Days to 50% Flowering	Plant Height	Panicles/m^2	Grain Yield/Ha
Days to 50% Flowering	1.000	-0.150 [NS]	0.283 [NS]	-0.511**
Plant Height	-0.149[NS]	1.000	-0.758**	0.058 [NS]
Panicles/M2	0.297 [NS]	-0.777**	1.000	-0.174 [NS]
Grain Yield/Ha	-0.564**	0.062 [NS]	-0.252 [NS]	1.000

Upper diagonal values are phenotypic correlation values and lower diagonal values are genotypic correlation values

High heritability values of a trait indicate less effect of environment on their expression.

The plant breeder, therefore adopt simple selection method on the basis of the phenotype of the characters which ultimately improves the genetic background of these traits.

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 3 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 panicle number/m^2 area (36.63%), grain yield (29.67%) followed by plant height (24.28%) while moderate value was recorded for days to 50% flowering (16.20%). Since the broad sense heritability includes both additive and non-additive components of genetic variance, heritability alone will not be of much practical value hence the concurrent use of genetic advance along with heritability would be more useful in predicting the resultant effect of selection on phenotypic expression (Johnson *et al.,* 1955). In the present study, high heritability coupled with high genetic advance as percent of mean was observed for plant height, number of panicles/m^2 area and grain yield while high heritability coupled with moderate genetic advance as percent of mean was observed for days to 50% flowering. These findings are in accordance with the results of Dhanwani *et al.,* (2013) who found the higher magnitude of PCV and GCV for number of grains per panicle (23.85%; 23.10%) and grain yield (23.17%; 22.04%).

The additive gene action is involved in the expression of those characters which show high

heritability coupled with high genetic advance (Panse, 1957) thus can be improved through simple or progeny selection methods while the characters with high heritability coupled with moderate or low genetic advance can be improved by inter-mating superior individuals from segregating population of a cross (Samadhia, 2005).

Correlation studies (Table 4) revealed that plant height had significantly negative correlation with number of panicle/m^2 area at both genotypic level (-0.777) and phenotypic level (-0.758) this indicated shorter plants produced more panicles. Days to 50% flowering exhibited significantly negative correlation with yield at both genotypic level (-0.564) and phenotypic level (-0.511) this indicated shorter duration genotypes produced higher grain yields. Kalyan *et al.,* (2017) reported similar results of negative correlation between days to 50% flowering and yield but he reported contrary results to the present results for correlation between plant height and tiller number.

From the present investigation it has been concluded that eight genotypes including local check were found to be resistant to leaf blast disease while seven entries showed moderately resistant reaction to leaf blast disease. The mean performance of individual rice genotypes revealed that the days to 50% flowering found to vary from 85.00 days to 114.50. Plant height was found to vary from 59.84 cm to 91.33 cm with average height of 75.42 cm. Number of panicles per m^2 area ranged from 304.52 (IET-1912) to 580.80 (IET-1902) with mean of 432.21 panicles/m^2 area. The genotype IET-1912 produced maximum grain yield (5172.60 kg/ha) and found to be 20.77% superior in grain yield than local check Tunga (3096.09 kg/ha) followed by IET-1914 (5059.61 kg/ha) which found 19.64% superior, whereas IET-1908 was found to be 3.74% inferior in grain yield (2722.42 kg/ha) than local check. 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 traits such as plant height,

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