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Genetic Variability Studies for Yield and Yield Components in Rice (*Oryza Sativa L.*)

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ABSTRACT

Twenty five rice genotypes were evaluated in randomized Block Design with three replications to examine the nature and magnitude of variability, heritability and genetic advance. Analysis of variance revealed that differences among twenty five rice genotypes were significant for all the characters. Among all the traits, number of tillers per plant, productive tillers per plant, number of grains per panicle and number of filled grains per panicle showed higher estimates of genotypic and phenotypic co-efficient of variation. High estimates of heritability were recorded for all the characters under study. High heritability coupled with high genetic advance as per cent of mean was recorded for number of tillers per plant, productive tillers per plant, number of grains per panicle and number of filled grains per panicle suggesting that these traits were more useful for targeted yield improvement programmes in rice.

Key words : Genetic advance, Heritability, Rice, Variance.

Rice is the most important grain and staple food for more than 100 countries of the world and has been referred to as "Global Grain" (Shalini and Tulasi, 2008). India being the second largest producer of rice still lacks behind in productivity. The rising demand, saturation of cultivable field and low gross domestic production of rice are likely to cause a supply shortage of a crop in the near future. By the year 2025, about 785 million tones of paddy which is 70 per cent more than the current production will be needed to meet the growing demand. According to FAO, the productivity of rice in India is very low (3.21 t/ha) as compared to the average productivity of China (6.35 t/ha) and world (4.15 t/ha). The production is very low in India due to non- availability of high yielding varieties. Therefore, being the staple food of the population in India, improving its productivity has become a crucial importance (Subudhi *et al.,* 2011).

Development of high yielding varieties requires the knowledge of existing genetic variability. Further, since the phenotypic expression of a character is the result of interaction between genotype and environment, total variation needs to be partitioned into variance due to genotype (heritable) and variance due to environment (non heritable) for assessing the true breeding behaviour of the phenotype. Efficiency of selection in plant breeding therefore largely depends upon the amount of heritable variation present in the material. The effective use of genetic variation for crop improvement programme is possible only if it is considered in relation to heritability. High heritability coupled with high genetic advance would be a more useful tool in predicting the resultant effect in selection of the best genotypes for yield and its components. It helps in determining the environmental influence on the expression of characters. With the above background information, the present investigation was undertaken to study the genetic parameters among the twenty five rice varieties.

MATERIAL AND METHODS

A field experiment was conducted during *Kharif,* 2013 at College Farm of Agricultural College, Mahanandi with 25 rice genotypes sown in a Randomized Block Design with three replications. Thirty day old seedlings of each genotype were transplanted in a row of 4.0 m length by adopting a spacing of 20 cm between rows and 15 cm between plants within the row. Observations were recorded on five randomly selected plants without border effect in each genotype in each

Table 1. Analysis of variance (ANOVA) for yield and yield components in rice.

Source of variation	Degrees of freedom	Days to 50 per cent flowering	Days to maturity	Plant height	Number of tillers per plant	Productive tillers per plant	Panicle length	Number of grains per panicle	Number of ill-filled grains per panicle	Number of filled grains per panicle	1000 Seed weight	Harvest index	Grain yield/ plant
Replications	2	0.89	0.81	17.32	0.26	0.48	0.39	13.59	1.06	11.73	0.12	1.79	1.31
Varieties	24	120.06**	117.72**	137.71**	14.79**	13.94**	15.32**	5894.99**	19.52**	4802.74**	34.77**	65.73**	20.98**
Error	48	2.05	1.22	10.84	0.17	0.13	0.69	20.40	0.89	9.63	0.54	0.95	1.16

*, ** Significant at 0.05 and 0.01 levels, respectively.

replication and the average values were subjected for statistical analysis. Observations were recorded on plant basis for all characters, except days to 50 per cent flowering and days to maturity which were recorded on plot basis. The differences between 25 genotypes for different characters were tested for significance by using Analysis of Variance technique as proposed by Panse and Sukhatme (1961), genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV), heritability in broad sense (h^2) and genetic advance as per cent of mean were estimated by the formula as suggested by Burton and Devane (1952) and Johnson *et al.* (1955).

RESULTS AND DISCUSSION

The analysis of variance (ANOVA) revealed highly significant differences among all the twenty five varieties for all the characters (Table 1) indicating the existence of sufficient variation in the materials. The mean performance of rice varieties for different yield and yield components are presented in Table 2. The estimates of co-efficient of variation observed for yield and yield components were presented in Table 3. In general, the phenotypic co-efficient of variation was higher than the genotypic co-efficient of variation indicating the influence of environment towards the total variance. Similar results were recorded by Sharma and Dubey (1997); Mamata *et al.* (2007). The high estimates of variability were recorded for productive tillers per plant (GCV=24.30; PCV=24.64) followed by number of tillers per plant (GCV=23.64; PCV=24.04), number of grains per panicle (GCV=20.67; PCV=20.78), number of filled grains per panicle (GCV=20.57; PCV= 20.24) indicating the existence of wide genetic base among the varieties taken for the study and possibility of genetic improvement through selection for these traits. Therefore simple selection can be practiced for further improvement of these characters through rice breeding programmes. These results were in conformity with the findings of Yadav *et al.,* (2010), Tushara *et al.,* (2012) and Bekele *et al.,* (2013) for Productive tillers per plant. However, the moderate estimates of variation was recorded by grain yield per plant (GCV=12.95; PCV=14.04), number of ill-filled grains per panicle (GCV= 12.59;

Table 2. Mean performance of rice varieties for yield and yield components

Variety	Days to 50 per cent flowering	Days to maturity	Plant height (cm)	Number of tillers/ plant	Productive tillers/ plant	Panicle length (cm)	Number of grains/ panicle	Number of ill- filled grains/ panicle	Number of filled grains/ panicle	1000 Seed weight (g)	Harvest index (%)	Grain yield/ plant (g)
BPT 2295	129.33	158.33	114.07	8.27	8.13	25.27	241.20	28.53	212.67	14.54	35.93	19.96
BPT 3291	109.67	140.33	109.80	7.60	7.00	22.45	180.20	13.93	166.27	21.65	41.50	18.75
BPT 5204	112.33	143.33	93.20	8.80	8.20	20.53	218.94	22.47	196.47	14.37	43.76	18.14
JGL 384	102.33	137.33	104.33	11.43	11.27	25.57	191.24	21.77	169.47	18.17	44.10	18.56
JGL 1798	96.67	125.67	98.47	11.27	9.20	24.57	192.20	19.80	172.40	15.68	48.96	17.63
JGL 3855	109.67	140.33	101.60	9.93	9.67	23.20	193.73	22.93	170.80	13.93	39.97	18.58
JGL 11118	93.67	122.33	116.27	11.27	11.12	26.03	231.54	37.87	193.67	12.15	42.55	18.67
JGL 11470	112.33	143.67	105.07	7.87	7.33	23.07	281.37	19.47	261.87	14.99	45.31	20.13
JGL 11727	105.67	134.33	101.60	8.87	8.77	29.30	233.94	20.07	213.87	17.87	48.69	20.27
JGL 19621	98.67	127.33	108.13	10.07	10.02	28.40	233.30	24.67	208.63	15.54	47.63	21.85
NDLR 7	103.00	137.33	103.10	10.47	10.33	23.63	197.73	14.20	183.53	14.19	38.69	18.63
NDLR 8	103.67	137.33	87.13	10.00	9.37	22.13	223.86	17.53	206.33	11.69	37.50	19.82
NLR 145	110.33	142.67	118.20	9.33	8.13	23.63	185.07	23.87	161.20	21.10	48.21	18.93
NLR 3042	93.33	134.00	118.27	9.60	9.07	25.33	184.93	12.20	172.73	16.56	43.74	19.65
NLR 3083	110.00	138.33	114.20	8.47	8.33	25.77	242.80	13.47	229.33	20.34	40.25	20.51
NLR 34449	106.00	134.33	118.27	9.40	9.10	26.57	293.14	30.87	262.27	15.12	47.99	23.59
NLR 40024	89.67	117.67	116.33	7.40	6.87	25.37	219.07	17.47	201.60	25.22	40.50	21.87
RDR 992	101.33	136.67	111.03	9.80	9.33	25.43	171.07	12.67	158.40	17.86	32.86	18.32
RGL 2332	112.67	147.33	120.07	9.40	8.27	24.33	161.00	9.80	151.20	22.13	34.84	18.82
RGL 11414	109.00	143.67	124.53	9.47	8.47	25.63	182.53	14.73	167.80	22.63	35.93	19.54
RNR 2354	100.33	131.33	115.27	8.67	8.40	24.70	206.46	19.73	186.73	17.02	41.25	19.05
RNR 2458	105.33	134.67	108.20	8.33	8.18	25.30	225.74	22.87	202.87	18.18	40.09	19.37
RNR 6378	109.13	140.67	114.67	8.87	8.60	23.73	190.06	14.13	175.93	16.84	41.89	21.32
RNR 15038	98.33	126.33	113.53	9.93	8.73	26.37	220.40	21.40	199.00	16.58	43.60	22.21
RNR 15048	95.33	126.67	96.47	8.87	8.97	22.17	250.53	18.60	231.93	12.73	43.99	21.96
Mean	104.71	136.08	109.27	9.34	8.83	24.74	214.08	19.80	194.28	17.08	41.99	19.85
S.E.	0.83	0.64	1.90	0.24	0.21	0.48	2.61	0.54	1.79	0.43	0.56	0.62
C.D. (0.05)	2.35	1.81	5.41	0.68	0.60	1.37	7.45	1.54	5.12	1.21	1.61	1.76

Table 3. Estimates of variability and genetic parameters for yield and yield components in rice.

Character	Mean	Range		Variance		Co efficient of variation (%)		Heritability in broad sense (h^2_b)	Genetic advance (%)	Genetic Advance as per cent of mean
		Minimum	Maximum	Genotypic (Vg)	Phenotypic (Vp)	Genotypic (GCV)	Phenotypic (PCV)			
Days to 50 per cent flowering	104.71	89.67	129.33	39.34	41.39	5.99	6.14	95.05	12.60	12.03
Days to maturity	136.08	117.67	158.33	38.83	40.05	4.58	4.65	96.95	12.64	9.29
Plant height (cm)	109.27	87.13	124.53	42.29	53.13	5.95	6.67	79.60	11.95	10.94
Number of tillers/plant	9.34	7.40	11.43	4.87	5.04	23.64	24.04	96.63	4.47	47.86
Productive tillers/plant	8.83	6.87	11.27	4.60	4.73	24.30	24.64	97.25	4.36	49.36
Panicle length (cm)	24.74	20.53	29.30	4.88	5.57	8.93	9.54	87.60	4.26	17.21
Number of grains/panicle	214.08	161.00	293.14	1958.20	1978.60	20.67	20.78	98.97	90.69	42.36
Number of ill-filled grains/panicle	19.80	9.80	37.87	6.21	7.10	12.59	13.46	87.46	4.80	24.25
Number of filled grains/panicle	194.28	151.20	262.27	1597.70	1607.33	20.57	20.64	99.40	82.09	42.26
1000 Seed weight (g)	17.08	11.69	25.22	11.41	11.95	19.78	20.24	95.48	6.80	39.81
Harvest index (%)	41.99	32.86	48.96	21.59	22.54	11.07	11.31	95.79	9.37	22.31
Grain yield/plant (g)	19.85	17.63	23.59	6.61	7.77	12.95	14.04	85.06	4.88	24.60

PCV=13.46) and harvest index (GCV=11.07; PCV=11.31). In contrast, low estimates of co-efficient of variation were observed for panicle length (GCV=8.93; PCV=9.54), days to 50 per cent flowering (GCV=5.99; PCV=6.14), plant height (GCV=5.95; PCV=6.67) and days to maturity (GCV=4.58; PCV=4.65) indicating low range of variation found in these characters in the present experimental material thus offers little scope for further improvement of these characters. Similar findings were reported earlier by Krishnanaik *et al.* (2004), and Idris and Mohammed (2013).

Investigation, heritability in broad sense was calculated for all the characters under study and are presented in Table 3. High heritability coupled with high genetic advance as per cent mean were recorded for all the characters under study namely, number of filled grains per panicle (99.40 and 42.36) followed by number of grains per panicle (98.97 and 42.26), productive tillers per plant (97.25 and 49.36), days to maturity (96.95 and 9.29), number of tillers per plant (96.63 and 47.86), harvest index (95.79 and 22.31), 1000 seed weight (95.48 and 39.81), days to 50 per cent flowering (95.05 and 12.03), number of ill-filled grains per panicle (87.46 and 24.25), panicle length (87.60 and 17.21), grain yield per plant (85.06 and 24.60) and plant height (79.60 and 10.94) indicating the least influence of environment on these characters.

The efficacy of selection not only depends on the magnitude of variability present in the genotypes but also on the extent of heritability of the desirable character. Johnson *et al.* (1955) suggested that, high heritability coupled with high genetic advance as per cent mean will give better picture for the selection of the genotypes. Thus heritability values coupled with high genetic advance as per cent mean would be more reliable and useful in predicting the genetic gain under selection than heritability estimates alone.

From the foregoing selection, it may be concluded that the traits, namely, productive tillers per plant followed by number of tillers per plant, number of grains per panicle, number of filled grains per panicle, and hence, indicates the preponderance of additive gene action and such characters could be improved through selection. Similar results were also reported by Manojkumarprajapati *et al.* (2011) and Selvaraj *et al.* (2011).

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