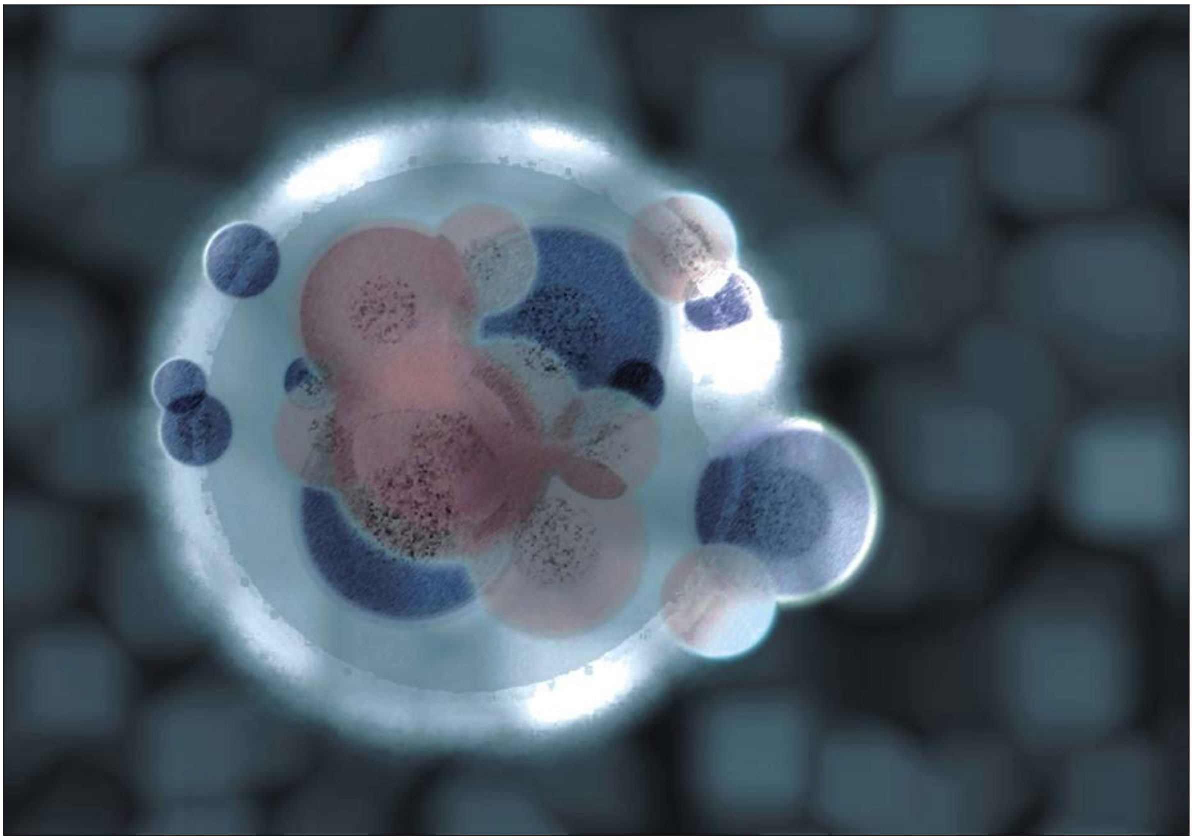

Journal of Biological Sciences

ISSN 1727-3048

Journal of Biological Sciences 5 (3): 315-318, 2005
ISSN 1727-3048

Genetic Analysis and Morpho-physiological Selection Criteria for Traditional Biroin Bangladesh Rice Germplasms

S.H. Habib, M.K. Bashar, M. Khalequzzaman, M.S. Ahmed and E.S.M.H. Rashid
Genetic Resources and Seed Division, Bangladesh Rice Research Institute, Gazipur-1701, Bangladesh

Abstract: Ten local biroin rice varieties were evaluated with a view to find out variability and genetic association for grain yield and its component characters. All the characters tested were showed significant variation among the varieties. The highest genetic variability was obtained in flag leaf area and filled grains/panicle. High heritability associated with high genetic advance was observed in filled grains/panicle, 1000-grain weight flag leaf area, harvest index and grain yield. Genotypic correlation coefficients were higher than the corresponding phenotypic correlation coefficients in most of the cases. Plant height, days to maturity and filled grains/panicle showed significant positive correlation with grain yield. Path analysis revealed that plant height, days to maturity, 1000-grain weight and chlorophyll content had positive and highest direct effect on grain yields. Moreover, panicle length had highest indirect effect on grain yield through plant height and filled grains/panicle had positive and higher indirect effect on grain yield through days to maturity, panicles per hill and panicle length.

Key words: Correlation, path analysis, yield and rice (*Oryza sativa* L.)

INTRODUCTION

Crop improvement programmes depend on utilization of germplasm stocks. The gene bank of Bangladesh Rice Research Institute contains more than eight thousands rice germplasms, among which biroin rice are important types of genotypes possessing some special qualities like good palatability, desirable amylose content etc. But these rice genotypes are traditional and low yielder. Therefore, the yield performances of these genotypes need to be improved. For successful utilization of biroin genotypes in the yield improvement breeding programmes, selection criteria of these genotypes need to be found out.

Grain yield in rice is a quantitative polygenic character and highly influenced by environment. Consequently, direct selection for grain yield is often misleading. Moreover, grain yield depends on a number of yield contributing characters. So, yield along with corresponding yield components should be considered in determining the selection criteria of germplasms. The success of breeding programmes also depend upon the amount of genetic variability present in the population and the extent to which the desirable traits are heritable.

Analysis on genetic parameters and selection criteria of modern rice have been worked out by a number of investigators[1-4]. But genetic analysis and selection criteria of traditional rice germplasms particularly of biroin rice germplasms are very scanty. Therefore, an attempt has been undertaken in order to find out genetic variability, character associations and selection criteria for yield and yield components in traditional biroin Bangladesh rice germplasms.

MATERIALS AND METHODS

The experiment was conducted at Bangladesh Rice Research Institute, Joydevpur, Gazipur during T. Aman season in 2003. The trial consisted of 10 local biroin rice varieties collected from Sylhet and greater Mymensingh region of Bangladesh. The trial was set in a Randomized Complete Block Design (RCBD) with three replications. Thirty-five days old seedlings grown in wet seedbed were transplanted in 3.4x2.4 m^2 plots with a spacing of 20x20 cm, using two seedlings per hill. Fertilizers were applied @ 60:40:40 kg NPK ha^{-1}. All other recommended nutrients were applied except nitrogen at final land preparation. Nitrogen was applied in three equal splits, at 15 Days after Transplanting (DAT), 45 DAT and just before panicle initiation. Intercultural operations and pest control measures were employed as and when necessary during whole growing period. At maturity, grain yield was taken excluding border area and yield was adjusted at 14% moisture level.

Corresponding Author: S.H. Habib, Scientific Officer, Genetic Resources and Seed Division, Bangladesh Rice Research Institute, Gazipur-1701, Bangladesh E-mail: kiftekhar@bdonline.com

Yield along with Plant Height in cm (PH), Days to Maturity (DM), Panicle Length (PL), Panicles/hill (PN), Filled Grains/panicle (FG), 1000-Grain Weight (GW), Flag Leaf Area (FLA), Harvest Index (HI), Chlorophyll Content (CHL) and Grain Yield (GY) g plant^{-1} were recorded and used in the analysis. Genetic variance (σ^2 g), environmental variance (σ^2 e), phenotypic variance (σ^2p), Genotypic Coefficient of Variation (GCV), Phenotypic Coefficient of Variation (PCV), Heritability in Broad sense (Hb), Genetic Advance in Percentage of Mean (GAPM), genotypic correlation coefficients (r_g) and phenotypic correlation coefficients (r_p) and path coefficient analysis were performed following Singh and Chaudhury[5]. The estimate of GCV and PCV were classified as low, medium and high[6]. The heritability was categorized as suggested by Robinson *et al.*[7]. Again, genetic advance was classified by adopting the method of Johnson *et al.*[8].

RESULTS AND DISCUSSION

Genetic parameters: The analysis of variance of the present study indicated highly significant variations among the varieties for all the characters studied (Table 1). In order to obtain a clear understanding of the pattern of variations, the phenotypic variance has been partitioned into genotypic and environmental variance. The highest genotypic, environmental and phenotypic variance was found in flag leaf area followed by filled grains/panicle. The lowest magnitude of genotypic, environmental and phenotypic variance was recorded in harvest index.

The extent of variability for any character is very important for the improvement of a crop through breeding. The variability of the characters was measured by range, GCV and PCV. PCV were slightly higher than GCV in case of plant height, days to maturity, panicle length, 1000-grain weight and chlorophyll content indicating presence of environmental influence to some degrees in the phenotypic expression of the characters. Biswas *et al.*[2] reported similar result for plant height, panicle length and 1000-grain weight and Iftekharuddaula *et al.*[3] for plant height, days to maturity and 1000-grain weight. On the other hand, panicles/hill, filled grains/panicle, flag leaf area, harvest index and grain yield showed PCV considerably higher than GCV which indicated marked influence of environment on the expression of these characters. Iftekharuddaula *et al.*[3] also reported higher PCV than GCV for panicles/m^2, grains/panicle and yield per plant.

High GCV and PCV were recorded for filled grains/panicle and grain yield but it was moderate for panicles/hill, 1000-grain weight, flag leaf area and harvest index. The findings were mostly supported by Saravanan and Senthil[9] who observed high GCV and PCV for grains/panicle and grain yield but moderate for 1000-grain weight in rice. Plant height, days to maturity, panicle length and chlorophyll content exhibited low genotypic as well as phenotypic coefficient of variation in the present study, which may be due to presence of both positive and negative alleles in the population.

High heritability was observed in plant height, days to maturity, panicle length, filled grains/panicle, 1000-grain weight, flag leaf area, harvest index, chlorophyll content and grain yield while moderate value of the parameter in panicles/hill. Iftekharuddaula *et al.*[3] reported high heritability for plant height, days to maturity, grains/panicle, 1000-grain weight and harvest index and moderate for panicles/m^2. Although high heritability estimates have been found to be effective in the selection of superior genotypes on the basis of phenotypic performance. Johnson *et al.*[8] suggested that heritability estimates along with genetic advance will be more useful in predicting the effect for selecting the best individual. High heritability associated with high genetic advance was obtained in filled grains/panicle, 1000-grain weigh, flag leaf area, harvest index and grain yield. Das *et al.*[10] also reported similar findings for grains/panicle, 1000-grain weight and grain yield and Kumar *et al.*[1] reported for flag leaf length, 1000-grain weight, spikelet sterility and grain yield in rice. The high heritability estimates along with low genetic advance indicates that non-additive type of gene action and genotype-environment interaction plays a significant role in the expression of the traits as observed in plant height, days to maturity, panicle length, panicles/hill and chlorophyll content in the present study. Filled grains/panicle, 1000-grain weight, flag leaf area, harvest index and grain yield had high heritability with high genetic advance making these five characters most effective in the selection of local rice varieties. High GCV, PCV, heritability and GA% mean of filled grains/panicle and grain yield suggested that these two characters could be transmitted to the hybrid progenies and phenotypic selection based on these characters would be effective.

Correlations: In most of the cases, genotypic correlation coefficients were higher than the corresponding phenotypic correlation coefficient values indicating suppressing effect of the environment, which modified the phenotypic expression of these characters by reducing phenotypic coefficient values (Table 2). Accordingly, Bai *et al.*[11] reported that the genotypic correlations were greater than the phenotypic values in medium duration rice varieties.

From the study, grain yield was found positively and significantly associated with plant height, days to maturity and filled grains/panicle at both genotypic and phenotypic levels. Similar association in rice were also

Table 1: Estimate of genetic parameters for 10 characters in biroin rice varieties

Characters	Range	MS	σ^2g	σ^2e	σ^2p	GCV	PCV	Hb	GAPM
PH	96.0-129.800	133.67*	34.4000	30.480	64.8800	5.00	6.86	53.02	7.49
DM	138.0-151.000	28.52**	8.9300	2.730	11.6600	2.06	2.35	76.57	3.71
PL	22.2-25.800	4.80**	1.4500	0.460	1.9100	5.07	5.81	75.93	9.10
PN	6.0-12.000	4.18**	1.0300	1.090	2.1300	12.13	17.41	48.52	17.40
FG	77.0-150.000	1809.00**	545.7600	171.740	717.5000	20.33	23.31	76.06	36.52
GW	14.35-25.750	26.33**	8.7600	0.060	8.8200	14.62	14.67	99.32	30.02
FLA	220.3-499	8445.99**	2285.4200	1589.750	3875.1700	15.18	19.76	58.98	24.01
HI	0.11-0.300	0.005**	0.0013	0.001	0.0023	19.17	25.66	55.82	29.50
CHL	31.0-43.000	13.16**	3.5700	2.440	6.0100	4.80	6.23	59.41	7.63
GY	3.4-14.900	23.31**	7.3400	1.400	8.7400	38.66	42.19	83.97	72.98

σ^2g = Genetic variance, σ^2p = phenotypic variance, σ^2e = environmental variance, GCV = genotypic coefficient of variation, PCV = phenotypic coefficient of variation, Hb = heritability in broad sense, GAMP = genetic advance in percentage of mean.
*Indicates significant at 5% level of significance, ** indicates significant at 1% level of significance

Table 2: Genotypic (G) and phenotypic (P) correlations among 10 characters in biroin rice varieties

		Effect through								
Characters		DM	PN	PL	FG	GW	HI	FLA	CHL	GY
PH	G	0.506**	-0.152	0.809**	-0.218	0.374*	0.365*	-0.222	0.183	0.422*
	P	0.221	-0.104	0.730**	-0.010	0.265	0.285	0.001	0.165	0.431*
DM	G		0.001	0.373*	0.736**	-0.218	-0.278	0.380*	0.143	0.901**
	P		0.058	0.324	0.503**	-0.180	0.015	0.113	0.155	0.749**
PN	G			-0.128	-0.529**	0.248	-0.359	-0.520**	0.049	-0.008
	P			-0.081	-0.432*	0.176	-0.203	-0.209	0.188	-0.019
PL	G				-0.225	0.281	-0.285	-0.390*	0.464*	0.178
	P				-0.131	0.240	-0.069	-0.293	0.352	0.210
FG	G					-0.563 **	0.133	0.740**	-0.085	0.632**
	P					-0.482*	0.118	0.563**	-0.109	0.502**
GW	G						-0.140	0.108	-0.165	-0.146
	P						-0.086	0.093	-0.135	-0.135
HI	G							0.325	0.008	0.174
	P							0.137	0.016	0.206
FLA	G								-0.668**	0.301
	P								-0.344	0.197
CHL	G									0.280
	P									0.182

PH = Plant Height, DM = Days to maturity, PL = Panicle Length, PN = Panicles/hill, FG = Filled grains/panicle, GW = 1000-grain weight, FLA = Flag Leaf Area, HI = Harvest Index, CHL=Chlorophyll content (SPAD value), GY=Grain yield * Significant at 5% level of significance, **Significant at 1% level of significance

Table 3: Path coefficient analysis showing direct (bold) and indirect effects of 10 characters on grain yield in biroin rice varieties

	Effect through									Genotypic
Characters	PH	DM	PN	PL	FG	GW	HI	FLA	CHL	correlation with yield
PH	**2.634**	1.022	0.355	-4.103	0.044	0.494	-0.614	0.423	0.169	0.422*
DM	1.333	**2.019**	-0.001	-1.893	-0.147	-0.288	0.468	-0.722	0.132	0.901**
PN	-0.401	0.001	**-2.330**	0.651	0.106	0.327	0.605	0.988	0.045	-0.008
PL	2.131	0.754	0.299	**-5.070**	0.045	0.372	0.480	0.740	0.428	0.178
FG	-0.574	1.486	1.233	1.140	**-0.200**	-0.745	-0.224	-1.406	-0.078	0.632**
GW	0.984	-0.440	-0.577	-1.426	0.113	**1.322**	0.235	-0.204	-0.152	-0.146
HI	0.960	-0.561	0.836	1.443	-0.027	-0.184	**-1.685**	-0.617	0.007	0.174
FLA	-0.586	0.768	1.212	1.975	-0.148	0.142	-0.547	**-1.899**	-0.615	0.301
CHL	0.483	0.289	-0.115	-2.353	0.017	-0.219	-0.013	1.268	**0.922**	0.280

* Significant at 5% level of significance; ** Significant at 1% level of significance Residual effect, R = 0.35

reported by Choudhury and Das[4]. Plant height showed significant and positive correlation with days to maturity, panicle length, 1000-grain weight and harvest index. Similarly, Iftekharuddaula *et al.*[3] reported positive correlation of plant height with days to maturity and 1000-grain weight in modern rice varieties whereas Biswas *et al.*[2] obtained plant height positively correlated with panicle length. Days to maturity showed significant and positive correlation with panicle length, filled grains/panicle and flag leaf area. Panicle length showed significant positive correlation with chlorophyll content, but negatively with flag leaf area. The significant and negative correlations of panicles/hill was observed with those of filled grains/panicle and flag leaf area. Filled grains/panicle had highly significant positive association with flag leaf area and significant and negative correlation with 1000-grain weight.

Iftekharuddaula *et al.*[3] obtained significant positive correlation between days to maturity and grains/panicle and significant negative correlation between panicles/m^2

and grains/panicle. Biswas *et al.*[2] obtained significant and negative correlation between filled grains/panicle and 1000-grain weight. However, the correlation study revealed that plant height, days to maturity and filled grains/panicle were the important parameters to be considered as high yield contributing characters. Hence, these parameters deserve considerable importance during the selection of genotypes in the yield improving breeding schemes of traditional biroin rice varieties.

Path coefficient analysis: From the path coefficient analysis (Table 3) it was revealed that the highest positive direct effect on grain yield was obtained by plant height followed by days to maturity, 1000-grain weight and chlorophyll content. The results are in agreement with Chaudhury and Das[4] who reported that days to maturity and plant height were the main component which affected grain yield directly and Iftekharuddaula *et al.*[3] who reported that 1000-grain weight had direct effect on grain yield. Although plant height exhibited highest positive direct effect, its indirect effect through panicle length mostly led it to negative association with grain yield. The indirect effect of chlorophyll content through panicle length was negative but considerable. Panicle length showed considerable negative direct effect but considerable positive indirect effect through plant height was found. Flag leaf area showed considerable negative direct effect but its positive indirect effect through panicle length was considerable. On the other hand, filled grains/panicle had no apparent direct effect but its indirect effects through days to maturity, panicles/hill and panicle length led it finally to significant positive correlation with grain yield. The residual effect of the present study was 0.35, indicating that 65% of the variability in grain yield was contributed by the nine characters studied in the path analysis. This gives an impression that some other characters than those involved in the present study might also contribute to yield.

Study of path coefficient analysis suggest that days to maturity, chlorophyll content, plant height and flag leaf area were the most important characters as they exhibited high direct effect on grain yield. The indirect effect filled grains/panicle, plant height and flag leaf area on grain yield through days to maturity also contributed greatly to grain yield. Selection for a late maturing plant having more numbers of filled grains should be given the importance in the selection of genotypes for higher grain yield in biroin rice improvement programmes.

REFERENCES

1. Kumar, G.S., M. Mahadevappa and M. Rudradhya, 1998. Studies on genetic variability, correlation and path analysis in rice during winter across the locations. Karnataka J. Agril. Sci., 11: 73-77.
2. Biswas, P.S., Bishwajit Prasad and S.B.A. Dewan, 2000. Variability, character association and path analysis in rice (*Oryza sativa* L.). Bangladesh J. Plant Breed. Genet., 13: 19-25.
3. Iftekharuddaula, K.M., M.A. Badshah, M.S. Hassan, M.K. Bashar and Khaleda Akter, 2001. Genetic variability, character association and path analysis of yield components in irrigated rice (*Oryza sativa* L.). Bangladesh J. Plant Breed. Genet., 14: 43-49.
4. Chaudhury, P.K.D. and P.K. Das, 1998. Genetic variability, correlation and path coefficient analysis in deep water rice. Annals. Agric. Res., 19: 120-124.
5. Singh, R.K. and B.D. Chaudhury, 1985. Biometrical Methods in Quantitative Genetic Analysis . Revised Edn., Kalyani Publishers, Ludhiana, India, pp: 318.
6. Sivasubramanian, S. and P. Madhavamenon, 1973. Genotypic and phenotypic variability in rice. Madras Agric. J., 60: 1093-1096.
7. Robinson, H.F., R.E. Comstock and P.H. Harvey, 1949. Estimation heritability and degree of dominance in corn. Agron. J., 41: 353-359.
8. Johnson, H.W., H.F. Robinson and R.E. Comstock, 1955. Genotypic and phenotypic correlations in soybean and their implications in selection. Agron. J., 74: 477-483.
9. Saravanan, R. and N. Senthil, 1997. Genotypic and phenotypic variability, heritability and genetic advance in some important traits in rice. Madras Agric. J., 84: 276-277.
10. Das, R.K., M.A. Islam, M. Howlader, S.M. Ibrahim, H.U. Ahmed and N.M. Miah, 1992. Variability and genetic association in upland rice (*Oryza sativa* L.). Bangladesh J. Plant Breed. Genet., 5: 51-56.
11. Bai, N.R., R. Devika, A. Regina and C.A. Joseph, 1992. Correlation of yield and yield components in medium duration rice cultivars. Environ. Ecol., 10: 469-470.