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Genetic Variability and Selection Criteria in Fine Rice (*Oryza sativa* L.)

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Abstract: Eight fine rice genotypes were studied to observe genetic variability and selection criteria for some yield contributing characters through correlation and path coefficient analysis. 1000 grain weight, number of effective tillers/plant, number of fertile grains/panicle and yield/plant showed high genotypic coefficient of variation and high heritability along with high genetic advance in percentage of mean, pointed out their importance for achieving genetic gain through selection. Correlation coefficient study revealed high positive correlation of grain yield with effective tillers/plant, fertile grains/panicle and 1000-grain weight. A significant negative correlation was obtained between grain yield and plant height. Path coefficient analysis revealed maximum contribution of fertile grains/panicle to grain yield.

Key words: Fine rice, *Oryza sativa*, variability, selection, correlation, path analysis

Introduction

Rice (*Oryza sativa* L.) has from time immemorial; been synonymous with life in the land that is now Bangladesh. It was in ancient times and still is the staple food of Bangladeshi people. Varieties having fine grain and aroma add to the quality of rice. Bangladesh has to import fine rice every year with the cost of formidable amount of foreign currency. Thus there is a need to enhance the productivity of fine rice varieties because it has some special preferences and also premium market price.

Yield is a complex character and various morphological and physiological characters contribute to grain yield. These yield contributing characters are interrelated showing a complex chain of relationship on grain yield. Many plant characters of economic value are highly influenced by environmental conditions; the progress of breeding in such population is primarily conditioned by the magnitude and nature of variation and interrelationship of plant characters (Gandhi *et al.*, 1964). Practice of unilateral selection could not fulfill the optimum demand for improvement. Information on correlation coefficient between yield and yield contributing characters has always been helpful as a basis for selection in a breeding programme. Path coefficient analysis partitions the components of correlation coefficient into direct and indirect effect and visualize the relationship in a more meaningful way. Little attention has been paid so far in Bangladesh to improve the yield status of fine rice varieties. Therefore, the present study was undertaken to find the genetic variability, character association and contribution of yield contributing characters on grain yield and thereby to establish appropriate plant attributes for selection to improve the yield status of fine rice varieties in Bangladesh.

Materials and Methods

The study was conducted in the field laboratory of Department of Genetics and Plant Breeding, Bangladesh Agricultural University, Mymensingh, Bangladesh in rainfed conditions of 1997. Eight fine rice genotypes were grown in a Randomized complete block design with 3 replications. The unit plot size was 4 x 2.5 m^2 maintaining a spacing of 25 cm from row to row and 15 cm from plant to plant. Thirty days old seedlings were transplanted with 2-3 seedlings/hill. Urea, Triple super phosphate (TSP) and Muriate of potash (MP) were applied @ 100, 90 and 70 kg/ha. One third of urea and the entire TSP and MP were applied during the final land preparation. Remaining urea was applied in two splits, one at 21 days after transplanting and the other before panicle initiation. Data were recorded on days to flowering, days to maturity, plant height (cm), number of effective tillers/plant, panicle length (cm), number of fertile grains/panicle, 1000 grain weight (gm) and yield/plant (gm). Ten plants were randomly selected for data recording and mean values were used for different statistical analysis.

Genotypic variance (σ^2_g), phenotypic variance (σ^2_p), genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were estimated according to Singh and Chaudhury (1985). Broad sense heritability (h^2_b) and genetic advance (GA) in percentage of mean were calculated according to Johnson *et al.* (1955). Genotypic (r_g) and phenotypic (r_p) correlation coefficients were estimated by the formula of Miller *et al.* (1958). Path coefficient analysis was done according to Dewey and Lu (1959).

Results and Discussion

Genetic variability: Genotypic (σ^2_g), phenotypic (σ^2_p) and environmental (σ^2_e) variances, genotypic coefficients of variation (GCV), phenotypic coefficient of variation (PCV), heritability in broad sense (h^2_b), genetic advance (% of mean) for the characters under study are presented in Table 1.

GCV ranged from 3.23 to 20.81, whereas PCV ranged from 3.25 to 21.29. Among the studied characters, highest GCV was obtained in 1000 grain weight followed by number of fertile grains/panicle, number of effective tillers/plant and yield/plant. Among them, 1000 grain weight, number of effective tillers/plant and number of fertile grains/panicle showed more than 15% variation at phenotypic level (PCV). Hemareddy *et al.* (1994) and Chookar *et al.* (1994) also reported similar results while studying genetic variability for grain yield and its component characters in 81 and 73 genotypes of rice respectively.

Heritability estimates in broad sense (h^2_b) were relatively higher for almost all the characters studied. Although high heritability estimates have been found to be helpful in making selection of superior genotypes on the basis of phenotypic performance. Johnson *et al.* (1955) suggested that heritability estimates along with genetic advance (% of mean) were more useful in predicting the effect of selecting the best individual. High heritability along with high genetic advance (% of mean) was recorded for 1000 grain weight, number of fertile grains/panicle, yield/plant and number of effective tillers/plant. Jangale *et al.* (1985) also reported similar results, while studying variability, heritability and genetic advance for some quantitative traits in upland rice. The characters with high value of GCV and heritability accompanied by high genetic

Table 1: Genetic parameters for yield and yield contributing characters of eight fine rice genotypes

Characters	σ^2_g	σ^2_p	σ^2_e	GCV (%)	PCV (%)	h^2_b (%)	GA (% of mean)
Days to flowering	27.327	1.256	28.583	4.83	4.94	95.60	9.72
Days to maturity	23.899	0.280	24.179	3.23	3.25	98.84	6.61
Plant height	110.781	6.778	117.559	7.75	7.98	94.23	15.50
No. of effective tillers/plant	1.815	0.567	2.382	13.31	15.25	76.19	23.93
Panicle length	0.582	0.142	0.724	3.37	3.76	80.39	6.23
No. of fertile grains/panicle	558.905	31.232	590.136	17.51	17.99	94.71	35.10
1000 grain weight	6.922	0.324	7.246	20.81	21.29	95.53	41.82
Yield/plant	1.748	0.311	2.059	12.06	13.08	84.90	22.89

Table 2: Genotypic (upper value) and phenotypic (lower value) correlation coefficient among different characters in eight fine rice genotypes

Characters		Days to flowering	Days to maturity	Plant height	No of effective tillers/ plant	Panicle length	No of fertile grains/ panicle	1000 grain weight	Yield / plant
Days to flowering	G	1.00	0.280	-0.256	0.095	-0.182	0.550	-0.291	0.317
	P		0.270	-0.243	0.047	-0.153	0.503	-0.287	0.311
Days to maturity	G		1.00	0.172	0.596	0.352	0.131	0.268	0.148
	P			0.170	0.538	0.290	0.132	0.261	0.146
Plant height	G			1.00	-0.405	0.789*	-0.173	-0.416	-0.766*
	P				-0.331	0.693	-0.125	-0.381	-0.660
No. of effective	G				1.00	0.087	0.388	0.292	0.569
tillers/plant	P					0.021	0.329	0.258	0.486
Panicle length	G					1.00	0.062	0.059	-0.318
	P						0.065	0.009	-0.197
No. of fertile	G						1.00	-0.527	0.497
grains/panicle	P							-0.477	0.430
1000 grain weight	G							1.00	0.488
	P								0.440
Yield/plant	G								1.00
	P								

* Significant at 5 % level

Table 3: Directs and indirect effects of yield components on grain yield in eight fine rice genotypes

Characters	Days to flowering	Days to maturity	Plant height	No of effective tillers/ plant	Panicle length	No of fertile grains/ panicle	1000 grain weight	Correlation with grain yield
Days to flowering	**-0.3539**	0.1383	0.3021	-0.0604	-0.0648	0.4635	-0.1078	0.317
Days to maturity	-0.0991	**0.494**	-0.203	-0.3789	0.12528	0.1104	0.0993	0.148
Plant height	0.0906	0.085	**-1.18**	0.2575	0.28082	-0.1458	-0.1541	-0.766
No. of effective tillers/plant	-0.0336	0.2944	0.4779	**-0.6358**	0.03096	0.3269	0.1082	0.569
Panicle length	0.0644	0.1739	-0.931	-0.0553	**0.35592**	0.0522	0.0219	-0.318
No. of fertile grains/panicle	-0.1946	0.0647	0.2041	-0.2467	0.02207	**0.8426**	-0.1952	0.497
1000 grain weight	0.103	0.1324	0.4909	-0.1857	0.021	-0.4441	**0.3705**	0.488

Residual effect = 0.1028, bold values are direct effects

advance (% of mean) indicating that they might be transmitted to their hybrid progenies and therefore phenotypic selection based on these characters would be effective.

Character association: The genotypic and phenotypic correlation coefficients between yield and yield contributing characters are presented in Table 2. In general, genotypic correlation coefficients were higher than their corresponding phenotypic correlation coefficients indicating a fairly strong inherent relationship among the traits. The lower estimates of phenotypic correlation coefficients indicated that the relationships were affected by environment at phenotypic level. Such environmental influence in reducing the correlation coefficients in rice was also reported by Chaubey and Singh (1994).

Results of correlation coefficients at genotypic and phenotypic levels showed that grain yield was positively correlated with days to flowering, days to maturity, number of effective tillers/plant, no. of fertile grains/panicle and 1000 grain weight and negatively correlated with plant height and panicle length. Among them, grain yield was negatively and significantly correlated with plant height at genotypic level, which indicates that the higher plant height caused the plant to produce lower yield. Amirthadevarathinam (1983) studied correlation coefficients between grain yield and its component characters in some rice genotypes and reported significant negative correlation between grain yield and plant height. Number of effective tillers/plant showed the highest positive correlation coefficients with grain yield followed by number of fertile grains/panicle and 1000 grain weight with grain yield. Yolanda and Das (1995) found similar results. The association between plant height and panicle length was found significantly positive at genotypic level, indicating that higher panicle length could be found while selection is made in favour of higher plant height, which is in full support with the findings of Chaubey and Singh (1994) and Mirza *et al.* (1992).

Path - coefficient analysis: Path-coefficient analysis (Table 3) revealed that the number of fertile grains/panicle had the highest positive direct effect on grain yield followed by days to maturity, 1000 grain weight and panicle length. Among them, fertile grains per panicle had higher positive direct effect than it's positive correlation coefficient with yield, indicating that selection based on this character would be effective. Although days to maturity had high positive direct effect on yield but it's indirect effect through some other characters were negative which consequently reduced the correlation coefficient of days to maturity with yield. Whereas, number of effective tillers/plant had high negative direct effect on grain yield, but the indirect effects through plant height was

relatively higher in comparison with most of the indirect effects of different characters on grain yield and also indirect effects of effective tillers/plant on grain yield through number of fertile grains per panicle, days to maturity, 1000 grain weight and panicle length were positive, which resulted high positive correlation coefficient with grain yield and effective tillers/plant. This result indicates that for increasing effective tillers/plant, other causal factors must be considered simultaneously. Plant height had the highest negative direct effect (-1.18) on grain yield. Highest positive indirect effect on yield was found with 1000 grain weight through plant height and negatively with panicle length through plant height. The correlation and path coefficient study revealed that shorter plant, higher number of effective tillers/plant, adequate number of fertile grains/panicle and heavy grains are the important characters, which should be considered while selection to be made for higher yield in fine rice genotypes. Saha *et al.* (1989) also pointed out the importance of those traits as the basis for selection in rice.

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