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Genetic Variability and Correlation in Yield and Grain Quality Characters of Rice Germplasm

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ABSTRACT

A field experiment was conducted involving 72 rice genotypes to study the extent of variability and associations in yield and grain quality traits under irrigated conditions. Coefficients of variation were high for filled grains per panicle and grain yield per plant. Existence of high heritability with high to moderate genetic advance as percentage of mean for filled grains per panicle, 100-grain weight and Kernel length indicated the possibility of yield and quality improvement through adoption of selection procedures. The characters, days to 50% flowering and filled grains per panicle had significant positive corrleation with grain yield per plant. These two traits also exhibited direct positive effects on yield. Increased growth period resulted in increase of yield through larger sink size. The resluts indicated that selection might be highly fruitful, if directed towards higher number of grains per panicle and long slender grains with moderate tillering to evolve potential genotypes suitable for *kharif* season under irrigated conditions.

Key words : Correlations, Rice, Variability, Yield traits.

The development of fertilizer-responsive, high yielding, semi-dwarf varieties was an important land mark in the history of research on tropical rice. This resulted in achievement of quantum jump in rice yields in 1960's through cultivation of these varieties in large scale in almost all rice growing areas of the world. However, subsequent release of new varieties could not improve varietal yields significantly. Therefore, to raise this yield ceiling, research efforts were further intensified to critically analyse the basis of yield potential and to establish the characteristics of functional ideotype for irrigated rice. One important constraint is less adoptability of newly introduced varieties. In the light of this, existence of sufficient variability specially in local developed lines to evolve location specific varieties is considered as prime requirement. Unfortunately, a weak area of research in many crop improvement programmes is low priority accorded to evaluation of germplasm in large scale and rice is no exception. The development of high yielding long duration rice varieties using Javanicas shows great potential still remaining unutilized in germplasm (Siddiq, 1989). Keeping in view the importance of variability in breeding programmes, the present study was undertaken to determine the extent of variability and association in yield and quality traits of rice with involvement of locally developed germplasm lines, under irrigated ecosystem.

MATERIAL AND METHODS

Seventy two rice genotypes were evaluated in a randomized block design replicating twice at Regional Agricultural Research Station, Jagtial during *kharif* 2003 season. Thirty day old seedlings were transplanted under recommended doses of fertilizers @ 100 N, 60 P_2O_5 and 40 K_2O (kg ha-1) adopting a spacing of 20 cm between rows and 15 cm between plants. Each plot consisted of 1 row of 4.5 meters long with 30 plants per row and one seedling per hill. Observations were recorded on 10 randomly selected plants in each replication. The characters studied were plant height, days to 50% flowering, productive tillers per plant, panicle length, filled grains per panicle, 100 grain weight, Kernel length (L) Kernel breadth (B), Kernel L / B ratio and grain yield per plant. Finally, genotypic and phenotypic coefficients of variation (Burton, 1952), heritability, genetic advance as percentage of mean (Johnson et al., 1955), simple correlations, direct and indirect effects (Singh and Choudhary, 1997) were estimated.

RESULTS AND DISCUSSION

Analysis of variance revealed significant genotypic difference for all the characters studied. In general, Phenotypic Coefficient of Variation (PVC) values were higher than Genotypic coefficicent of variation (GCV) values (Table 1). High variability was observed for filled grains per panicle and grain yield

Table 1 .Genetic parameters for yield and grain quality characters in rice.

S. No.	Parameter	Days to 50% flowering	Plant height (cm)	Productive tillers plant^{-1}	Panicle length (cm)	Filled grains panicle^{-1}	100 grain weight (g)	Kernel length (mm)	Kernel breadth (mm)	Kernel L B ratio	Grain yield plant^{-1}
1	PCV (%)	6.06	14.18	17.19	9.31	30.31	18.49	9.66	5.33	8.41	28.83
2	GCV (%)	5.78	12.95	14.23	6.65	28.64	16.42	9.27	4.56	7.58	26.67
3	h^2 (Broad sense)	0.91	0.83	0.68	0.51	0.89	0.80	0.92	0.73	0.81	0.85
4	GA (%)	12.52	23.09	2.22	2.19	107.35	0.54	1.07	0.12	0.51	9.83
5	GAM (%)	11.38	24.37	24.28	9.80	55.73	30.78	18.32	8.03	14.08	50.84

per plant, where as, it was low in case of days to 50% flowering, panicle length, Kernel length, Kernel breadth and Kernel L/B ratio. The remaining characters possessed moderate variability. Though heritability was high, the genetic advance as percentage of mean (GAM) was low in case of days to 50% flowering (Chookar *et al*., 1994), which indicated that the inheritance of this trait was largely governed by non-acddditive gene action and mostly attributable to environmental effects, hence selection might not be effective for improvement of this character. High heritability coupled with high genetic advance as percentage of mean in case of filled grains per panicle and 100-grain weight indicates that these two traits are largely controlled by additive gene action, which is in confirmity with the findings of Govindarasu, 1995 and Reddy and De, 1996 (filled grains) and Aswani Panwar *et al*., 1997 (100 seed weight). Hence, yield improvement to certain extent is simple and straight forward through directing selection towards higher number of grains per panicle and high 100-seed weight. The other characters, which could be considered for improvement through simple selection on account of having high heritability and high to medium GAM are Kernel length and Kernel L/B ratio.

Although, the genetic parameters are improvement to know the nature of inheritance (additive or non additive gene action) and expected quantum of improvement in a particular trait, a simultaneous study on inter relationships existing among different characters would be of great value to exercise selection on desired traits, as yield is ultimately dependent on interaction of these attributes.

In the present study, days to 50% flowering (Prasanthi, 1993), filled grains per panicle (Meenakshi *et al*., 1999) and productive tiller per plant exhibited significant positive correlations with grain yield per plant as reported earlier (Table 2). The association between 100-seed weight and grain yield per plant, although is negative, but not significant. Interestingly, this trait exhibited significant positive correlation with filled grains per panicle and the grain quality characterstics under study. This indicates that these two yield components viz., filled grains per panicle and 100-grain weight have to be taken into consideration for yield improvement. Furtehr, it is possible to improve yield and grain quality simultaneously as evident from the significant positive correlations between these two traits and kernel L/B ratio.

Table 2 .Estimates of simple correlation coefficients for yield and grain quality characteristics in rice.

Characters	Days to 50% flowering	Plant height (cm)	Productive tillers plant $^{-1}$	Panicle length (cm)	Filled grains panicle $^{-1}$	100 grain weight (g)	Kernel length (mm)	Kernel breadth (mm)	Kernel L B ratio	Grain yield plant $^{-1}$
Days to 50% flowering	**1.0000**	0.0561	0.0687	0.0412	0.2309	-0.1931*	-0.2596**	-0.2037*	-0.1590	0.2982**
Plant height (cm)		**1.0000**	0.1753*	0.3770**	-0.0118	0.3037**	0.2709**	0.2898**	0.1229	0.3863**
Productive tillers plant $^{-1}$			**1.0000**	0.0412	-0.1518	0.0947	0.0017	0.1764*	-0.1112	0.4285**
Pancile length (cm)				**1.0000**	0.0412	0.3312**	0.3925**	0.2903**	0.2467**	0.0655
Filled grains pancile $^{-1}$					**1.0000**	-5.399**	-0.4569**	-0.3906**	-0.2828**	0.4620**
100 grain weight (g)						**1.0000**	0.6500**	0.5497**	0.3880**	-0.1247
Kernel length (mm)							**1.0000**	0.4748**	0.8304**	-0.2335**
Kernel breadth (mm)								**1.0000**	-0.0932	-0.0668
Kernel length/breadth ratio									**1.0000**	-0.2276**
Grain yield plant $^{-1}$										**1.0000**

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

Simple correlations provide the relationship between two characters but may not give a sound basis for selection criteria, unless it is supported by the information on direct and indirect effects of each trait on yield. In the present study, filled grains per panicle exhibited highest positive direct effect on yield followed by productive tillers per plant and plant height (Table 3). Considering the significant positive correlations and high direct positive effects of filled grains per panicle and plant height on yield, it can be concluded that selection for improvement of these traits would automatically result in varietal yield improvement. Increased duration resulted in increase of height, panicle length accommodating more number of grains per panicle (larger sink size). Thus varieties with medium height and study culms would be more advantageous for rainy (*kharif*) season.

The yield triat 100-grain weight and quality trait kernel L/B ratio also expressed direct positive effects on yield at medium level and higher kernel L/B ratio inturn, indirectly was contributed by higher Kernel length.

Present study revealed that there was good amount of variability in the trait filled grains per panicle and 100-grain weight and selection towards higher number of grains per plant would be more effective to develop high yielding genotypes for kharif season. This trait exhibited high heritability coupled with high genetic advance as percentage of mean in addition to significant positive correlation and direct positive effect with grain yield per plant. Next important characters are 100 grain weight and kernel length. The productive tillers per plant though contributed to yield, cannot be considered as selection criteria due to possession of low heritability.

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Table 3 .Estimates of direct and indirect effects of yield and grain quality characteristics in rice.

Characters	Days to 50% flowering	Plant height (cm)	Productive tillers plant $^{-1}$	Panicle length (cm)	Filled grains panicle $^{-1}$	100 grain weight (g)	Kernel length (mm)	Kernel breadth (mm)	LB ratio
Days to 50% flowering	**0.1205**	0.0068	0.0083	0.0050	0.0278	-0.0233	-0.0313	-0.0246	-0.0192
Plant height (cm)	0.0175	0.3127	0.0548	0.1179	-0.0037-	0.0950	0.0847	0.0906	0.0384
Productive tillers plant $^{-1}$	0.0299	0.0762	0.4350	0.0179	0.0660	0.0412	0.0007	0.0768	-0.0484
Pancile length (cm)	-0.0005	-0.0044	-0.0005	-0.0116	0.0011	-0.0038	-0.0045	-0.0034	-0.0029
Filled grains pancile $^{-1}$	0.1185	-0.0060	-0.0779	-0.0500	0.5133	-0.2772	-0.2346	-0.2005	-0.1452
100 grain weight (g)	-0.0267	0.0420	0.0131	0.0458	-0.0747	0.1384	0.0900	0.0761	0.0537
Kernel length (mm)	0.0964	-0.1007	-0.0006	-0.0458	0.1698	-0.2415	-0.3716	-0.1764	-0.3086
Kernel breadth (mm)	-0.0234	0.0332	0.0202	0.0333	-0.0448	0.0630	0.0544	0.1147	-0.0107
Kernel L B ratio	-0.0342	0.0264	-0.0239	0.0531	-0.0608	0.0834	0.1786	-0.0201	0.1251
Grain yield plant $^{-1}$	0.2982	0.3863	0.4285	0.0655	0.4620	-0.1247	-0.2335	-0.0668	-0.2276

Residual effect = 0.6384

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