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Character association and path coefficient analysis for grain yield of parents and hybrids in rice (*Oryza sativa* L.)

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Abstract: An experiment was conducted to study the inter-relationships, direct and indirect effects of various yield attributing characters towards grain yield per plant, at Rice Research Centre, Rajendranagar. Grain yield per plant had significant positive correlation with productivity per day (0.97), panicle weight (0.71), number of filled grains per panicle (0.57), panicle length (0.46), number of productive tillers per plant (0.34), days to 50 per cent flowering (0.23) and plant height (0.16).Path analysis revealed that productivity/ day (0.91) was the major contributor for grain yield followed by, days to 50 per cent flowering (0.19), grain length (0.05), number of productive tillers per plant (0.04), panicle weight (0.04) and number of filled grains per panicle (0.04). It can be concluded from the study that, the above characters can be used as the selection criteria in any rice yield improvement breeding programmes.

Keywords: Direct effects, Indirect effects, Phenotypic correlation, Selection

INTRODUCTION

As rice is the staple food in most parts of India providing 43 per cent of calorie requirement for more than 70 per cent of Indian population and there is a need to increase production of rice and productivity of land under rice cultivation. India has the largest acreage under rice at 44 M. ha (22% of cropped area) with annual production of 106.65 MT in the year 2013-14 as per Agricultural Statistics Division, Directorate of Economics & Statistics, Department of Agriculture and Cooperation. However, crop yield is the end product of the interaction of a number of other interrelated attributes. A thorough understanding of the interaction of characters among themselves had been of great use in plant breeding. The efficiency of selection for yield mainly depends on the direction and magnitude of association between yield and its component characters and also among themselves. Character association provides information on the nature and extent of association between pairs of metric traits and helps in selection for the improvement of the character. Correlation gives only the relation between two variables whereas path coefficient analysis allows separation of the direct effect and their indirect effects through other attributes by partitioning the correlations (Wright, 1921). Path analysis is that, it permits the partitioning of the correlation coefficient into its components, one component being the path coefficient that measures the direct effect of a predictor variable upon its response variable; the second component being the indirect effect(s) of a predictor variable on the response variable through another predictor variable (Dewey and Lu, 1959). This study made an attempt to identify the genetic variability in the parents and the hybrids that are obtained by crossing them. Further an attempt was made to identify the major contributing characters for grain yield, their direct and indirect effects.

MATERIALS AND METHODS

This study involved 51 genotypes which includes, 15 parents (*i.e.*, Rajendra, MTU 1010, IR 64, KNM 118, NLR 33358, Satya, Varalu, RNR 15048, RNR 15038, Tellahamsa, RNR(RK) 28, RNR(RK) 53, IR 72081A, IR 68902A and IR 58025A) and 36 cross combinations among these parental lines, was conducted at Rice Research Centre, Rajendranagar during *Kharif 2014*. The experiment for studying character association and their direct and indirect effects on grain yield was laid in Randomized Block Design (RBD) with three replications. Twenty eight days old seedlings were transplanted in the main field and all the necessary package of practices were followed to raise a healthy crop. Observations were recorded on 16 characters *viz.*, days to 50 per cent flowering, plant height, panicle length, panicle weight, number of productive tillers per plant, number of unproductive tillers per plant, flag leaf length, flag leaf width, spikelet fertility%, number of filled grains per panicle, grain yield per plant, productivity/day, 1000 grain weight, grain length, grain breadth and grain length-breadth ratio and subjected to statistical analysis. Statistical analysis and methodology used to conduct this study, for the above charac-

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ters as per Singh and Chaudhary (1985) for correlation coefficient and Dewey and Lu (1959) for path analysis which were standard procedures used till today.

RESULTS AND DISCUSSION

Selection with complete knowledge of the magnitude and direction of association between, yield and its contributing characters is important in identifying the main characters that can be exploited for yield improvement through suitable breeding programmes. Phenotypic and genotypic correlations between yield and yield components *viz.*, days to 50 per cent flowering, plant height, panicle length, panicle weight, number of productive tillers per plant, number of unproductive tillers per plant, flag leaf length, flag leaf width, spikelet fertility%, number of filled grains per panicle, grain yield per plant, productivity/day, 1000 grain weight, grain length, grain breadth and grain length-breadth ratio were estimated. In general, genotypic correlations were found to be higher than phenotypic correlations, which indicate that though there is strong inherent association between characters studies, its expression is lessened due to influence of environment and considering the importance of phenotypic correlation it was discussed in the results which were presented in Table 1.

Days to 50 per cent flowering recorded a significant positive phenotypic correlation with grain yield per plant, plant height, panicle length, number of filled grains per panicle, and grain length-breadth ratio while negative significant correlation with grain breadth. Bhadru *et al.* (2011) and Patel *et al.* (2014) also reported significant positive phenotypic correlation of days to 50 per cent flowering with grain yield per plant. The plant height recorded a significant positive phenotypic correlation with, grain yield per plant, days to 50 per cent flowering, panicle length, flag leaf width, spikelet fertility %, number of filled grains per panicle and grain length-breadth ratio. The significant positive phenotypic correlation of plant height with, grain yield per plant was also reported earlier by Bhadru *et al.* (2011), Eswara Reddy *et al.* (2013) and Patel *et al.* (2014). While negative and significant correlation of plant height was observed with number of unproductive tillers/ plant, flag leaf length and grain breadth where as significant positive correlation with flag leaf length was reported by Bhadru *et al.* (2011). Panicle length recorded a significant positive phenotypic correlation with, grain yield per plant, days to 50 per cent flowering, plant height, panicle weight, number of filled grains per panicle, productivity/ day and grain length-breadth ratio. Significant positive phenotypic correlation of panicle length with, grain yield per plant was also reported by Bhadru *et al.* (2011) and Patel *et al.* (2014). Panicle weight recorded a significant positive phenotypic correlation with, grain yield per plant, panicle length, number of filled grains per panicle, productivity/ day, as reported earlier by Bhadru *et al.* (2011) while negative significant for number of productive tillers/ plant and grain breadth. Number of productive tillers per plant exhibited significant positive phenotypic correlation with grain yield per plant and productivity/ day while significant negative correlation with panicle weight, unproductive tillers/ plant and number of filled grains per panicle but, in contrast positive significant correlation of number of productive tillers with number of filled grains per panicle was reported by Seyoum *et al.* (2012) and Patel *et al.* (2014). Sabesan *et al.* (2009), Patel *et al.* (2014) and Moosavi *et al.* (2015) also reported desirability of significant positive phenotypic correlation of number of productive tillers per plant, with grain yield per plant. Number of unproductive tillers per plant exhibited significant negative phenotypic correlation with grain yield per plant, plant height, number of productive tillers/ plant and productivity/ day whereas contrary to above, significant positive correlation with number of productive tillers/ plant was reported by Bhadru *et al.* (2011). Flag leaf length showed significant negative correlation with plant height and spikelet fertility % where as it was reported that plant height showed significant positive correlation by Bhadru *et al.* (2011) and Eswara Reddy *et al.* (2013). Flag leaf width showed significant negative correlation with spikelet fertility % and 1000 grain weight where as it was reported significant positive correlation with 1000 grain weight by Bhadru *et al.* (2011) and Eswara Reddy *et al.* (2013).

Spikelet fertility % showed significant negative correlation with grain yield per plant, flag leaf length, flag leaf width and significant positive correlation with plant height. Number of filled grains per panicle exhibited a significant positive phenotypic correlation with grain yield per plant, days to 50 per cent flowering, plant height, panicle length, panicle weight, productivity/ day, grain breadth and grain length-breadth ratio. Bhadru *et al.* (2011), Seyoum *et al.* (2012) and Patel *et al.* (2014) also reported the desirability of significant negative correlation of Spikelet fertility % with grain yield per plant. It has significant negative correlation with number of productive tillers/ plant and grain length whereas significant positive correlation with number of productive tillers/ plant was reported by Seyoum *et al.* (2012) and Patel *et al.* (2014). Productivity per day exhibited a significant positive phenotypic correlation with, grain yield per plant, panicle length, panicle weight, number of productive tillers/ plant and number of filled grains per panicle whereas significant negative correlation with number of unproductive tillers/plant. Bhadru *et al.* (2011) also reported significant positive phenotypic correlation of productivity per day with, grain yield per plant.1000 grain weight has positive significant correlation with grain length and grain breadth as reported by Patel *et al.* (2014) whereas significant negative correlation with flag leaf width and grain length-breadth ratio and similar results pertaining to flag leaf width was reported by Bhadru *et al.* (2011). Grain length showed significant

positive correlation with 1000 grain weight and grain length-breadth ratio as reported by Patel *et al.* (2014) whereas significant negative correlation with number of filled grains per panicle. Grain breadth showed significant positive correlation with number of filled grains per panicle and 1000 grain weight as reported by Sabesan *et al.* (2009) and Patel *et al.* (2014) for 1000 grain weight whereas for number of filled grains per panicle significant negative correlation was reported by Sabesan *et al.* (2009). Grain breadth showed, significant negative correlation with days to 50 per cent flowering, plant height, panicle weight and grain length-breadth ratio where significant negative correlation of grain breadth pertaining to grain length-breadth ratio was reported by Patel *et al.* (2014). Grain length-breadth ratio showed significant positive correlation with days to 50 per cent flowering, plant height, panicle length, number of filled grains per panicle and grain length and significant negative correlation with 1000 grain weight and grain breadth where significant positive correlation of grain length-breadth ratio with plant height, panicle length and grain length was also reported by Patel *et al.* (2014).

As simple correlation does not provide the true contribution of the characters towards the yield, these genotypic correlations were partitioned into direct and indirect effects through path coefficient analysis. It allows separating the direct effect and their indirect effects through other attributes by partitioning the correlations (Wright, 1921) for better interpretation of cause and effect relationship. The estimates of path coefficient analysis are provided for yield and yield component characters in Table 2. Among all the characters productivity/ day was the major contributor for grain yield followed by, days to 50 per cent flowering, grain length, number of productive tillers per plant, panicle weight, number of filled grains per panicle, 1000 grain weight, flag leaf width, flag leaf length, number of unproductive tillers per plant. These characters showed direct positive effects for grain yield per plant. On other hand characters that had negative direct effect include plant height, panicle length, spikelet fertility percent, grain breadth and grain length-breadth ratio. Days to 50 per cent flowering, had positive indirect effect with grain yield through, panicle weight, number of productive tillers per plant, flag leaf width, number of filled grains per panicle, productivity/ day, grain length and grain breadth. Plant height had positive indirect effect with grain yield through days to 50 per cent flowering, panicle weight, number of productive tillers/ plant, flag leaf width, number of filled grains per panicle, productivity/ day and grain breadth. Panicle length had positive indirect effect with grain yield through days to 50 per cent flowering, panicle weight, number of productive tillers per plant, number of filled grain per panicle, productivity/ day, 1000 grain weight, grain length and grain breadth. Panicle weight had positive indirect effect with grain yield through, days to 50 per cent flowering, number of unproductive tillers/ plant, flag leaf length, number of filled grain per panicle, productivity/ day and grain breadth. Number of productive tillers per plant had positive indirect effect with grain yield through, days to 50 per cent flowering, flag leaf width, spikelet fertility %, productivity/ day and grain length-breadth ratio. Flag leaf length had positive indirect effect with grain yield through, plant height, panicle length, panicle weight, number of unproductive tillers/ plant, flag leaf width, spikelet fertility %, productivity/ day, 1000 grain weight, grain length and grain length-breadth ratio. Number of filled grains per panicle had positive indirect effect with grain yield through, days to 50 per cent flowering, panicle weight, number of unproductive tillers per plant, flag leaf width, productivity/ day and grain breadth. Productivity per day positive indirect effect with grain yield through, days to 50 per cent flowering, panicle weight, number of productive tillers per plant, flag leaf length, spikelet fertility %, number of filled grains per panicle, 1000 grain weight and grain breadth. Grain length-breadth ratio had positive indirect effect with grain yield through days to 50 per cent flowering, panicle weight, flag leaf width, number of filled grains per panicle, productivity/ day, grain length and grain breadth. Bhadru *et al.* (2011) reported the positive direct effects of productivity/ day, days to 50 per cent flowering, grain length, number of productive tillers per plant, panicle weight, number of filled grains per panicle, 1000 grain weight, flag leaf length, number of unproductive tillers per plant, plant height, panicle length, grain breadth and grain length-breadth ratio and negative direct effects of flag leaf width and spikelet fertility percent, on grain yield per plant.

Earlier Panwar and Mashiat Ali (2007) also reported negative indirect effect of 1000 grain weight through panicle length on grain yield where as Yugandhar Reddy *et al.* (2008) and Eswara Reddy *et al.* (2013) reported positive indirect effect of 1000 grain weight through panicle length on grain yield. Ekka *et al.* (2011) reported negative indirect effect of grain length through number of filled grains on rice grain yield and Patel *et al.* (2014) also reported negative indirect effect of grain breadth through grain length on the rice grain yield. In present study, number of unproductive tillers per plant had negative indirect effects with grain yield through days to fifty percent flowering, number of productive tillers per plant, spikelet fertility %, productivity/ day and grain breadth. Flag leaf width had negative indirect effect with grain yield through, plant height, panicle weight, productivity/ day, 1000 grain weight and grain length-breadth ratio. Spikelet fertility % had negative indirect effect with grain yield through, plant height, panicle length, number of productive tillers/ plant, flag leaf length, flag leaf width, productivity/ day, 1000 grain weight, grain length and grain length-breadth ratio. 1000 grain weight had negative indirect effect with grain yield through, days to 50 per cent flowering, panicle length, panicle weight, number of productive tillers per plant, flag leaf width,

Table 1. Estimates of phenotypic and genotypic correlation coefficients among the yield and its attributing characters.

Trait		DF	PH	PL	P WT	P TIL	UP TIL	FL	FW	S F(%)	FG/ P	PDP	1000 GW	GL	GB	L/ B	GYP
DF	P	1.0000	0.2471**	0.2434**	0.1119	0.1097	-0.1164	-0.0681	0.1170	0.1280	0.1726*	0.0368	-0.0637	0.0833	-0.2814**	0.2735**	0.2337**
	G	1.0000	0.1431	0.0995	0.1319	-0.1015	-0.1075	-0.1672	0.1403	0.1621	0.2143	-0.0615	-0.0895	0.0960	-0.3645	0.3500	0.1082
PH	P		1.0000	0.4856**	0.1080	0.0735	-0.1706*	-0.1894**	0.2958**	0.2254 **	0.2111**	0.1174	-0.0685	-0.0218	-0.2535**	0.1986*	0.1609*
	G		1.0000	0.5729	0.1116	-0.0221	-0.1570	-0.2579	0.3180	0.2452	0.2222	0.0617	-0.0778	-0.0242	-0.2680	0.2138	0.0855
PL	P			1.0000	0.3606**	0.1499	-0.1518	-0.1021	-0.0948	0.0765	0.2685**	0.4420**	0.1226	0.0747	-0.1544	0.1659*	0.4641**
	G			1.0000	0.4704	0.0594	-0.2365	-0.2248	-0.1593	0.0989	0.3636	0.4913	0.1171	0.0965	-0.2135	0.2353	0.4913
PWT	P				1.0000	-0.3467**	0.1260	0.0167	-0.1048	0.0202	0.8023**	0.7026**	0.0515	-0.0976	-0.2104**	0.1174	0.7130**
	G				1.0000	-0.3643	0.1309	0.0138	-0.1127	-0.0122	0.8058	0.7233	-0.0749	-0.0963	-0.2244	0.1276	0.7458
P TIL	P					1.0000	-0.5544**	-0.0080	0.0251	-0.0497	-0.2585**	0.3376**	0.0236	-0.0336	0.1053	-0.0844	0.3400**
	G					1.0000	-0.5892	-0.0584	0.0244	-0.0302	-0.2725	0.3048	-0.0180	-0.0364	0.1274	-0.0990	0.2766
UP TIL	P						1.0000	0.0589	0.1148	0.0233	0.0707	-0.2628**	0.0987	0.0176	0.1288	-0.0845	-0.2691**
	G						1.0000	0.0699	0.1267	0.0257	0.0745	-0.2733	0.0998	0.0140	0.1553	-0.1082	-0.2748
FL	P							1.0000	0.0459	-0.1868 *	-0.0125	0.0327	0.0493	0.0878	0.0893	-0.0111	0.0301
	G							1.0000	0.0358	-0.1945	-0.0103	-0.0012	0.0405	0.0962	0.0982	-0.0116	-0.0102
FW	P								1.0000	-0.2238**	0.0693	-0.0976	-0.2104**	0.0163	-0.1009	0.1120	-0.0542
	G								1.0000	-0.2297	0.0705	-0.1096	-0.2245	0.0243	-0.1182	0.1305	-0.0678
S F (%)	P									1.0000	0.0704	-0.0391	-0.0414	-0.0854	-0.1183	0.0328	-0.0181
	G									1.0000	0.0450	-0.0568	-0.0425	-0.0914	-0.1259	0.0346	-0.0342
FG/ P	P										1.0000	0.5325**	0.5920	-0.2619**	0.5734**	0.3357**	0.5686**
	G										1.0000	0.5492	-0.6074	-0.2676	-0.6057	0.3554	0.5956
PDP	P											1.0000	0.0147	-0.1068	-0.0865	0.0216	0.9742**
	G											1.0000	-0.0024	-0.1038	-0.0945	0.0304	0.9846
1000 GW	P												1.0000	0.2791**	0.6223**	-0.3584**	-0.0159
	G												1.0000	0.2977	0.6701	-0.3833	-0.0328
GL	P													1.0000	-0.0872	0.6033**	-0.0912
	G													1.0000	-0.0623	0.5993	-0.0919
GB	P														1.0000	-0.3584**	-0.1564
	G														1.0000	-0.8307	-0.1673
L/ B	P															1.0000	0.0863
	G															1.0000	0.0972

DF-Days to 50% flowering; PH-Plant height; PL-Panicle length; PWT- Panicle weight; P TIL- No. of Productive tillers per plant; UP TIL- No. of unproductive tillers per plant; FL- Flag leaf length; FW-Flag leaf width; S F(%)- spikelet fertility%; FG/ P- No. of filled grains per panicle; PDP- Productivity per day; 1000GW-1000 Grain weight; GL-Grain length; GB- Grain breadth; L/B- Length-Breadth ratio; GYP- Grain yield per plant P- Phenotypic correlation coefficient , G- Genotypic correlation coefficient ** Significant at 1% level of significance; * Significant at 5 % level of significance

Table 2. Estimates of direct and indirect effects of various yield attributing characters.

Trait		DF	PH	PL	P WT	P TIL	UP TIL	FL	FW	S F(%)	FG/ P	PDP	1000 GW	GL	GB	L/ B	GYP
DF	P	0.1859*	-0.0010	-0.0037	0.0047	0.0048	-0.0004	-0.0008	0.0020	-0.0003	0.0064	0.0336	-0.0014	0.0039	0.0249	-0.0248	0.2337**
	G	0.1768*	0.0024	-0.0017	0.0008	0.0027	-0.0022	-0.0032	0.0003	-0.0004	-0.0143	-0.0642	0.0031	-0.0092	-0.0369	0.0542	0.1082
PH	P	0.0459	-0.0039	-0.0073	0.0045	0.0032	-0.0006	-0.0021	0.0050	-0.0005	0.0078	0.1070	-0.0015	-0.0010	0.0225	-0.0180	0.1609*
	G	0.0253	0.0164	-0.0100	0.0007	0.0006	-0.0032	-0.0049	0.0008	-0.0007	-0.0149	0.0644	0.0027	0.0023	-0.0272	0.0331	0.0855
PL	P	0.0452	-0.0019	-0.0151	0.0151	0.0065	-0.0006	-0.0011	-0.0016	-0.0002	0.0099	0.4031**	0.0026	0.0035	0.0137	-0.0151	0.4641**
	G	0.0176	0.0094	-0.0174	0.0030	-0.0016	-0.0049	-0.0043	-0.0004	-0.0003	-0.0243	0.5128**	-0.0040	-0.0092	-0.0216	0.0364	0.4913**
PWT	P	0.0208	-0.0004	-0.0054	0.0418	-0.0151	0.0005	0.0002	-0.0018	0.0000	0.0296	0.6406**	-0.0011	-0.0045	0.0186	-0.0107	0.7130**
	G	0.0233	0.0018	-0.0082	0.0064	0.0097	0.0027	0.0003	-0.0003	0.0000	-0.0539	0.7551**	0.0026	0.0092	-0.0227	0.0197	0.7458**
P TIL	P	0.0204	-0.0003	-0.0023	-0.0145	0.0437	-0.0021	-0.0001	0.0004	0.0001	-0.0095	0.3079**	-0.0005	-0.0016	-0.0093	0.0077	0.3400**
	G	-0.0179	-0.0004	-0.0010	-0.0023	-0.0266	-0.0121	-0.0011	0.0001	0.0001	0.0182	0.3182**	0.0006	0.0035	0.0129	-0.0153	0.2766**
UP TIL	P	-0.0216	0.0007	0.0023	0.0053	-0.0242	0.0038	0.0007	0.0019	-0.0001	0.0026	-0.2396**	0.0021	0.0008	-0.0114	0.0077	-0.2691**
	G	-0.0190	-0.0026	0.0041	0.0008	0.0157	0.0206	0.0013	0.0003	-0.0001	-0.0050	-0.2853**	-0.0034	-0.0013	0.0157	-0.0167	-0.2748**
FL	P	-0.0127	0.0007	0.0015	0.0007	-0.0004	0.0002	0.0112	0.0008	0.0004	-0.0005	0.0298	0.0010	0.0041	-0.0079	0.0010	0.0301
	G	-0.0296	-0.0042	0.0039	0.0001	0.0016	0.0014	0.0189	0.0001	0.0005	0.0007	-0.0012	-0.0014	-0.0092	0.0099	-0.0018	-0.0102
FW	P	0.0217	-0.0012	0.0014	-0.0044	0.0011	0.0004	0.0005	0.0169	0.0005	0.0026	-0.0890	-0.0045	0.0008	0.0089	-0.0102	-0.0542
	G	0.0248	0.0052	0.0028	-0.0007	-0.0006	0.0026	0.0007	0.0024	0.0006	-0.0047	-0.1144	0.0077	-0.0023	-0.0120	0.0202	-0.0678
S F (%)	P	0.0238	-0.0009	-0.0012	0.0008	-0.0022	0.0001	-0.0021	-0.0038	-0.0023	0.0026	-0.0356	-0.0009	-0.0040	0.0105	-0.0030	-0.0181
	G	0.0287	0.0040	-0.0017	-0.0001	0.0008	0.0005	-0.0037	-0.0005	-0.0027	-0.0030	-0.0593	0.0015	0.0087	-0.0128	0.0054	-0.0342
FG/ P	P	0.0321	-0.0008	-0.0041	0.0336	-0.0113	0.0003	-0.0001	0.0012	-0.0002	0.0369	0.4855**	-0.0126	-0.0122	0.0508	-0.0305	0.5686**
	G	0.0379	0.0037	-0.0063	0.0052	0.0073	0.0015	-0.0002	0.0002	-0.0001	-0.0669	0.5733**	0.0209	0.0255	-0.0614	0.0550	0.5956**
PDP	P	0.0068	-0.0005	-0.0067	0.0294	0.0147	-0.0010	0.0004	-0.0017	0.0001	0.0197	0.9118**	0.0003	-0.0050	0.0077	-0.0020	0.9742**
	G	-0.0109	0.0010	-0.0085	0.0047	-0.0081	-0.0056	0.0000	-0.0003	0.0002	-0.0367	1.0439**	0.0001	0.0099	-0.0096	0.0047	0.9846**
1000	P	-0.0118	0.0003	-0.0019	-0.0022	-0.0010	0.0004	0.0006	-0.0036	0.0001	-0.0219	0.0134	0.0212	0.0130	-0.0551	0.0325	-0.0159
GW	G	-0.0158	-0.0013	-0.0020	-0.0005	0.0005	0.0021	0.0008	-0.0005	0.0001	0.0406	-0.0025	-0.0344	-0.0284	0.0679	-0.0593	-0.0328
GL	P	0.0155	0.0001	-0.0011	-0.0041	-0.0015	0.0001	0.0010	0.0003	0.0002	-0.0097	-0.0974	0.0059	0.0466	0.0077	-0.0548	-0.0912
	G	0.0170	-0.0004	-0.0017	-0.0006	0.0010	0.0003	0.0018	0.0001	0.0002	0.0179	-0.1083	-0.0103	-0.0953	-0.0063	0.0928	-0.0919
GB	P	-0.0523	0.0010	0.0023	-0.0088	0.0046	0.0005	0.0010	-0.0017	0.0003	-0.0212	-0.0789	0.0132	-0.0041	-0.0885	0.0763	-0.1564
	G	-0.0644	-0.0044	0.0037	-0.0014	-0.0034	0.0032	0.0019	-0.0003	0.0003	0.0405	-0.0986	-0.0231	0.0059	0.1013	-0.1286	-0.1673*
L/ B	P	0.0508	-0.0008	-0.0025	0.0049	-0.0037	-0.0003	-0.0001	0.0019	-0.0001	0.0124	0.0197	-0.0076	0.0281	0.0743	-0.0908	0.0863
	G	0.0619	0.0035	-0.0041	0.0008	0.0026	-0.0022	-0.0002	0.0003	-0.0001	-0.0238	0.0318	0.0132	-0.0571	-0.0842	0.1548	0.0972

DF-Days to 50% flowering; PH-Plant height; PL-Panicle length; PWT- Panicle weight; P TIL- No. of Productive tillers per plant; UP TIL- No. of unproductive tillers per plant; FL- Flag leaf length; FW-Flag leaf width; S F(%)-spikelet fertility%; FG/ P- No. of filled grains per panicle; PDP- Productivity per day; 1000GW-1000 Grain weight; GL-Grain length; GB- Grain breadth; L/B- Length-Breadth ratio; GYP-Grain yield per plant Phenotypic residual effect = 0.1015, Genotypic residual effect = 0.0234 ; P- Phenotypic level, G- Genotypic level ; Bold values - Direct effects, Normal Values - Indirect effects; ** Significant at 1%, * Significant at 5 %

number of filled grains per panicle and grain breadth. Grain length had negative indirect effect with grain yield through, panicle length, panicle weight, number of productive tillers per plant, number of filled grains per panicle, grain length-breadth ratio. Grain breadth had negative indirect effect with grain yield through, days to 50 per cent flowering, panicle weight, flag leaf width, number of filled grains per panicle, productivity/ day and grain length.

Conclusion

The study of phenotypic correlation studies showed that selection of plants with greater panicle length, more panicle weight, more number of filled grains per panicle, more number of productive tillers per plant, high productivity per day, more plant height and more days to 50 per cent flowering would result in improvement of yield. Path analysis revealed that number of productivity/ day, days to 50 per cent flowering, grain length, number of productive tillers per plant, panicle weight, number of filled grains per panicle, 1000 grain weight, flag leaf width, flag leaf length, number of unproductive tillers per plant are the most important characters which could be used as selection criteria for effective improvement of grain yield. Therefore, it is suggested that preference should be given to these characters in the selection programmes, to isolate superior lines with genetic potentiality for higher yield in rice genotypes.

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