



Research Article

GENETIC VARIABILITY STUDIES FOR YIELD AND YIELD COMPONENTS IN RICE (*Oryza sativa* L.)

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Abstract- An experiment was oversaw to determine genetic variability of yield and yield components in Rice at the Field Experimentation Site of Department of Genetics and Plant Breeding, SHIATS, Allahabad during *Kharif*-2015 in Randomized Block Design having 30 genotypes grown in three replications. The data were recorded for 13 quantitative characters to study genetic variability, heritability and genetic advance. The highest grain yield per plant was observed in genotype KR 15-01. High estimates of GCV and PCV were observed for biological yield per plant followed by grain yield per plant and panicles per plant. High measure of heritability was observed for test weight and days to maturity. Genetic advance as per cent of mean was highest for test weight followed by biological yield per plant, number of panicles per plant, grain yield per plant. High heritability together with modest genetic advance was observed for days to maturity. High genetic advance as per cent of mean was recorded for test weight followed by biological yield per plant, panicles per plant, grain yield and tillers per plant. High heritability coupled with high genetic advance as percent of mean was observed for test weight followed by panicles per plant and biological yield per plant. This shows that selection is effective for the improvement of these characters.

Keywords- Rice (*Oryza sativa* L.), GCV, PCV, Heritability and genetic advance

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Introduction

Rice (*Oryza sativa* L.) is the most important staple food crop of the world on account of existence of significant source of calories for more than half of the total global population. The importance of rice is not only as a fundamental commodity and primary food source for more than half of the world's population, but also as emerges from the complex rice based ecosystems that influence issues of global concern such as food security and development. More than 90 % of the world's rice is grown and consumed in Asia, known as rice bowl of the world, where 60 % of the total population and 2/3 rd of world's poor live [1]. Rice is the most important staple food for more than 70 per cent of our nation's population and source of livelihood for 120-150 million rural households, is backbone to the Indian Agriculture. However, yield level of this crop has reached a plateau and improving its productivity and quality traits has become crucial [2]. To accomplish this, crop improvement programmes should aim at broadening the genetic base of breeding stock. Success in crop improvement generally depends on the extent of genetic variability and the extent to which the desirable characters are heritable. Assessment of genetic variability exist in the germplasm of a crop is a pre-requisite for making any effective breeding program. However, variability studies and association grain quality characters of high yielding rice varieties of specific eco-geographical origin are limited. Hence, the present study was undertaken to evaluate the extent of variability and genetic parameters in high yielding diverse genotypes for important yield parameters.

Materials and Methods

The experiment was conducted with 30 diverse genotypes of rice during *Kharif* 2015 at the Field Experimentation Centre, Department of Genetics and Plant Breeding, Sam Higgin bottom Institute of Agriculture Technology and Sciences,

(Deemed-to-be-University), Allahabad (U.P.). Twenty one days old seedlings were transplanted in 5 x 4 m² plot in RBD (Randomized Block Design) with 3 replications. Distance between plant to plant and row to row were 20 cm and 15 cm respectively. Definitive agronomic practices were followed throughout the crop growth period to obtain good harvest. Quantitative observations were recorded on five randomly selected plants from each of the blocks for 13 biometrical characters i.e, days to 50% flowering, plant height, flag leaf length, flag leaf width, tillers per plant, panicles per plant, panicle length, spikelets per panicle, days to maturity, biological yield per plant, harvest index, test weight and grain yield per plant. The observations on days to 50% flowering and days to maturity were recorded on plot basis. The mean over replication of each character was subjected to statistical analysis. The Analysis of variance was estimated according to procedure proposed by [3], coefficient of variation (GCV and PCV) by [4]. Heritability for the grain yield and yield components in rice were worked out in broad sense by adopting formula proposed by [5]. Genetic advance was calculated by the method suggested by [6].

Results and Discussion

Analysis of Variance: ANOVA revealed that all the genotypes differed highly significantly for all the characters under study [Table-1], which implies that there is wide scope of improvement in the germplasm available. A wide range for all the traits illustrated the presence of variation among the different traits. Similar results were also reported prior by [7,8].

Mean Performance: The mean performance of rice genotypes for different yield and yield components are presented in [Table-2]. Genotype KR 15-01 and KR 15-

33 were found to be early flowering 85.67 (days) and early maturing 115.67 (days) while, Genotype KR 15-15 found to be late flowering 116.00 (days) and late maturing 146.00 (days). Genotype KR 15-16 was tallest 122.33 (cm) amongst all while KR 15-04 was found dwarf 97.00 (cm) amongst all. Flag leaf length was longest for KR 15-18 46.93 (cm) and shortest for KR 15-24 30.60 (cm). Flag leaf width was wider for the genotypes KR 15-09 and KR 15-11 1.71 (cm) while it was narrower for the genotype KR 15-01 1.30 (cm). Tillers per plant were maximum for genotype KR 15-33 (12.60) and minimum for KR 15-04 (7.47). Panicles per plant were more for genotype KR 15-33 (11.87) while minimum for KR 15-18 (5.73).

Genotype KR 15-33 recorded longest panicle length 26.73 (cm) while it was shortest for KR 15-04 (21.73). Maximum no of spikelets per plant were recorded by KR 15-01 (230.08) while minimum number of spikelets per plant were recorded by KR 15- 41 (156.07). Biological yield per plant ranged from 83.74 (g) for KR 15-01 to 42.22 (g) for KR 15-28. Test weight of grains was recorded maximum for KR 15-39 27.91 (g) and minimum for KR 15- 16 14.20 (g). Highest grain yield per plant was recorded for the genotype KR 15-01 43.40 (g) while lowest for KR 15-26 22.23 (g). High harvest index was found for the genotypes KR 15-15 65.60 (%) while lowest for genotype KR 15-24 29.99 (%).

Table-1 Analysis of variance for 13 characters in 30 rice hybrids during Kharif-2015

S. No.	Characters	Mean sum of squares		
		Replication (d.f=2)	Genotypes (d.f =29)	Error (d.f=58)
1	Days to 50% flowering	32.41	257.34**	24.64
2	Plant height	59.14	148.87**	19.17
3	Flag leaf length	13.07	31.58**	8.79
4	Flag leaf width	0.01	0.04**	0.01
5	Tillers / plant	0.07	6.18**	1.31
6	Panicles / plant	3.21	6.04**	0.91
7	Panicle length	0.28	5.41**	1.58
8	Spikelets / panicle	65.54	770.09**	150.57
9	Days to maturity	1.91	270.80**	9.55
10	Biological yield	89.36	354.71**	62.76
11	Test weight	0.63	27.70**	67.53
12	Harvest index	18.79	134.84*	0.42
13	Grain yield / plant	24.96	74.73**	15.92

* Significant at 5 %, ** Significant at 1 %.

Table-3 Genetic parameters for 13 quantitative characters in 30 rice genotypes

S. No.	Characters	σ^2_g	σ^2_p	Coefficient of variation		h^2 (B.S.) (%)	GA	GA as % of mean
				GCV	PCV			
1	Days to 50% Flowering	77.57	102.21	9.15	10.51	75.90	15.81	16.43
2	Plant Height	43.23	62.41	6.19	7.44	69.30	11.27	10.62
3	Flag Leaf Length	7.60	16.39	7.43	10.91	46.40	3.87	10.42
4	Flag Leaf Width	0.01	0.02	6.01	9.34	41.40	0.12	7.97
5	Tillers/ Plant	1.62	2.93	13.19	17.73	55.30	1.95	20.22
6	Panicles/ Plant	1.71	2.62	15.50	19.19	65.20	2.17	25.79
7	Panicle Length	1.27	2.86	4.70	7.03	44.60	1.55	6.46
8	Spikelets/ Panicle	206.51	357.08	7.22	9.49	57.80	22.51	11.30
9	Days to Maturity	87.08	96.64	7.37	7.76	90.10	18.25	14.41
10	Biological Yield/ Plant	97.32	160.08	16.92	21.70	60.80	15.85	27.17
11	Test Weight	9.09	9.52	14.10	14.43	95.60	6.07	28.40
12	Harvest Index	22.44	89.96	9.51	19.03	24.90	4.87	9.78
13	Grain Yield/ Plant	19.60	35.52	15.53	20.91	55.20	6.78	23.77

σ^2_g = Genotypic variance. σ^2_p = Phenotypic variance. h^2 = Heritability GCV = Genotypic coefficient of variation. PCV = Phenotypic coefficient of variation

Variability, Heritability and Genetic Advance: A wide range of variability was exhibited by most of the traits under study [Table-3]. Spikelets per plant recorded highest phenotypic and genotypic variation (357.08 and 206.51) followed by biological yield per plant (160.08 and 97.32). High genetic variability for different quantitative traits in rice was also outlined by [7, 8]. Coefficient of variation truly provides a relative measure of variation among the different traits. Genotypic coefficient of variation and phenotypic coefficient of variation was highest for biological yield per plant followed by grain yield per plant and panicles per plant. The estimates for the PCV were slightly higher than those of GCV for all the traits. High magnitude of differences between PCV and GCV was observed in harvest index (9.52) which indicates the influence of environmental factors is more than the other traits as compared. The measure of high GCV and PCV for biological yield per plant in rice is in conformity with the findings of earlier workers [9-12]. Heritability plays an important role in deciding the suitability and strategy for selection of the character. The characters viz. test weight (95.60 %) and days to maturity (90.10 %) had high heritability while harvest index (24.90 %) was found to be less heritable, nevertheless high heritability indicates the effectiveness of selection on the basis of phenotypic performance, it does not exhibit any hint of the amount of genetic progress for selecting the best individual which is possible by using the estimates of genetic advance. High heritability coupled with moderate

genetic advance was observed for days to maturity (90.10 and 18.25). High heritability coupled with high genetic advance as % of mean was observed for test weight (95.60 and 28.40) followed by panicles per plant (65.20 and 25.79) and biological yield (60.80 and 27.17) indicating additive gene action controlling these traits. Hence, phenotypic selection may be effective for improving these characters.

Conclusion

From the present investigation it is concluded that genotype KR 15- 01 has highest grain yield per plant (43.4 gm), more number of spikelets per plant (230.08) and Biological yield per plant (83.74).

Conflict of Interest: None declared

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Table-2 Mean performance of 13 characters of 30 rice genotypes during Kharif-2015

No	Genotypes	Characters												
		Days to 50% Flowering	Plant Height (cm)	Flag Leaf Length (cm)	Flag Leaf Width (cm)	Tillers/ Plant	Panicles/ Plant	Panicle Length (cm)	Spikelets/ Panicle	Days to Maturity	Biological Yield/ Plant	Test Weight	Grain Yield/ Plant	Harvest Index
1.	KR 15-01	85.67	119.6	37.67	1.3	9.47	8.8	24.2	230.08	115.67	83.74	23.37	43.4	52.30
2.	KR 15-02	98.33	99.17	39.93	1.65	8.00	6.47	22.6	207.67	128.33	50.31	24.05	23.83	47.43
3.	KR 15-03	86.33	112.13	35.87	1.51	11.73	8.67	25.53	222.02	116.33	76.15	22.17	37.86	50.27
4.	KR 15-04	89.67	97.00	39.67	1.44	7.47	6.47	21.73	205.93	121.33	61	25.77	31.39	51.60
5.	KR 15-05	88.00	113.60	34.80	1.57	9.40	8.57	24.47	224.59	119.67	74.98	19.67	39.93	53.78
6.	KR 15-07	87.33	105.73	38.47	1.70	8.60	7.70	22.87	187.83	117.33	56.2	24.31	29.12	52.37
7.	KR 15-09	115.33	107.87	34.27	1.71	7.73	6.87	22.00	217.32	145.33	70.19	18.52	33.95	48.38
8.	KR 15-11	107.67	99.07	35.00	1.71	9.87	8.33	24.47	198.33	137.67	52.67	14.70	26.21	49.95
9.	KR 15-13	107.33	97.27	37.43	1.50	7.87	7.20	22.60	204.81	137.67	63.06	21.62	29.08	46.49
10.	KR 15-15	116.00	99.27	31.53	1.45	8.73	7.50	23.00	212.96	146.00	50.95	21.50	31.97	65.60
11.	KR 15-16	91.00	122.33	44.27	1.53	10.27	9.17	24.80	200.10	122.00	56.45	14.20	24.93	44.09
12.	KR 15-17	104.33	103.27	37.93	1.44	9.20	7.93	23.60	202.73	134.33	50.86	20.37	25.49	50.11
13.	KR 15-18	90.33	116.00	46.93	1.57	7.53	5.73	21.93	187.67	121.33	54.00	20.54	26.06	48.31
14.	KR 15-19	91.67	111.67	38.67	1.49	8.93	7.50	23.33	207.98	118.00	55.42	19.00	29.17	53.56
15.	KR 15-20	105.67	109.07	37.67	1.56	10.73	9.00	24.87	190.77	135.67	67	20.37	29.27	44.33
16.	KR 15-22	98.33	111.93	38.27	1.51	10.00	9.63	24.47	198.67	131.00	43.20	20.92	23.19	53.63
17.	KR 15-24	108.67	102.73	30.60	1.55	10.93	9.93	24.93	196.90	142.67	82.67	21.50	24.88	29.99
18.	KR 15-26	104.33	108.87	37.53	1.35	11.07	10.14	25.00	170.00	134.33	50.14	26.10	22.23	44.47
19.	KR 15-28	89.00	104.20	37.93	1.39	9.20	8.03	23.33	184.37	119.67	42.22	20.09	24.88	59.86
20.	KR 15-30	91.67	104.33	36.00	1.32	9.27	8.63	23.60	177.30	121.67	60.62	17.70	29.07	48.55
21.	KR 15-31	86.33	102.13	38.47	1.45	8.80	7.67	23.00	208.34	116.33	55.22	23.45	28.68	52.37
22.	KR 15-32	105.00	105.93	37.80	1.47	10.07	8.97	24.60	203.96	135.00	55.95	22.42	24.90	45.00
23.	KR 15-33	85.67	116.20	32.93	1.47	12.60	11.87	26.73	204.97	115.67	56.46	20.70	28.33	50.14
24.	KR 15-34	91.00	99.07	37.33	1.46	10.33	9.97	24.73	176.88	121.00	65.20	22.28	28.49	44.17
No	Character	Days to 50% Flowering	Plant Height (cm)	Flag Leaf Length (cm)	Flag Leaf Width (cm)	Tillers/ Plant	Panicles/ Plant	Panicle Length (cm)	Spikelets/ Panicle	Days to Maturity	Biological Yield/ Plant	Test Weight	Grain Yield/ Plant	Harvest Index
25.	KR 15-35	87.33	113.40	38.33	1.56	10.33	7.27	24.73	205.00	117.33	51.40	21.46	24.94	48.40
26.	KR 15-37	90.00	102.27	35.47	1.53	8.67	7.77	23.20	205.09	120.00	47.55	22.82	22.54	47.58
27.	KR 15-39	91.00	99.80	34.00	1.43	12.53	10.07	26.00	201.97	121.00	66.23	27.91	29.79	45.20
28.	KR 15-41	103.67	102.07	34.40	1.33	12.33	11.40	25.67	156.07	133.67	46.64	17.57	28.47	61.56
29.	KR 15-43	98.00	97.63	37.03	1.40	8.60	7.80	22.80	191.08	131.00	54.93	24.24	24.21	44.31
30.	PHB- 71	91.67	101.20	36.87	1.40	9.53	7.93	26.54	193.17	121.67	47.99	22.25	28.89	61.09
	Mean	96.21	106.16	37.10	1.49	9.66	8.43	24.04	199.15	126.62	58.31	21.38	28.51	49.83
	C.V.	5.16	4.12	7.99	7.15	11.85	11.32	5.23	6.16	2.44	13.59	3.04	14.00	16.49
	Range	Min	85.67	97.00	30.60	1.30	7.47	5.73	21.73	115.67	42.22	14.20	22.23	29.99
		Max	116.00	122.33	46.93	1.71	12.60	11.87	26.73	146.00	83.74	27.91	43.40	65.60
	S.E.	2.87	2.53	1.71	0.06	0.66	0.55	0.73	7.08	1.78	4.58	0.37	2.30	4.74
	C.D. 5%	8.11	7.16	4.85	0.17	1.87	1.56	2.06	20.06	5.05	12.95	1.06	6.52	13.43