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Assessment of high yielding rice genotypes with some yield attributing traits

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Global demand has been projected that the growth of rice productivity should match the population growth to make a balance for calorie requirement of human population which is increasing at an alarming rate and for this reason it requires 70% increase in supply of rice by the year 2025 *i.e.*, 765 million tonnes of rice. The annual growth rate in global rice production was only 1.8% during the 1985-95 period compared to 2.8% during 1975-85 and 3.6% during 1965-75 (Nanda, 2000). Over the years there has been gradual decline in annual growth rate of global rice production and the population in rice growing countries are still growing at the rate of 1.8% per year. In order to meet the future demand of rice, its production must be increased to match the rate of increase in population growth to maintain the food-population balance. The magnitude in difference between growth and demand for rice will require new challenging research approaches to meet the food needs. Yield improvement through breeding needs studies on association of yield and its components and also the extent of genetic variability within available germplasm. In the present investigation attempts have been made to study the inter relationships between yield and yield components with estimation of genetic variability.

The experiment was conducted on twenty genotypes of rice (*Oryza sativa*) which includes IR 64, Satabdi, PNR 381, Rasi, MTU 1010, Annada, Dular, Vandana, IET 15847, IET 826, Narendra, Dudheswar, IR 20, IR 36, NC 1281, IR 69705, ND 97, Tulaipangi, Pusa Sugandha and JK 2, conducted at the Agricultural Instructional farm, Jaguli, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal during Boro season 2010. Thirty days old seedlings were transplanted in five row plot at 5m length in Randomized Block Design replicated thrice Normal agronomic practices were followed for obtaining good harvest. Five plants were selected randomly from each genotype and were recorded for the nine biometrical parameters like plant height (cm), panicle length (cm), number of effective tillers plant^{-1}, number of grains panicle^{-1}, length of rough rice (mm), L/B ratio, 1000 grain weight (g) and yield plant^{-1} (g). The genetic parameters were estimated based on the method suggested by Al Jibouri *et al.* (1958). The genotypic and phenotypic correlations were estimated following Johnson *et al.* (1955).

A wide variation was noticed among the genotypes against all the characters (Table 1). This would offer a good scope for selection of promising desirable varieties. Estimated values on genetic parameters like PCV, GCV, heritability, genetic advance etc. were shown in table 2, where least variation was observed between PCV and GCV for all the traits which illustrated little influence of environment on the traits which could provide enough scope for selection of the desirable lines on the basis of phenotypic values of the traits.

Table 1: Analysis of Variance for yield and its attributing traits in rice

Characters	Mean sum of squares		
	Replication (2)	Treatment (19)	Error 38
Plant height (cm)	0.831	1230.946**	1.983
No. of effective tillers plant^{-1}	1.250	15.236**	0.368
Panicle length (cm)	0.841	29.448**	0.856
No. of grains panicle^{-1}	2.050	2170.605**	2.375
1000 grain weight (g)	0.235	30.726**	0.367
Length of rough rice (mm)	0.465	2.002**	0.440
Breadth of rough rice (mm)	0.0001	0.368**	0.008
L/B of rough rice	0.006	1.619**	0.004
Length of Brown kernel (mm)	0.012	1.052**	0.002
Breadth of Brown kernel (mm)	0.0005	0.134**	0.001
L/B ratio of brown kernel	0.0008	0.558**	0.003
Yield plant^{-1} (g)	0.253	68.035**	1.037

*Note: Figures in the parentheses are the respective degree of freedom, ** significant at 1% level*

Short Communication

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High estimates of GCV and PCV were obtained for grain yield per plant, number of grains per panicle, number of effective tillers plant^{-1}, plant height, L/B of rough rice and 1000 grain weight. Ganshan *et al.* (1995), Sawant *et al.* (1995), Nayak *et al.* (2002), Singh *et al.*(2002) and Chand *et al.* (2004) reported high GCV and PCV for grain yield plant^{-1} and number of grains panicle^{-1}. High heritability was observed for most of the characters studied *viz.*, plant height, number of grains panicle^{-1}, breadth of rough rice, L/B of rough rice, length and breadth of brown kernel, L/B ratio of brown kernel and 1000 grain weight. The characters like panicle length, number of effective tillers plant^{-1}, yield plant^{-1} had also shown high heritability except length of rough rice where it was least. Such findings were also reported earlier by Sawant *et al.* (1994) and Bharadwaj *et al.* (2007). Significant positive correlation was found to be present between 1000 grain weight and yield plant^{-1} both at genotypic and phenotypic levels and similarly association of the trait was found with breadth of rough and brown rice. Abd-El-Samie and Hassaan (1994), Padmavathi *et al.* 1996), Marekar and Siddiqui (1996), Sarawgi *et al.*(1997), Luzi – Kihupi (1998), Sinha *et al.* (2004) and Veni *et al.* (2007) have found significant positive association of this character with yield. As the trait had shown significant association with yield and breadth of kernel, it can be used for development of bold seeded high yielding varieties. Length and breadth of brown kernel exhibited positive association with yield plant^{-1} though not significant. Though L/B ratio of brown kernel and number of grains panicle^{-1} showed high magnitude of direct positive effect it showed very low correlation coefficient with yield and the positive effect may be negated by indirect negative contribution via breadth of brown kernel, length of brown kernel and L/B of rough rice for L/B ratio of brown kernel and breadth of brown kernel for number of grains panicle^{-1}. The character 1000 grain weight had also shown significant positive association with grain yield accompanied by high positive direct effect which was immediately followed by breadth of brown kernel and these traits could be effectively employed for yield improvement in rice. Sawant *et al.* (1995), Santhakumar *et al.* (1998), Singh *et al.* (1998) and Khedikar *et al.* (2004) observed positive association of 1000 grain weight with yield. Shanthala *et al.* reported positive association between yield and L/B ratio of brown kernel and as it had shown highest direct effect on grain yield, so the characters may be employed for yield improvement through selection of reduced breadth of brown kernel. Yield plant^{-1} followed by number of effective tillers plant^{-1}, plant height, L/B ratio of rough rice, number of grains panicle^{-1} had shown highest percentage of genetic advance over mean and the characters were also coupled with high heritability and thus it could be predicted that the traits were predominantly controlled by additive gene action providing enough scope for rice improvement with the help of simple breeding methods. In addition characters like number of effective tillers plant^{-1} and number of grains panicle^{-1} also had positive correlation with high positive direct effect on yield. So, these characters are also expected to bring effective yield improvement. Ultimately, the characters, *viz.*, numbers of effective tillers plant^{-1}, number of grains panicle^{-1}, 1000 grain weight, length of rough rice, breadth of brown kernel and L/B of brown kernel were found to be important for selection of high yielding lines in rice.

Table 2: Genetic parameters of different yield attributing traits and correlation coefficients with yield

Characters	Grand Mean	Range	Variances			CV	GCV	PCV	H^2	GA
			PV	GV	EV					
Plant height (cm)(X1)	108.26	82.83-141.85	411.64	409.65	1.98	1.3	18.7	18.7	99.5	41.6
Panicle length (cm)(X2)	26.90	22.02-32.92	10.45	9.50	0.96	3.6	11.5	12.0	90.8	6.1
No. of effective tillers plant^{-1}(X3)	10.55	7.85-15.56	5.33	4.96	0.37	5.7	21.1	21.9	93.0	4.4
No. of grain panicle^{-1}(X4)	151.46	106.78-189.45	725.12	722.74	2.38	1.0	17.7	17.8	99.6	55.3
Length of rough rice (mm) (X5)	8.92	7.79-11.40	0.96	0.52	0.44	7.4	8.1	11.0	54.1	1.1
Breadth of rough rice (mm) (X6)	2.24	1.84-3.06	0.12	0.12	0.00	1.3	15.6	15.7	99.3	0.7
L/B rough rice (mm) (X7)	4.11	2.89-5.86	0.54	0.54	0.00	1.5	17.9	17.9	99.2	1.5
Length of brown kernel (mm) (X8)	6.72	5.99-8.49	0.35	0.35	0.00	0.7	8.8	8.8	99.2	1.2
Breadth of brown kernel (mm) (X9)	1.93	1.65-2.42	0.05	0.04	0.00	1.6	10.9	11.0	97.7	0.4
L/B brown kernel (mm) (X10)	3.51	2.55-4.34	0.19	0.19	0.00	1.5	12.3	12.4	98.0	0.9
1000 grain weight (g) (X11)	19.15	15.12-26.22	10.49	10.12	0.37	3.2	16.6	16.9	96.4	6.4
Yield plant^{-1} (g)(Y)	15.46	9.19-25.27	23.37	22.33	1.04	6.6	30.6	31.3	95.5	9.5

Table 3: The Genotypic (G) and phenotypic (P) correlation coefficients between yield and its attributing traits

Characters		No. of effective tillers plant^{-1}	Panicle length (cm)	No. of grain panicle^{-1}	1000 grain weight (g)	Length of rough rice (mm)	Breadth of rough rice (mm)	L/B of rough rice (mm)	Length of brown kernel (mm)	Breadth of brown kernel (mm)	L/B of brown rice (mm)	Yield plant^{-1} (g)
Plant height (cm)	G	-0.142	0.617*	0.123	-0.283	0.105	-0.217	0.190	-0.423*	-0.305	-0.045	-0.152
	P	-0.137	0.597*	0.123	-0.275	0.081	-0.214	0.190	-0.421	-0.301	-0.045	-0.155
No. of effective tillers plant^{-1}	G		-0.310	-0.145	0.087	0.018	0.266	-0.236	0.333	0.378	-0.114	0.328
	P		-0.318	-0.141	0.074	0.009	0.261	-0.229	0.329	0.357	-0.099	0.301
Panicle length (cm)	G			0.324	0.367	0.163	-0.444*	0.492*	-0.139	-0.502*	0.350	-0.042
	P			0.310	0.317	0.126	-0.423*	0.471*	-0.136	-0.474*	0.328	-0.045
No. of grains panicle^{-1}	G				0.332	-0.164	-0.430*	0.389	-0.130	-0.394	0.261	0.194
	P				0.327	-0.119	-0.428*	0.387	-0.128	-0.387	0.256	0.188
1000 grain weight (g)	G					0.032	0.774**	-0.581*	0.155	0.779**	-0.510*	0.515*
	P					0.025	0.759**	-0.570*	0.153	0.766**	-0.504*	0.492*
Length of rough rice (mm)	G						0.025	0.463*	0.614**	0.055	0.395	0.167
	P						0.020	0.350	0.446*	0.037	0.287	0.097
Breadth of rough rice (mm)	G							-0.858**	0.056	0.927**	-0.719**	0.240
	P							0.853**	0.056	0.914**	-0.710**	0.230
L/B of rough rice (mm)	G								0.191	-0.789**	0.806**	0.019
	P								0.88	-0.781**	0.797**	0.015
Length of brown kernel (mm)	G									0.137	0.563*	0.390
	P									0.143	0.554*	0.373
Breadth of brown kernel (mm)	G										-0.732**	0.316
	P										-0.733**	0.299
L/B of brown kernel (mm)	G											0.045
	P											0.042

*, ** *Significant at 5% and 1% level of significance, respectively*

Table 4: Path analysis of yield attributing characters with yield

Characters	Plant height (cm)	No of effective tillers plant $^{-1}$	Panicle length (cm)	No. of grains panicle^{-1}	1000 grain weight (g)	Length of rough rice (mm)	Breadth of rough rice (mm)	L/B rough rice	Length of brown kernel (mm)	Breadth of brown kernel (mm)	L/B brown kernel	Genotyic Yield plant^{-1}
Plant height (cm)	0.159	-0.139	-0.169	0.0943	-0.298	0.057	0.438	-0.126	4.712	0.840	-0.140	-0.152
No of effective tillers plant^{-1}	-0.022	0.976	0.084	-0.111	0.091	0.009	-0.536	0.157	-3.709	1.041	-0.351	0.328
Panicle length (cm)	0.098	-0.303	-0.273	0.248	-0.387	0.089	0.895	-0.328	1.548	-1.383	1.0830	-0.042
No of grains panicle^{-1}	0.019	-0.141	-0.088	0.767	-0.350	-0.090	0.866	-0.259	1.448	-1.085	0.807	0.194
1000 grain weight (g)	-0.045	0.084	0.100	-0.254	1.055	0.017	-1.561	0.388	-1.720	2.146	-1.576	0.515*
Length of rough rice (mm)	0.016	0.017	-0.044	-0.125	0.033	0.550	-0.049	-0.309	-6.831	0.150	1.223	0.167
Breadth of rough rice(mm)	-0.034	0.259	0.121	-0.330	0.817	0.013	-2.016	0.572	-0.627	2.55	-2.224	0.240
L/B rough rice (mm)	0.030	-0.230	-0.134	0.298	-0.613	0.254	1.728	-0.668	-2.129	-2.173	2.493	0.019
Length of brown kernel(mm)	-0.067	0.325	0.038	-0.099	0.163	0.337	-0.113	-0.127	-11.132	0.378	1.742	0.390
Breadth of brown kernel (mm)	-0.048	0.369	0.137	-0.302	0.871	0.30	-1.868	0.526	-1.530	2.755	-2.265	0.316
L/B brown kernel (mm)	-0.00	0.110	-0.095	0.200	-0.538	0.217	1.44	-0.538	-6.268	-2.016	3.094	0.045

Note: Residual effect = 0.424 *, ** *Significant at 5% and 1% level of significance, respectively*

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