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"Heritability and Genetic Advance for Yield and Yield Attributes in Rice (*Oryza sativa* L.)"

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ABSTRACT: *An investigation was carried out on forty rice genotypes during Kharif, 2011 at the experimental fields of Department of Genetics and Plant Breeding, SHIATS, Allahabad in Randomized Block Design with three replications to analyze the variability, heritability and genetic advance for 13 characters. A close perusal of variability coefficients revealed that the differences between PCV and GCV were small indicating little influence of environment on the expression of the characters. High to moderate estimates of GCV and PCV were recorded for number of panicles per hill followed by biological yield per hill, grain yield per hill, number of spikelets per panicle and flag leaf length. High estimates of heritability were observed for biological yield per hill, grain yield per hill, number of spikelets per panicle and days to 50 percent flowering which suggested that these traits would respond to selection owing to their high genetic variability and transmissibility. High estimates of heritability along with moderate to low estimates of genetic advance were observed for biological yield per hill, grain yield per hill, number of spikelets per panicle and days to 50 percent flowering.*

Keywords: *Rice genotypes, variability, heritability (broad sense) and genetic advance.*

INTRODUCTION

Rice (Oryza sativa L.) is the most important cereal crop of the world and about 90 per cent of the people of India as staple food. According to FAO, the productivity level of rice in India is very low (3. 21 t/ ha) as compared to the average productivity of the china (6.35 t/ha) and world (4.15 t/ha). The low productivity in India is due to non-availability of high yielding varieties. Development of high yielding varieties requires the knowledge of existing genetic variability. The genetic reconstruction of plant as required for developing high yielding varieties by incorporating and improving the characters. The available germplasm serves as the most valuable natural reservoir in providing the needed attributes (Hawkes, 1981). The success of any crop breeding depends on the nature and amount of variability existing in the germplasm collection.

Heritability is a measure of the phenotypic variance attributable to genetic causes and has predictive function in plant breeding. It provides information on the extent to which a particular morphogenetic character can be transmitted to successive generations. Knowledge of heritability influences the choice of selection procedures used by the plant breeder to decide which selection methods would be most useful to improve the character, to predict gain from selection and to determine the relative importance of genetic effects. The most important function of heritability in genetic studies of quantitative characters is its predictive role to indicate the reliability of phenotypic value as a guide to breeding value. Characters with high heritability can easily be fixed with simple selection resulting in quick progress. However, it has been accentuated that heritability values would not be of practical importance to make sufficient improvement through selection in advanced generations without genetic advance. The usefulness of heritability however increases not only with genetic advance estimates which show the degree of gain obtained in a character under a particular selection pressure, but also change

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in mean values between generations. High genetic advance coupled with high heritability estimates offers the most suitable condition for selection. Falconer (1996) reported the limitation of estimating heritability in narrow sense, as it included both additive and epistatic gene effects, and thereby suggested that heritability estimates in the broad sense will be reliable if accompanied by a high genetic advancement. With the above background information, the present investigation was undertaken to study the genetic parameters among the forty rice genotypes.

MATERIALS AND METHODS

The experiment was conducted in *Kharif*, 2011 at Field Experimentation Centre, Department of Genetics and Plant Breeding, SHIATS, Allahabad. A randomized block design was adopted with three replications adopting a spacing of 30 cm between rows and 25 cm between plants. All the recommended package of practices was followed to raise the crop uniformly. Biometrical observations were recorded from 10 randomly selected plants in each replication for plant height, number of tillers per hill, number of panicles per hill, panicle length, number of spikelets per panicle, flag leaf length, flag leaf width, test weight, biological yield per hill, harvest index and grain yield per hill. Days to 50 percent flowering and days to maturity were recorded on plot basis. The analysis of variance was done as suggested by Panse and Sukhatme (1967). Variability for different characters was estimated by Burton and De Vane (1953). Heritability and expected genetic advance was calculated according to Hanson *et al.* (1956) and Johnson *et al.* (1955) respectively.

RESULTS AND DISCUSSION

The mean sum of square due to genotypes (table 1) revealed significant differences for all the 13 quantitative characters, which indicates the presence of sufficient genetic variability among the genotypes. Thus, reveal ample scope for selection for different quantitative characters for rice improvement. These findings are in accordance with Sarkar (2006). In the present investigation, a wide range of phenotypic coefficient of variance (PCV) was observed for different traits. It ranged from 3.70 (days to maturity) to 18.61 (number of panicles per hill). Genotypic coefficient of variance (GCV) varied from 3.26 (days to maturity) to 16.24 (biological yield per hill). Environmental coefficient of variance (ECV) varied from 1.22 (days to 50 per cent flowering) to 13.31 (number of panicle per hill). PCV values were higher than GCV values for different characters and the difference between PCV and GCV values is small which indicates lesser role of environment on the expression of various quantitative characters, also reported by Sabesan *et al.* (2009). The genotypic coefficient of variance is most important and useful in the measurement of range and genetic variability for a specific character. It also provides a means to compare the genetic variability for the quantitative traits. In the present investigation, the higher genotypic coefficient of variation accompanied with higher phenotypic coefficient of variation for number of spikelets per panicle and grain yield per hill suggest enough genetic variability present among 40 rice genotypes.

Heritability plays an important role in deciding the stability and strategy for selection of a character. Heritability estimates (table 2) revealed that character like biological yield per hill (99.00 percent) exhibited highest heritability followed by grain yield per hill (94.00 percent), number of spikelets per panicle (92.00 percent) and plant height (89.00 percent) as also reported by Mohammad *et al.* (2002). A perusal of genetic advance for different traits revealed that it varied from 0.41 (flag leaf width) to 49.94 (number of spikelets per panicle). Estimates of genetic advance revealed that character number of spikelets per panicle (49.94) exhibited highest genetic advance followed by biological yield per hill (22.62) and plant height (19.63).The present findings find support from the study of Karthikeyan *et al.* (2009).

Shift in gene frequency towards superior side under selection pressure is termed as genetic advance. Johnson *et al.* (1955) suggested that estimates of heritability and genetic advance should be considered together for more reliable conclusions. High estimates of heritability coupled with moderate to low values of genetic advance (table 2) as percent of mean was observed on biological yield per hill (99.00 and33.20), grain yield per hill (94.00 and 29.65), number of spikelets per panicle (92.00 and 25.57), days to 50 percent flowering (90.00 and 7.10) and plant height (89.00 and 17.30) respectively suggesting that there was preponderance of additive gene action for the expression of these characters. These observations find support from Ragvendra *et al.* (2011).

The present study concludes that high estimates of heritability coupled with moderate values of genetic advance as percent of mean was observed for biological yield per hill, grain yield per hill, number of spikelets per panicle, days to 50 per cent flowering

Table 1
Analysis of Variance for thirteen Quantitative Characters in Rice

S.No.	Characters	Replications	Genotypes	Error
	Degree of freedom	2	39	78
1.	Days to 50% flowering	4.23	37.56**	1.35
2.	Plant height (cm)	24.62	319.13**	12.74
3.	Flag leaf length (cm)	19.18	59.07**	11.20
4.	Flag leaf width (cm)	0.03	0.149**	0.0092
5.	Tillers/hill	1.57	9.96**	2.13
6.	Panicle/hill	3.30	8.20**	2.12
7.	Panicle length (cm)	1.27	14.64**	1.55
8.	Days to maturity	1.85	50.22**	4.38
9.	Spikelets/panicle	34.05	1984.26**	58.96
10.	Biological yield/hill (g)	0.77	368.66**	1.79
11	Harvest Index (%)	0.94	39.53**	2.10
12.	Test weight (g)	0.86	10.98**	0.94
13.	Grain yield/hill (g)	0.16	60.27**	1.34

* Significant at 5% level and ** Significant at 1% level

Table 2
Estimation of Components and Genetic Parameters for Different Quantitative Characters in Rice

Character	ECV	GCV	PCV	h^2 (%)	G.A	G.A (% mean)
Days to 50% flowering	1.22	3.64	3.83	90.0	6.79	7.10
Plant height	3.15	8.91	9.46	89.0	19.63	17.30
Flag leaf length	9.45	11.27	14.71	59.0	6.31	17.80
Flag leaf width	6.64	14.94	16.35	84.0	0.41	28.13
Tillers/ hill	11.68	12.93	17.43	55.0	2.47	19.77
Panicles/ hill	13.31	13.01	18.61	49.0	2.05	18.74
Panicle length	4.74	7.94	9.25	74.0	3.70	14.05
Days to maturity	1.75	3.26	3.70	78.0	7.10	5.92
Spikelets/ panicle	9.93	12.97	13.55	92.0	49.94	25.57
Biological yield/hill	1.96	16.24	16.35	99.0	22.62	33.20
Harvest index	2.29	8.02	8.67	86.0	6.73	15.28
Test weight	4.50	8.48	9.60	78.0	3.33	15.43
Grain yield/hill	3.90	14.88	15.38	94.0	8.83	29.65

and plant height indicate that the selection of these characters can bring enhancement in rice production and productivity.

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