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CORRELATION AND DISCRIMINANT FUNCTION ANALYSIS OF SOME SELECTED CHARACTERS IN FINE RICE (*Oryza sativa* L.) AVAILABLE IN BANGLADESH

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ABSTRACT

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A field experiment was conducted with 30 fine rice genotypes for correlation and discriminant function analysis of some selected characters. A remarkable variation in plant characters and yield performance was noticed among the fine rice. Genotypic correlation coefficients indicated a fairly strong inherent relationship among the characters. A total of the 31 selection indices along with genetic worths and relative efficiencies over straight selection were estimated the five single character selection indices, grain yield offered maximum genetic worth (12.05). The two character combination function a substantial gain of 171.45% was observed when effective tillers/hill was selected together with 1000-grain weight. It is obvious that the index, I_{245} accounted a profitable efficiency (217.18%) as compared to other three character functions studied and the four character index, I_{1245} appeared to be highly beneficial over straight selection. However, the tedious approach, I_{12345} might be adopted while attention of a breeder is solely engaged for increasing grain yield in fine rice.

Key words: *fine rice, variation, selection index*

INTRODUCTION

Rice (*Oryza sativa* L.) is considered a model cereal crop in the world due to its relatively small genome size, vast germplasm collection, enormous repertoire of molecular genetic resources, and efficient transformation system (Paterson *et al*. 2005). Bangladesh agriculture is predominantly rice based. It is fourth rice producing country in the world. In Bangladesh, rice is cultivated in 10.579 million hectares having the average yield of 2.58 metric tons ha^{-1} with the production of 27.318 million for the year 2006-2007 (HAS 2007) which is very poor as compared to other advanced rice growing countries. The genetic improvement of crop plants in relation to various quality attributes is referred to quality breeding. Rice grain quality consists of several components: cooking texture, palatability, flavor, grain appearance, milling efficiency, and nutritional quality. Among these, the cooking, eating, and appearance qualities constitute important economic concerns that influence rice production in many rice-producing areas of the world.

Selection index is the most widely used method for selection which can be used more than one trait. The superiority of index increases with increasing number of traits under selection but decreases with increasing differences in relative importance. The superiority of the selection index is maximal when the traits considered are equally important. For grain yield improvement, selection could be made mainly on panicles/plant and grains/panicle. Therefore, taking into joint venture of genetic parameters and association of characters, panicle length, spikelets/panicle, effective tillers/hill, 1000-grain weight along with grain yield/ha was considered in discriminate function analysis (Akhond *et al.* 1998).

Little attention has been paid so far in Bangladesh to improve the yield status of fine rice varieties. The present work was taken with a view to study to assess the character association and contribution of characters towards grain yield in selected genotypes and to construct selection index to determine the contribution of selected characters towards yield.

MATERIALS AND METHODS

The experiment was conducted at the experimental field of the Department of Genetics and Plant Breeding, Hajee Mohammad Danesh Science and Technology University**,** Dinajpur during the period from June, 2008 to December, 2008 to study the correlation and discriminant function in fine rice. The experiment was conducted with 30 accessions of fine rice namely Zirashail, Lal Paijam, Kalosuru, Badshabhog, Paijam, Shilkamal, Binnipakri, Shadakatari, Shitabhong, Zetha katari, Malshira, Katari, BRRI dhan 34, Najirshail, Sanla, Ranjid, Chiconsarna, Zira, Boldar, Lalfota, Darkashail, Dudshar, Begunbichi, Sumonsarna, Moulata, Lalchicon, Chinigura, Rajshahisharna, Uknimodhu and Motamota. From these genotypes, first thirteen were collected from Dinajpur district, one variety from BRRI (Bangladesh Rice Research Institute) and another sixteen from different regions of Bangladesh.

The experimental plot was laid out in Randomized Complete Block Design with three replications. Each replication contained plants of 30 genotypes having 20cm×15 cm spacing and individual plot size was 2m×1.5m. The land was ploughed by tractor and country plough followed by laddering to get a good puddled condition. Weeds and stubbles were removed from the field prior to sowing/transplanting of seedlings. The same procedure of land preparation was followed in case of transplanting. Manures and fertilizers were applied following the recommended dose of SRDI (Soil Resource Development Institute) manual and irrigation channels were made around the each block.

Seeds were sown on 26 June, 2008 in the experimental seed beds. The healthy seedlings of 25 days old were transplanted in separate strip of the experimental field on 20 July, 2008. In each strip 15cm×20cm spacing between plant to plant and row to row, respectively were maintained. All of the fertilizers except urea were applied as basal dose at the time of final land preparation. Urea (150kg ha^{-1}) was applied in equal three splits. The first dose of urea was applied at 21 days after transplanting (DAT). The second dose of urea was added as top dressing at 45 days (active vegetative stage) after transplanting and third dose was applied at 60 days (panicle initiation stage) after transplanting recommended by BRRI.

The collected data were compiled and tabulated in proper form for statistical analysis. Analysis of variance was done following Randomized Complete Block Design (RCBD) with the help of a computer package (MSTAT) and the mean differences among the varieties were adjudged by Duncan's Multiple Range Test (Gomez and Gomez, 1984). The genotypic and phenotypic correlation coefficients between yield and its different contributing characters were estimated with the formula given by Johnson *et al*. 1955. Application of discriminant function as a basis for making selection on several characters simultaneously and aimed at discriminating the desirable genotypes from undesirable ones on the basis of their phenotypic performance (Smith 1936).

RESULTS AND DISCUSSION

Analysis of variance showed significant variation among the genotypes in respect of all the characters under studied. The performance of the genotypes for yield and different yield contributing characters were evaluated and there were significant variations observed among the genotypes. Different genotypes showed better performance under different characters (Table 1).

Table 1. Mean squares (MS) derived from 15 morphophysiogenic characters in fine

Characters	Source of variation with mean sum square			
	Replication (2 d.f.)	Genotypes (29 d.f.)	Error (58 d.f.)	Co-efficient of variation (%)
Panicle length (cm)	0.097	33.101**	0.264	1.95
Spikelets/panicle	0744	779.551**	1.147	0.72
1000-grain weight (g)	0.027	76.468**	0.020	0.81
Effective tillers/hill	0.081	20.852**	0.291	5.06
Yield/ha(t)	0.189	1.429**	0.398	10.11

** indicates significant at 1% level of probability

The performance of the genotypes for yield and different yield contributing characters were evaluated. It was observed that there were significant variations among the genotypes for all the characters studied. Different genotypes showed better performance for different characters (Table 1). The variation in panicle length was not very high. The genotype BR-34 had the highest panicle length (32.90 cm) and lowest was in Zira (20.20 cm).Incase of number of spikelets/panicle (cm), the range was high (121.0-186.0).The genotype Ranjid (186 cm) showed higher number of spikelets/panicle and the lowest was in Lalfota (121 cm). Motasota (30.72 g) exhibited the maximum 1000 grain weight whereas Chinigura showed the minimum (10.03 g). The highest number of effective tillers/hill was produced by Ranjid (15.97) and Lalfota (5.9) showed the lowest. The highest yield/ha was observed in the genotype Ranjid (4.32 t/ha) followed by Dudshor (4.18 t/ha) and Silkumul (4.16 t/ha) (Table 2).

Table 2. Mean Performance of morphophysiogenic characters in fine rice

Accession No.	Variety	Panicle length (cm)	Spikelets/panicle (no.)	1000-grain weight (g)	Effective tillers/hill	Yield/ha(t)
FR1	Zirashail	25.07 kl	141.0 l	19.67 e	10.37 h-k	3.80 a-d
FR2	Najirshail	22.80 o	145.7 k	21.45 d	10.43 g-j	2.40 f
FR3	Lal payjam	31.83 b	151.0 i	16.32 j	10.73 f-i	3.86 a-d
FR4	Kalosuru	26.17 j	134.0 n	13.26 o	8.800 l-o	2.50 f
FR5	Sanla	28.50 ef	153.7 h	10.80 q	11.80 de	3.38 b-e
FR6	Ranjid	24.33 lm	186.0 a	18.17 gh	15.97 a	4.32 a
FR7	Chiconsarna	26.33 ij	161.0 f	18.28 g	8.667 m-o	3.03 d-f
FR8	Payjam	28.57 ef	138.0 m	16.01 k	9.067 l-n	4.12 ab
FR9	Silkumul	23.97 n	181.0 b	21.42 d	15.70 ab	4.16 ab
FR10	Binnipakri	30.70 c	151.3 i	18.13 gh	7.333 pq	3.86 a-d
FR11	Sadakatari	29.37 de	142.7 l	13.91 n	7.900 op	3.81 a-d
FR12	Shitabhog	23.20 no	147.0 jk	19.67 e	13.63 c	4.14 ab
FR13	Zira	20.20 r	167.0 d	11.74 p	9.767 i-l	3.42 b-e
FR14	Boldar	32.30 ab	138.0 m	10.52 r	11.87 de	3.20 c-f
FR15	Lalfota	24.73 lm	121.0 r	21.62 d	5.900 r	2.40 f
FR16	Dairkashail	27.20 gi	131.7 0	25.32 b	9.700 j-l	3.12 d-f
FR17	Badshabhog	24.33 lm	129.0 p	17.15 i	11.40 e-g	3.42 b-e
FR18	BRRI dhan 34	32.90 a	142.0 l	11.91 p	15.23 ab	4.09 ab
FR19	Dudshor	22.57 op	156.0 g	18.17 gh	14.93 b	4.18 ab
FR20	Begunbichi	26.17 j	141.0 l	10.32 r	6.833 q	3.42 b-e
FR21	Sumonsarna	21.83 pq	163.0 e	18.03 h	12.57 d	2.83 ef
FR22	Maulata	27.30 gh	148.7 j	25.51 b	11.00 e-h	4.03 a-c
FR23	Zatha katari	24.10 m	150.7 i	14.24 m	8.433 no	2.66 ef
FR24	Lalchicon	21.47 q	146.7 k	24.39 c	11.60 ef	3.10 d-f
FR25	Malshira	26.57 hj	163.0 e	19.15 f	10.70 f-i	4.15 ab
FR26	Chinigura	29.90 cd	125.0 q	10.03 s	9.433 k-m	2.72 ef
FR27	Raj sarna	25.17 kl	157.0 g	19.28 f	11.20 e-h	3.42 b-e
FR28	Uknimadhu	28.00 fg	126.0 q	15.34l	12.67 d	3.38 b-e
FR29	Motasota	25.67 jk	173.0 c	30.72 a	8.067 op	4.07 ab
FR30	Katari	29.97 cd	165.3 d	14.15 m	8.067 o	2.74 ef
	LSD	0.8398	1.750	0.231	0.8817	0.7105
	Mean	26.37	149.211	17.49	10.658	3.46
	Range	20.20-32.90	121.0-186.0	10.03-30.72	5.9-15.97	2.40-4.32

Correlation coefficients

The genotypic and phenotypic correlation coefficients among yield and four yield contributing characters in rice are presented in Table 3. In general, genotypic correlation coefficients were higher than their corresponding phenotypic correlation coefficients; indicating a fairly strong inherent relationship among the characters. The higher estimates of phenotypic correlation coefficients indicated that the relationships were affected by the environment at phenotypic level. Such environmental influence in reducing correlation coefficients in rice was also reported by Chaubey and Singh (1994), Ajmer *et al.* (1979) and Haque *et al.* (1991). Selection for yield may not be effective unless the other yield components influencing it directly or indirectly are taken into consideration. So, measurement of correlation coefficient helps to identify the relative contribution of component characters towards yield (Panse 1957).

Table 3. Genotypic (r_g) and phenotypic (r_p) correlation coefficients among grain yield and four important selected characters of fine rice

Characters		Spikelets/ panicle	1000-grain weight	Effective tillers/hill	Grain yield/ha
Panicle length	r_g	0.00636	0.251	-0.210	0.402**
	r_p	0.00632	0.248	-0.205	0.313
Spikelets/panicle	r_g		-0.00829	0.0186	0.366*
	r_p		-0.00823	0.0182	0.321
1000-grain weight	r_g			0.435*	0.695**
	r_p			0.234	0.495**
Effective tillers/hill	r_g				0.536**
	r_p				0.437*

* and ** indicates significant at 5% and 1 % level of probability respectively

Panicle length and number of spikelets/panicle showed positive and significant association with grain yield at both genotypic level but not at phenotypic levels. Number of spikelets/panicle was found to show both genotypiccally and phenotypically non-significant and negative correlation with 1000-grain weight and positive correlation with effective tillers/hill. Therefore, selection based on this character would influence the grain yield.

Effective tillers/hill and 1000-grain weight showed significant and positive correlation with grain yield/ha indicated that yield could be improved by increasing effective tillers/hill. So, selection based on this character would be very effective for increasing grain yield. 1000-grain weight was found to show significant and positive association with effective tillers/hill at genotypic level only. It indicated that the due to increase of effective tillers/hill 1000-grain weight has increased.

From the correlation study it was evident that panicle length, number of spikelets/panicle, effective tillers/hill and 1000-grain weight had the maximum contribution for increasing grain yield. The study suggested that selection on the basis of number of spikelets/panicle, panicle length 1000-grain weight and effective tillers/hill might be more effective for improving grain yield and the characters might be incorporated to build up a selection index.

Selection index

Akhond *et al.* (1998) suggested that for grain yield improvement and selection could be made mainly on panicles/plant and grains/panicle. Therefore, taking into joint venture of genetic parameters and association of characters, panicle length, spikelets/panicle, effective tillers/hill, 1000-grain weight along with grain yield/ha were considered in discriminant function analysis. A total of 31 selection indices along with genetic worths and relative efficiencies over straight selection are presented in Table 4. It is apparent that greater the number of characters included in discriminant function, higher was the efficiency over straight selection. The maximum relative efficiency over straight selection was realized when grain yield/ha (x_1), panicle length (x_2), spikelets/panicle (x_3), effective tillers/hill (x_4) and 1000-grain weight (x_5) comprised the selection index (I_{12345}). A plant breeder is always interested to have maximum genetic gain with incorporation minimum characters in selection function. Keeping eyes on judicious breeding exercise, so far ranking of the single character index selection, 1000-grain weight is the key component to construct selection index in fine rice. However, among the two character combination functions a substantial gain of 171.45% was observed when effective tillers/hill was selected together with 1000-grain weight. It is obvious that the index, I_{245} accounted a profitable efficiency (217.18%) as compared to other three character functions studied. Nevertheless, cumbersome in breeding program, the four character index, I_{1245} appeared to be highly beneficial over straight selection. However, the tedious approach, I_{12345} might be adopted while attention of a breeder is solely engaged for increasing grain yield in fine rice.

Table 4. Discriminant function analysis on selected characters in fine rice

Index selection	Expected genetic worth	Relative efficiency over straight selection (%)
I_1=0.614 x_1	12.05	100
I_2=0.997 x_2	8.78	72.86
I_3=0.995 x_3	10.62	88.13
I_4=0.988 x_4	9.05	75.10
I_5=0.959 x_5	11.23	93.19
I_{12}=0.361 x_1+0.937 x_2	15.68	130.12
I_{13}=0.561 x_1+1.013 x_3	13.07	108.46
I_{14}=0.555 x_1+1.017 x_4	16.35	135.68
I_{15}=0.443 x_1+0.962 x_5	16.75	139.00
I_{23}=1.015 x_2+1.001 x_3	19.45	161.41
I_{24}=0.953 x_2+0.982 x_4	18.49	153.44
I_{25}=0.972 x_2+1.002 x_5	20.26	168.13
I_{34}=0.965 x_3+1.006 x_4	18.57	154.10
I_{35}=0.971 x_3+0.966 x_5	19.92	165.31
I_{45}=1.011 x_4+0.951 x_5	20.66	171.45
I_{123}=0.519 x_1+ 0.93 x_2 +1.048 x_3	20.85	173.03
I_{124}=0.454 x_1+1.044 x_2+1.063 x_4	16.67	138.34
I_{125}=0.402 x_1+1.027 x_2+0.969 x_5	21.18	175.76
I_{134}=0.670 x_1+1.002 x_3+1.002 x_4	21.25	176.35
I_{135}=0.533 x_1+1.021 x_3+0.969 x_5	22.15	183.82
I_{145}=0.521 x_1+1.022 x_4+0.986 x_5	22.65	187.96
I_{234}=0.950 x_2+0.909 x_3+0.981 x_4	21.05	174.68
I_{235}=1.014 x_2+0.982 x_3+ 1.02 x_5	21.56	178.42
I_{245}=1.033 x_2+0.978 x_4+0.979 x_5	26.17	217.18
I_{345}=0.939 x_3+1.007 x_4+0.981 x_5	23.20	192.53
I_{1234}=0.632 x_1+1.014 x_2+1.060 x_3+0.946 x_4	25.07	208.05
I_{1235}=0.492 x_1+1.027 x_2+1.007 x_3+0.885 x_5	25.50	211.62
I_{1245}=0.486 x_1+0.999 x_2+1.058 x_4+0.963 x_5	27.25	226.14
I_{1345}=0.635 x_1+1.018 x_3+1.007 x_4+0.997 x_5	27.12	225.06
I_{2345}=1.035 x_2+0.975 x_3+0.974 x_4+0.998 x_5	24.72	205.14
I_{12345}=0.500 x_1+1.002 x_2+1.010 x_3+1.055 x_4+1.007 x_5	28.26	234.52

Where x_1= Grain yield/ha, x_2= Panicle length, x_3= Spikelets/panicle, x_4= Effective tillers/hill and x_5= 1000-grain weight

CONCLUSION

Results of the present studies indicated significant variation among the genotypes for all the characters studied and selection would be effective for the characters viz. panicle length, spikelets/panicle, effective tillers/hill and 1000-grain weight to increase the grain yield/hectare as reflected by strong and positive correlation.

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