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ESTIMATION OF GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE IN "NEW PLANT TYPE" TROPICAL JAPONICA RICE UNDER UPLAND ENVIRONMENT

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ABSTRACT

Estimation of genetic variability, heritability and genetic advance were studied for twelve characters in thirty nine "New Plant Type" Tropical Japonica rice lines received from International Rice Research Institute, (IRRI), Los Banos, Philippines, with three check varieties at Crop Research Centre of G.B. Pant University of Agriculture and Technology, Pantnagar under upland conditions, during wet season 2000. The genotypes showed wide range of variation for all the characters. High coefficients of variation were observed for grain yield per plant followed by harvest index and biological yield per plant. High value of heritability coupled with high-expected genetic advance were observed for the characters grain yield/plant, harvest index and biological yield per plant. Hence selection should be based on these traits.

Rice breeding strategy involves assembling or generating variable germplasm and selection of superior genotypes from the germplasm for utilizing them in hybridization programme to develop a superior variety. In all these stages estimation of genetic variability, heritability and genetic advance is necessary. Yield is a complex character being governed by a large number of cumulative, duplicate and dominant genes and highly influenced by environment. This necessitates a thorough knowledge of variability owing to genetic factors, actual genetic variation heritable in the progeny and the genetic advance that can be achieved through selection. The aim of this study was to estimate the magnitude of phenotypic and genotypic coefficients of variation, heritability and genetic advance to select superior genotypes among the 39 "New Plant Type" tropical japonica lines belonging to *Oryza sativa* L. group.

The experimental material comprised 39 "New Plant Type" Tropical Japonica lines and 3 check varieties. These lines were received from International Rice Research Institute (IRRI), Los Banos, Philippines and maintained at G.B. Pant University of Agriculture and Technology, Pantnagar. The experiment was laid out in a randomized block design with three replications during *kharif* season 2000. 10 g m^{-2} seeds were taken for direct sowing. Each plot had two rows of two meter length with an inter and intra row spacing of 20 x 15 cm respectively. The normal cultivar practices (120 N: 60 P: 40 K kg/ha) and crop protection practices were followed to raise healthy crop. Except for days to 50% flowering which was recorded on whole plot basis, other characters i.e. plant height (cm), number of tillers per plant, panicle number per plant, panicle length (cm), length of flag leaf (cm), width of flag leaf (cm), grain number per panicle, 1000-grain weight (g), biological yield per plant (g), harvest index (%) and grain yield per plant (g) were recorded on the basis of five randomly taken competitive plants. The mean values were subjected to analysis of variance and phenotypic and genotypic coefficients of variation, heritability and genetic advance were calculated by following formulae suggested by Burton (1952), Singh and Chaudhary (1979) and Allard (1960) respectively.

The standard error of mean for all the

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Table 1. ANOVA for various characters (R.B.D.) under upland environment

Source of variation	d.f.	Days to 50% flowering (No.)	Plant height (cm)	Number of tiller per plant (No.)	Panicle number per plant (No.)	Panicle length (cm)	Length of flag leaf (cm)	Width of flag leaf (cm)	Grain number per panicle (No.)	1000-grain weight (g)	Biological yield per plant (g)	Harvest index (%)	Grain yield per plant (g)
Replication	2.0	37.3035	48.6755	0.7245	0.6521	27.5859	100.6313	0.2860	291.8601	0.4616	1.0636	0.0005	0.1969
Treatment	41.00	320.4167**	77.5111**	2.4620**	2.4622**	9.1693**	30.3718**	0.1683**	700.5193**	48.7543**	175.7135**	0.0376**	49.1875**
Error	82.00	25.3909	17.4649	0.3636	0.3581	1.7454	5.9917	0.0244	105.8977	1.3130	1.8750	0.0003	0.7844
CV (%)	-	5.6017	5.0875	12.6332	13.0197	5.7384	8.3807	8.6243	12.4066	4.9326	5.5627	5.6340	10.3050
CD (1%)	-	10.8505	8.9990	1.2984	1.2887	2.8449	5.2709	0.3363	22.1593	2.4675	2.9486	0.0420	1.9071
CD (5%)	-	8.1847	6.7881	0.9794	0.9721	2.1459	3.9759	0.2537	16.7151	1.8612	2.2242	0.0317	1.4385

** Significant at 1% level.

Table 2. Range, mean coefficient of variation, heritability and genetic advance for various characters under upland environment

Characters	Range	Mean	SEM ±	GCV	PCV	ECV	Heritability (%)	Expected genetic advance	Genetic advances % of mean
Days to 50% flowering	73.33-115.00	89.95	2.90	11.02	12.36	5.60	79.47	18.21	20.24
Plant height	69.33-92.27	82.14	2.41	5.44	7.45	5.08	53.40	6.73	8.07
Number of tiller per plant	3.53-7.40	4.77	0.34	17.52	21.60	12.63	65.79	1.39	29.14
Panicle number per plant	3.38-7.23	4.59	0.34	18.21	22.39	13.01	66.19	1.40	30.50
Panicle length	18.28-26.26	23.02	0.76	6.83	8.92	5.73	58.63	2.48	10.77
Length of flag leaf	22.51-36.33	29.20	1.41	9.76	12.86	8.38	57.56	4.45	15.23
Width of flag leaf	1.45-2.66	1.81	0.09	12.09	14.85	8.62	66.29	0.36	19.88
Grain number per panicle	52.66-127.33	82.94	5.94	16.97	21.02	12.40	65.17	23.41	28.22
1000-grain weight	15.38-35.33	23.23	0.66	17.11	17.81	4.93	92.33	7.87	33.87
Biological yield per plant	13.16-51.33	24.61	0.79	30.92	31.41	5.56	96.86	15.43	62.69
Harvest index	0.17-0.59	0.34	0.011	32.16	32.65	5.63	97.02	0.22	64.70
Grain yield per plant	3.59-20.38	8.59	0.511	46.73	47.85	10.30	95.36	8.08	94.06

characters under study were less except for grain number/panicle and days to 50% flowering, which indicated a least role of environment for expression of these traits except grain number per panicle and days to 50% flowering (Table 1).

The analysis of variance revealed the presence of high genetic variability (Table 1). Estimate of genotypic and phenotypic variances revealed that grain yield/plant exhibited highest phenotypic and genotypic coefficients of variation followed by harvest index and biological yield per plant (Table 2). These results are in confirmation of earlier findings of Balan *et al.* (1998).

The phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were of near about the same magnitude for all the traits indicating the least effects of environmental factors. Genetic coefficients of variability along with heritability gives an idea of expected genetic advance from selection (Burton, 1952). The character which exhibited high heritability and genetic advance indicates the broad minance of additive gene effects in its inheritance and such characters could be improved by selection (Panse, 1957).

In the present study, days to 50% flowering, and 1000-grain weight although had high heritability values but exhibited less expected genetic advance, suggesting preponderance of non-additive gene action in the inheritance of these traits. Similar results were also reported earlier by Sawant and Patil (1995).

Plant height had low heritability with low expected genetic advance suggesting largely non-additive gene action responsible for expression of this character. This result was in confirmation with earlier findings of Patil *et al.* (1993).

High heritability coupled with high expected genetic advance were observed for grain yield per plant followed by harvest index and biological yield per plant. The high heritability with high expected genetic advance observed for these traits might be due to additive gene effects. Saini *et al.* (2001) and Dey and Sarkar (2001) also reported similar results.

Therefore selection should be based on the characters grain yield per plant, harvest index and biological yield per plant having high heritability coupled with high genetic advance which may leads to desired improvement in yield.

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