Selection criteria for high yield in early segregating generation of rice (*Oryza sativa* L.) crosses

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ABSTRACT

India produces some of the best quality rice of the world. Long grained export quality Basmati rice and a host of locally adapted small and medium grained scented rice varieties are some of them, known for their excellent cooking and eating qualities. Due to tall stature they suffer from lodging as a result these elite varieties are poor yielder. In order to blend the quality characteristics with the high yield eight varieties viz. IR 30, IR 50, IR 62, IET 5656, IET 8002, Kunti, Langulmota and Sabita with high yield background were crossed with six quality rice varieties viz. Basmati 385, Kataribhog, Kalonunia, Radhunipagal, Dudheswar and Sambamahsuri,. From the hybrids generated through Line x tester model 25 were selected to proceed to F_2 generation. They were evaluated during kharif season 2006 in randomized block design with two replications for eleven biometrical characters to study the correlation coefficient and cause and effect relationship. Grain yield plant^{-1} showed significant correlation with panicle number plant^{-1}, panicle weight and grain number panicle^{-1} in positive direction while it had negative correlation with plant height. Panicle number plant^{-1} imparted the highest positive direct effect on grain yield plant^{-1} followed by grain number panicle^{-1}, 1000 grain weight and panicle length in this regard. Thus, correlation studies and path analysis reveal the fact that panicle number plant^{-1} and grain number panicle^{-1} should be considered as the most important characters during selection for yield improvement in segregating generations of rice.

Key words: Correlation coefficient, direct effect, quality rice, segregating generation and residual effect.

The changing scenario of agriculture has led to increasing awareness about quality all over the World. Demand for quality rice is increasing at the global market as well as for domestic consumption. Traditional quality rice cultivars are usually poor yielder and suffer from lodging but possess excellent cooking and eating qualities. Modern high yield yielding varieties that have replaced the traditional landraces are mostly lacking such quality traits. In order to blend the quality characters with high yield a crossing programme between quality rice cultivars and high yielding varieties was taken up. Selected F_2 progenies were evaluated to find out the selection criteria in the segregating generations of rice.

MATERIALS AND METHODS

The present study was conducted at Regional Research Station, New Alluvial Zone, Bidhan Chandra Krishi Viswavidyalaya, Sub-Centre Chakdaha, Nadia, during 2004-2006. Eight high yielding rice varieties *viz*. IR-30, IR-50, IR-62, IET-5656, IET-8002, Kunti, Langulmota and Sabita were crossed with six quality rice varieties *viz,* Basmati 385, Kataribhog, Kalonunia, Radhunipagal, Dudheswar and Sambamahsuri using a Line × tester's mating design during *Kharif* 2004. Out of the 48 hybrids generated , 25 were selected on the basis of their phenotypic performance to proceed to F_2 generation. They were raised during *Kharif* 2006 in randomized block design with two replications. All the entries were grown in 10 rowed plot of 6m length. Normal agronomic practices were followed to obtain a good harvest. Observations on eleven biometrical characters viz. Plant height (cm), panicle number plant $^{-1}$, panicle weight (g), panicle length (cm), grain number panicle^{-1}, fertility percentage, grain length (mm), grain breadth (mm), grain L/B ratio, 1000 grain weight (g) and grain yield plant^{-1} were recorded from 20 randomly selected plants from each entry. The correlation and path coefficients were computed following Dewey and Lu (1959).

RESULTS AND DISCUSSION

Correlation studies revealed that all the character pairs, except panicle length and grain number panicle^{-1} were associated in the same direction at genotypic and phenotypic levels (Table-1). The genotypic estimates were higher in magnitude than the respective phenotypic values indicating an inherent association between various characters. The grain yield plant^{-1} showed a highly significant correlation with panicle number plant^{-}, panicle weight and grain number panicle^{-1} in positive direction. This indicated that selection for these traits would lead to an improvement in grain yield in rice. These results are in accordance with Sarkar *et al.* (2005) and Senapati *et al.* (2008).An inverse relationship between plant height and grain yield was observed. Such results imply that dwarf stature would be more rewarding against the yield improvement in rice. Interestingly, plant height exhibited significantly negative correlation with L/B ratio but with breadth alone it had significantly positive correlation at genotypic level. Panicle number plant^{-1} showed negative significant correlation with fertility percentage and grain breadth at genotypic level. This suggested that higher number of panicle plant^{-1} may bring about decrease in fertility percentage and grain breadth in this regard. Highly significant positive correlation of panicle weight with grain number

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Table 1. Genotypic (G) and phenotypic (P) correlations among grain yield and its components in F_2 progenies of rice

Character		Plant height (cm)	Panicle no. / plant	Panicle weight (g)	Panicle length (cm)	Grain no./ panicle	Fertility %	Grain length (mm)	Grain breadth (mm)	Length / breadth ratio	1000-grain weight (g)	Grain yield / plant (g)
Plant height (cm)	G	1.000	– 0.378*	– 0.372*	– 0.066	– 0.361*	– 0.118	– 0.327	0.399*	– 0.350*	– 0.301	– 0.532**
	P	1.000	– 0.305	– 0.295	– 0.072	– 0.231	– 0.076	– 0.283	0.201	– 0.260	– 0.281	– 0.450*
Panicle no. / plant	G		1.000	0.193	0.085	0.633**	– 0.371*	0.053	– 0.393*	0.196	– 0.105	0.820**
	P		1.000	0.206	0.106	0.367*	– 0.179	0.035	– 0.185	0.118	– 0.137	0.764**
Panicle weight (g)	G			1.000	0.002	0.696**	0.724**	– 0.229	0.255	– 0.298	0.029	0.619**
	P			1.000	0.108	0.634**	0.549**	– 0.123	0.071	– 0.150	0.017	0.647**
Panicle length (cm)	G				1.000	– 0.007	– 0.227	– 0.016	0.500**	– 0.241	0.142	0.242
	P				1.000	0.139	– 0.155	0.004	0.247	– 0.155	0.039	0.288
Grain no./ panicle	G					1.000	0.527**	– 0.633**	0.090	– 0.498**	– 0.480**	0.835**
	P					1.000	0.206	– 0.361*	0.045	– 0.250	– 0.257	0.652**
Fertility (%)	G						1.000	– 0.317	0.190	– 0.295	– 0.333	0.095
	P						1.000	– 0.219	0.024	– 0.160	– 0.298	0.183
Grain length (mm)	G							1.000	– 0.587**	0.904**	0.602**	– 0.160
	P							1.000	– 0.546**	0.873**	0.486**	– 0.093
Grain breadth (mm)	G								1.000	– 0.885**	0.145	– 0.015
	P								1.000	– 0.879**	0.121	– 0.068
Length / breadth ratio	G									1.000	0.304	– 0.128
	P									1.000	0.196	– 0.043
1000-grain weight (g)	G										1.000	– 0.055
	P										1.000	– 0.117
Grain yield / plant (g)	G											1.000
	P											1.000

Table 2. Matrix of direct (Bold) and indirect effects of yield components on grain yield in F_2 progenies of rice

Character	Plant height (cm)	Panicle no. / plant	Panicle weight (g)	Panicle length (cm)	Grain no./ panicle	Fertility (%)	Grain length (mm)	Grain breadth (mm)	Length / breadth ratio	1000-grain weight (g)	Yield correlation (g)
Plant height (cm)	**0.055**	– 0.218	– 0.024	– 0.019	– 0.166	– 0.024	0.056	– 0.046	– 0.035	– 0.108	– 0.532**
Panicle no. / plant	– 0.021	**0.577**	0.012	0.017	0.292	– 0.076	– 0.009	0.045	0.020	– 0.037	0.820**
Panicle weight (g)	– 0.020	0.111	**0.066**	0.000	0.321	0.150	0.039	– 0.029	– 0.030	0.010	0.619**
Panicle length (cm)	– 0.003	0.033	0.000	**0.291**	– 0.003	– 0.047	0.002	– 0.058	– 0.024	0.051	0.242
Grain no./ panicle	– 0.020	0.365	0.046	– 0.001	**0.461**	0.109	0.108	– 0.010	– 0.051	– 0.172	0.835**
Fertility (%)	– 0.006	– 0.214	0.047	– 0.066	0.243	**0.207**	0.054	– 0.022	– 0.030	– 0.119	0.095
Grain length (mm)	– 0.018	0.030	– 0.015	– 0.004	– 0.292	– 0.065	**– 0.171**	0.068	0.092	0.216	– 0.160
Grain breadth (mm)	0.022	– 0.226	0.016	0.145	0.041	0.039	0.100	**– 0.116**	– 0.090	0.052	– 0.015
Length / breadth ratio	– 0.019	0.113	– 0.019	– 0.070	– 0.230	– 0.061	– 0.155	0.102	**0.102**	0.109	– 0.128
1000-grain weight (g)	– 0.016	– 0.060	0.001	0.041	– 0.221	– 0.069	– 0.103	– 0.016	0.031	**0.359**	– 0.055

*,** Significant at 5% and 1% probability level respectively, Residual effect = 0.207

panicle^{-1} and fertility percentage indicates that these two characters mainly determine the panicle weight in rice. Grain number plant^{-1}, one of the important yield contributing traits showed negative association with grain length, grain L/B ratio and 1000 grain weight, while it had positive association with fertility percentage at genotypic level.

The Path coefficient analysis (Table-2) revealed that the characters chosen for the study were very much appropriate as evident from the low amount of residual effect. The partioning of correlation coefficient into direct and indirect effects showed that panicle number plant^{-1} exerted highest positive direct effect on grain yield followed by grain number panicle^{-1} and 1000 grain weight Interestingly ,panicle number plant^{-1}, panicle weight and grain number panicle also had highly significant positive correlation with yield. These characters, therefore, require to be considered during selection for yield improvement in rice. The present result corroborated the findings of Chaubey and Richharia (1993), Chaubey and Singh (1994), Choudhury and Das (1997 & 1998), Padmavathi *et al* (1996), Sarkar *et al*.(2005). Panicle number plant^{-1} contributed higher amount of positive direct effect toward yield as well as it registered highest amount of positive indirect effect on yield via grain number panicle$^{-1.}$ On the contrary, grain number panicle^{-1} also contributed a considerably high amount of positive indirect effect via panicle number plant^{-1} in addition to high amount of positive direct effect on grain yield leading to significantly positive correlation. This observation highlighted the importance of these two characters for controlling of grain yield in rice.

Therefore, the present investigation revealed that panicle number plant^{-1}, grain number panicle^{-1} and panicle weight were the principle yield determining traits in rice. Hence, these characters should be considered during selection in early segregating generation of rice.

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