Genetic Variability and Character Association Studies on Some Exotic Germplasm Lines in *Kharif* Rice (*Oryza sativa* L.)

S. S. Karande*, B. L. Thaware, S. G. Bhave and J. P. Devmore
Department of Agriculture Botany, College of Agriculture, Dapoli
Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli - 415 712 (MS)

Abstract

A study was undertaken to find out the genetic variability and correlation between yield and other yield attributing characters of rice genotypes in *kharif* 2013. High genotypic coefficient of variation, high heritability with high genetic advance as per cent of mean was observed for grain yield per plant, total tillers per plant, productive tillers per plant and grains per panicle, whereas days to initiation of flowering, days to 50 % flowering and days to maturity had high heritability with low genetic advance as per cent of mean. The genotypic correlation of grain yield was positive and significant with total tillers per plant, productive tillers per plant, spikelet fertility, 1000 grain weight and straw yield per plant where as phenotypic correlation of yield was positive and significant with productive tillers per plant, spikelet fertility and straw yield per plant.

Keywords : Genetic variability, character association, exotic germplasm, *kharif* rice.

Introduction

Rice (*Oryza sativa* L.) is one of the commonly consumed cereals and staple food for more than half of the world's population. The variability in the breeding material is extremely important in the selection of superior plant types where selection is based not only on yield but also on its component traits. Genetic variability is the prime requirement for breeding programme. An understanding of the nature and magnitude of genetic variation present in the germplasm lines and cultivated varieties is necessary before initiating a breeding programme aiming to develop high yielding varieties.

***Corresponding author :** karande74@gmail.com

Correlation analysis is the important biometrical technique to determine the yield components. The characters that are positively correlated with yield are of considerably important to plant breeder for selection purpose. Yield is a complex character and is influenced by various other characters. Therefore, it is essential to understand the association of other characters with yield in addition to the information on genetic variability. Correlation coefficient indicates the nature of association among the different traits. Since, the effectiveness of selection depends upon the extent of genetic variability and correlation for different characters, an attempt has been made to evaluate 53 exotic germplasm lines and one variety of rice from DBSKKV, Dapoli for twelve quantitative characters. The present investigation was conducted aiming to assess the range of variability, heritability and genetic advance and association between yield and yield component traits in rice.

Material and Methods

Fifty four genotypes of rice were grown in randomized block design with three replications during *Kharif* 2013 at Agriculture Research Station, Shirgaon, Maharashtra, India. Each genotype had 3 rows of 1.5 m length with spacing of 20 x 15 cm. Twenty five days' old one seedling was transplanted per hill. Fertilizer dose of 100 kg N + 50 kg P_2O_5 + 50 kg K_2O per hectare, other recommended package of practices and plant protection measures were adopted to raise the crop healthy. Observations on five randomly selected plants were recorded for the characters *viz*. days to initiation of flowering, days to 50 % flowering, days to maturity, plant height (cm), total tillers per plant, productive tillers per plant, panicle length (cm), grains per panicle, spikelet fertility (%), 1000 grain weight (g), straw yield per plant (g) and

grain yield per plant (g). Analysis of variance was done by method suggested by Panse and Sukhatme (1954). Genotypic and phenotypic coefficient of variation, heritability and genetic advance were studied as per the standard procedures(Burton 1952; Burton and De Vane 1953; Johnson *et al.* 1955), respectively. The genotypic and phenotypic correlations were determined as per the method suggested by Johnson *et al.* (1955).

Results and Discussion

Analysis of variance showed the significant difference among genotypes for all the characters studied (Table 1) indicating presence of variability in the material. Estimates of genetic parameters like Genetic coefficient of variance (GCV), Phenotypic coefficient of variance (PCV) heritability, genetic advance and genetic advance as per cent of mean were studied (Table 2). Maximum variation was observed in the traits viz; plant height (73 to 120 cm), productive tillers per plant (5.7 to 9.6), panicle length (21.9 to 27.6 cm), grain per panicle (86 to 179), 1000 grain weight (20.9 to 31.6 g) and grain yield per plant (14.2 to 24.8 g). Similar results were reported in rice by others (Karim *et al.* 2007, Bhadru *et al.* 2012, Tuwar *et al.* 2013 and Singh *et al.* 2013). In general, the phenotypic variences were higher than the genotypic variances. High PCV for the characters *viz*. total tillers per plant, productive tillers per plant, grains per panicle and grain yield per plant (g) indicated that these characters were influenced by environmental factors.

High GCV and PCV was observed in total tillers per plant, productive tillers per plant, grains per panicle, 1000 grain weight and grain yield per plant (g).The results are in agreement with the previous research findings (Yadav *et al.* 2011, Bhadru *et al.* 2012, Shukla *et al.* 2005 and Tuwar *et al.* 2013). Highest heritability was observed in days to initiation of flowering, days to 50 % flowering followed by grains per panicle, plant height (cm), 1000 grain weight (g), days to maturity and grain yield per plant (g). The high genetic advance was observed for grains per panicle, plant hight (cm), days to maturity and days to 50% flowering. High estimates of heritability along with high genetic advance as per cent of mean were observed for the characters, grains per panicle, grain yield per plant (g), productive tillers per plant, total tillers per plant and 1000 grain weight (g) which finds support from previous results (Bhadru *et al.* 2012 and Tuwar *et al.* 2013).

Table 1 : Analysis of variance for different characters in rice under study

Characters	Mean sum of squares		
	Replication (2)	Genotypes (53)	Error (106)
Days to initiation of flowering	5.45	34.82**	3.61
Days to 50 % flowering	12.08	38.04**	4.63
Days to maturity	3.02	40.78**	4.55
Plant height (cm)	0.51	198.13**	7.51
Total tillers per plant	1.71	7.50**	0.99
Productive tillers per plant	1.88	3.91**	1.08
Panicle length (cm)	2.73	7.76**	1.29
Grains per panicle	6.94	1737.71**	87.41
Spikelet fertility %	21.58	180.79**	8.28
1000 grain weight (g)	2.60	14.50**	0.95
Straw yield per plant (g)	4.55	7.24**	3.14
Grain yield per plant (g)	18.61	24.68**	6.16

** Significance at 1%; Figures in parentheses show degrees of freedom.

Table 2 : Variability parameters for different characters in rice

Characters	Range	Mean	GCV (%)	PCV (%)	h^2b (%)	GA	GAM %
Days to initiation of flowering	88 to 104	93	3.44	3.99	74	5.72	6.10
Days to 50 % flowering	91 to 108	97	3.43	4.08	71	5.78	5.94
Days to maturity	116 to 134	122	2.84	3.33	73	6.10	4.98
Plant height (cm)	73 to 120	100	7.92	8.38	89	15.53	15.43
Total tillers per plant	7.5 to 13.6	9.5	15.36	18.55	69	2.51	26.21
Productive tillers per plant	5.7 to 9.6	7.2	13.45	19.69	47	1.37	18.93
Panicle length (cm)	21.9 to 27.6	25	5.88	7.43	63	2.39	9.58
Grains per panicle	86 to 179	121	19.34	20.74	87	45.13	37.16
Spikelet fertility (%)	51.4 to 94.4	83.5	9.08	9.71	87	14.60	17.48
1000 grain weight (g)	20.9 to 31.6	25.6	8.29	9.13	83	3.98	15.52
Straw yield per plant (g)	13.5 to 20.1	16.3	7.14	12.97	30	1.32	8.09
Grain yield per plant (g)	14.2 to 24.8	19.3	12.83	18.14	50	3.62	18.70

GCV : Genotypic coefficient of variance, PCV : Pheotypic coefficient of variance,
h^2b : Heritability in broad sense, GA : Genetic advance GAM : Genetic advance of percent of mean

It appeared that the above mentioned characters might exhibit predominance of additive gene effects; hence selection for these characters would be effective for the genetic improvement of yield. High heritability was accompanied with low genetic advance for the characters, *viz* days to initiation of flowering, days to 50% flowering and days to maturity which was apparently due to low PCV. High heritability and low genetic advance for such characters indicated that dominance and epistatic effects were of considerable value in the inheritance of these characters. The genotypic and phenotypic correlation coefficient among all these traits showed that the genotypic correlation of yield was positive and significant with total and productive tillers per plant, spikelet fertility, 1000 grain weight and straw yield per plant (Table 3). On the other hand, phenotypic correlation of yield was positive and significant with productive tillers per plant, spikelet fertility and straw yield per plant and days to maturity.

Conclusion

Significant differences among the genotypes for all the characters studied indicating the presence of variability in the materials. The high GCV, high heritability with high genetic advance as per cent of mean were observed for grains per panicle, grain yield per plant (g), productive tillers per plant and total tillers per plant. The genotypic correlation of yield was positive and significant with total and productive tillers per plant, spikelet fertility, 1000 grain weight and straw yield per plant. Phenotypic correlation of yield was positive and significant with productive tillers per plant, spikelet fertility and straw yield per plant. This suggests that these traits can be manoeuvred successfully for breeding high yielding rice varieties for this dynamic ecology.

Table 3 : Phenotypic and genotypic correlation coefficients among various characters in rice.

Characters		Days to initiation of flowering	Days to 50 % flowering	Days to maturity	Plant height (cm)	Total tillers/ plant	Productive tillers/ plant	Panicle length (cm)	Grains/ panicle	Spikelet fertility (%)	1000 grain weight (g)	Straw yield/ plant (g)	Grain Yield/ Plant (g)
Days to initiation of flowering	P	1.0000	0.8742**	0.909**	0.1302	0.0695	- 0.0269	0.0288	0.0328	0.0099	- 0.0699	0.0318	-0.0466
	G	1.0000	0.9549**	0.980**	0.1469	0.1515	0.1527	0.0709	0.0769	-0.0124	-0.1083	0.1393	0.0498
Days to 50% flowering	P		1.0000	0.823**	0.0826	0.1098	0.0269	0.0054	0.0507	0.0314	-0.1218	0.0426	-0.0316
	G		1.0000	0.964**	0.1534	0.1258	0.1146	0.0748	0.0760	0.0247	-0.1353	0.0424	-0.0196
Days to maturity	P			1.0000	0.1359	0.0617	-0.0044	0.0099	0.0108	0.0442	-0.1112	-0.0355	-0.0418
	G			1.0000	0.1412	0.1465	0.1515	0.0295	0.0407	0.0260	-0.1543*	0.0766	0.0289
Plant height (cm)	P				1.0000	-0.243**	-0.2097**	0.338**	0.188*	0.0296	0.253**	0.1172	-0.0537
	G				1.0000	-0.293**	-0.2971**	0.436**	0.211*	0.0333	0.301**	0.246**	-0.0862
Total tillers/ plant	P					1.0000	0.6330**	-0.0983	-0.0033	0.0935	-0.1599*	0.162*	0.1460
	G					1.0000	0.9891**	-0.0667	0.0070	0.1042	-0.1717	-0.1338	0.218**
Productive tillers/ plant	P						1.0000	-0.0247	0.0089	0.1292	-0.0822	0.1066	0.377**
	G						1.0000	-0.1276	-0.1960	0.2167*	-0.1402	0.158*	0.1598*
Panicle length (cm)	P							1.0000	0.168*	0.0530	0.341**	0.0682	0.0502
	G							1.0000	0.180*	0.0870	0.4845	0.1375	-0.0384
Grains/ panicle	P								1.0000	-0.1734*	0.0444	0.0310	-0.0056
	G								1.0000	-0.2056*	0.0441	0.0604	-0.270**
Spikelet fertility (%)	P									1.0000	-0.0199	0.166*	0.211**
	G									1.0000	-0.0291	0.314**	0.317**
1000 grain weight (g)	P										1.0000	0.161*	0.1539
	G										1.0000	0.351**	0.266**
Straw yield/plant (g)	P											1.0000	0.384**
	G											1.0000	0.8303**

**, * Significance at 1 % and 5 % level respectively: P: Phenotypic correlation, G : Genotypic correlation

References

Akhatar N, M F Nazir, A Rabanwaz, T Mahmood, M E Safdar, M Asif, A Rehman. 2011. Estimation of heritability, correlation and path analysisin fine grain rice (*Oryza sativa* L.). Journal of Animal and Plant Sciences. 21(4):660-664.

Akinwale M G, Gregorio G, Nwilene F, Akinyele B O, Ogunbayo S A, Odiyi A C. 2011. Heritability and correlation coefficient analysis for yield and its Components in rice (*Oryza sativa*L.). African Journal of Plant Science. 5: 207-212.

Aljibouri H A, P A Miller, H F Robonson. 1958. Genotypic and environmental variances and covariances in and upland cotton cross of interspecific origin. Agronomy Journal. 50:633-637.

Bhadru D, Tirumalarao V, Chandramohan Y and Bharathi D. 2012. Genetic variability and diversity studies in yield and its component traits in rice (*Oryza sativa* L.). SABRAO J. Breeding and Genetics. 44(1): 129-137.

Burton G W and E H deVane. 1953. Estimating heritability in tall fesche (*Festuca arundinacea*) from replicated clonal material. Agronomy Journal. 45:478-481.

Johnson H W, Robinson H E and Comstock R E. 1955. Estimates of genetic and environmental variability in soybean. Agronomy Journal. 47 (7): 314-318.

Karim D, Sarkar U, Siddique M N A, Khalequimia M A and Hasnat M Z. 2007. Variablitiy and genetic parameter analysis in aromatic rice. Int. J. Sustain. Crop Prod. 2(5): 15-18.

Panse V G and Sukhatme P V. 1954. Statistical methods for agricultural workers. 4th Edn. 1985, ICAR, New Delhi.

Shukla V, Singh S, Singh S K and Singh H. 2005. Estimation of genetic variability, heritability and genetic advance in 'New plant type' tropical japonica rice under upland environment. Agric. Sci. Digest. 25 (3): 207-209.

Singh CM, Babu S G, Kumar B and Mehandi S. 2013. Analysis of quantitative variation and selection criteria for yield improvement in exotic germplasm of upland rice (*Oryza sativa*L.). The Bioscan. 8 (2): 485-492.

Tuwar A K, Singh S K, Sharma A and Bhati P K. 2013. Appraisal of genetic variability for yield and its component characters in rice (*Oryza sativa*L.). Biolife. 1 (3): 84-89.

Yadav S K, Pandey P, Kumar B and Suresh B G. 2011. Genetic architecture, inter- relationship and selection criteria for yield improvement in rice (*Oryza sativa* L.) Pak. J. Biol. Sci. 14 (9): 540-545.