



Research Note

Correlation and path coefficient analysis of yield and yield contributing traits in rice hybrids and their parental lines

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Abstract:

Correlation and path coefficient analysis was carried out for yield and yield components in 93 rice genotypes involving hybrids and their parental lines. Plant height, productivity per day, filled grains per panicle, days to 50 per cent flowering and panicle weight had a significant positive association with yield and also had a positive direct effect on yield both at the phenotypic and genotypic levels. These traits contributed maximum to higher grain yield compared to other characters, thus, selection for these characters helps in selection of superior cross combinations in hybrid rice.

Keywords: Hybrid rice, correlation, path analysis

Rice is the staple food for two thirds of the Indian population. It contributes 43 per cent of caloric requirement and 20-25% of agricultural income. In India, rice is grown in an area of 43.5 million ha (23% of gross cropped area) with an annual production of 90 million tons (Viraktamath and Sundaram, 2010). Yield is a complex character, which is highly influenced by the environment, hence direct selection for yield alone limit the selection efficiency and ultimately results in limited success in yield improvement. Thus, effective improvement in yield may be brought about through selection of yield component characters. Yield component characters show association among themselves and also with yield. Plant Breeder has to find significant correlations among yield and yield component traits, and effect of yield component traits on grain yield to predict the superior cross combinations and to select ideal plant type with increased yield. The present study was undertaken to derive information on correlation among yield and yield component traits and to estimate the direct and indirect effects of yield component traits on grain yield. This helps in selection of superior cross combinations in hybrid rice.

The material used in the present study consisted of 93 genotypes (68 hybrids, 21 parents and 4 checks). The experiment was carried out during *Kharif* 2008 at two locations viz., Regional Agricultural Research Station, Jagtial (Northern Telangana agro-climatic zone) and Agricultural Research Station, Kampasagar (Southern Telangana agro-climatic zone) of Andhra Pradesh. The experimental material was planted in Randomized block design with two replications. Each replication consisted of two rows of 4 m length with a spacing of 20 cm between the rows and 15cm between the plants. Observations were recorded on five randomly selected plants in each replication. The characters studied were days to 50% flowering, plant height (cm), panicle length (cm), panicle weight (g), flag leaf length (cm), flag leaf width (cm), productive tillers per plant, unproductive tillers per plant, filled grains per panicle, spikelet fertility (%), grain yield per plant (g), test weight (g) and productivity per day (kg/ha). Phenotypic and genotypic correlation coefficients were estimated by pooling the data of both the locations as per the procedure outlined by Panse and Sukhatme (1985). Path analysis was carried out following the method suggested by Dewey and Lu (1959).

Analysis of variance was significant for all the traits among the entries, indicating the presence of considerable genetic variation in the experimental material. Genotypic correlations were found to be higher than phenotypic correlations (Table 1) indicating a strong inherent association between the characters. The yield component traits such as days to 50 per cent flowering, plant height, panicle weight, filled grains per panicle and productivity per day exhibited significant positive association with grain yield per plant at both genotypic and phenotypic levels. The results were supported by the earlier findings of Vinothini and Ananda Kumar (2005) and Krishna *et al.*, (2008) for all the traits and Swain and Reddy (2006) for panicle weight. Panicle length showed significant and positive association with grain yield at genotypic level, which is in consonance with Yugandhar Reddy *et al.*, (2008). A significant negative association was observed between yield and its component traits such as flag leaf width and unproductive tillers per plant. It is contrary to earlier finding of Yugandhar Reddy *et al.*, (2008). The highest degree of associations were observed among the major yield component traits such as productivity per day, filled grains per panicle and panicle weight. These associations can be well utilized as an indicator of grain yield in designing selection strategies to improve the grain yield.

Association analysis among yield component characters revealed that days to 50 per cent flowering had positive significant association with plant height, panicle length, panicle weight, flag leaf width and productive tillers per plant. Similar positive association of days to 50 per cent flowering with other traits such as plant height (Panwar and Mashiat Ali, (2007), Anbumalarmathi and Nadarajan (2008)), with panicle length (Sharma and Sharma, (2007)) and with spikelet fertility per cent (Eradasappa *et al.*, (2007)) were reported. Panicle length, panicle weight, flag leaf length, flag leaf width, productive tillers per plant, productivity per day, spikelet fertility and filled grains per panicle showed significant positive association with plant height. Panicle length was positively correlated with panicle weight, flag leaf length, filled grains per panicle, productive tillers per plant and spikelet fertility. Panicle weight was positively correlated with flag leaf length, spikelet fertility and filled grains for panicle and productivity per day. Flag leaf length had positive association with flag leaf width, productive tillers per plant, filled grains per panicle, productivity per day and spikelet fertility with grain yield and selection would offer the scope for simultaneous improvement in all these traits in addition to improving the yield. Negative and

significant association observed days to 50 per cent flowering with productivity per day, flag leaf width with 1000 grain weight and productivity per day, productive tiller per plant with spikelet fertility and 1000 grain weight and unproductive tillers per plant with spikelet fertility.

The correlation coefficient alone is inadequate to interpret the cause and effect relationships among the traits and ultimately with yield. Path analysis technique furnishes a method portioning the correlation coefficients into direct and an indirect effect, provides the information on actual contribution of a trait on the yield. The path coefficient analysis revealed that productivity per day, days to 50 per cent flowering and flag leaf width had maximum direct effect on seed yield (Table 2). These results are in conformation with the earlier reports for days to 50 per cent flowering (Panwar and Mashiat Ali, (2007) and flag leaf width Yugandhar Reddy *et al.*, (2008). Plant height and productive tillers per plant exhibited less direct effects on grains per plant, which is in conformation with earlier reports of Eradasappa *et al.*, (2007) and Krishna *et al.*, (2008). Moderate to low level of indirect effect was exerted on grain yield per plant by productivity per day through plant height, panicle weight, flag leaf length, filled grains per panicle and 1000 grain weight at genotypic and phenotypic levels. Low level of positive indirect effect was exerted on grain yield per plant by days to 50 per cent flowering through plant height and productive tillers per plant (Krishna *et al.*, 2008) and panicle weight (Swain and Reddy (2006). Panicle length had a positive indirect effect on grain yield through days to 50 per cent flowering and plant height (Eradasappa *et al.*, (2007), panicle weight, flag leaf length and productivity per day. Filled grains per panicle had the indirect positive effect on grain yield through days to 50 per cent flowering (Krishna *et al.*, (2008), panicle weight and productivity per day. In plant breeding, it is very difficult to have complete knowledge of all component traits of yield. The residual effects permit precise explanation about the pattern of interaction of other possible components of yield. The phenotypic and genotypic residual effect recorded 0.2087 and 0.2646 respectively; it indicates the characters used in our experiments explain above 75 per cent of variations which may contribute to higher yields in rice.

It may be conclude that, plant height, productivity per day, filled grains per panicle, days to 50 per cent flowering and panicle weight had a significant positive association with yield and also had a positive direct effect on yield both at the phenotypic and



genotypic levels. These traits contributed maximum to higher grain yield compared to other characters, thus, selection for these characters helps in selection of superior cross combinations in hybrid rice.

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Table 1: Genotypic (G) and phenotypic (P) correlations for yield and yield contributing characters in hybrid rice

Character	Days to 50% Flowering	Plant Height (cm)	Panicles Length (cm)	Panicles Weight (g)	Flag Leaf Length (cm)	Flag Leaf Width (cm)	Productive Tillers per Plant	Unproductive Tillers per Plant	Spikelet fertility (%)	Filled Grains per Panicle	Grain Weight (g)	1000 Grain Weight (g)	Productivity per day	Grain yield/Plant
Days to 50% Flowering	1.000	0.110*	0.133**	0.169**	0.022	0.237**	0.115*	-0.025	-0.018	0.084	-0.028	1.000	-0.106*	0.12
	1.000	0.123*	0.244**	0.247**	0.0326	0.313**	0.216**	-0.058	-0.030	0.049	-0.0714	1.000	-0.125*	0.12
Plant Height (cm)	1.000	1.000	0.506**	0.126*	0.3293**	0.156**	0.149**	0.069	-0.0614	0.082	-0.0988	1.000	0.102*	0.12
	1.000	1.000	0.735**	0.173**	0.454**	0.200**	0.216**	0.088	-0.067	0.118*	-0.151**	1.000	0.139**	0.16
Panicles Length (cm)	1.000	1.000	1.000	0.221**	0.395**	0.058	0.113*	-0.037	0.074	0.134**	0.0226	1.000	0.082	0.00
	1.000	1.000	1.000	0.378**	0.589**	0.071	0.188**	-0.110*	0.150**	0.178**	0.0729	1.000	0.178**	0.19
Panicles Weight (g)	1.000	1.000	1.000	1.000	0.177**	-0.028	0.016	0.012	0.202**	0.427**	0.0105	1.000	0.217**	0.25
	1.000	1.000	1.000	1.000	0.239**	-0.054	-0.046	-0.248**	0.257**	0.585**	-0.0380	1.000	0.146**	0.22
Flag Leaf Length (cm)	1.000	1.000	1.000	1.000	1.000	0.162**	0.209**	-0.129**	0.090	0.147**	-0.0594	1.000	0.064	0.00
	1.000	1.000	1.000	1.000	1.000	0.216**	0.384**	-0.078	0.217**	0.279**	-0.0977	1.000	0.0651	0.00
Flag Leaf Width (cm)	1.000	1.000	1.000	1.000	1.000	1.000	0.196**	0.012	-0.097	-0.037	-0.1208*	1.000	-0.193**	-0.14
Productive tillers per plant	1.000	1.000	1.000	1.000	1.000	1.000	0.304**	0.007	-0.151**	-0.075	-0.151**	1.000	-0.334**	-0.24
	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.198**	-0.193**	0.086	-0.1311*	1.000	0.064	0.00
Un Productive tillers per Plant	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.325**	-0.365**	-0.042	-0.213**	1.000	-0.141**	-0.00
	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	-0.265**	0.069	-0.0230	1.000	0.039	0.00
Spikelet fertility (%)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	-0.496**	-0.168**	-0.0083	1.000	-0.185**	-0.17
	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.277**	-0.014	1.000	-0.021	-0.00
Filled grains per Panicle	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.430**	-0.048	1.000	-0.006	-0.00
	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	-0.086	1.000	0.225**	0.26
1000 Grain Weight (g)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	-0.145**	1.000	0.323**	0.34
	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.040	0.00
Productivity/day (kg/ha)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.101*	0.00
	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.95
Yield/plant (g)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.96
	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.00

Table 2: Genotypic (G) and phenotypic (P) path coefficients for yield and yield contributing characters in Hybrid rice

Character	Days to 50% Flowering	Plant Height (cm)	Panicle Length (cm)	Panicle Weight (g)	Flag Leaf Length (cm)	Flag Leaf Width (cm)	Productive tillers per Plant	Unproductive tillers per Plant	Spikelet Fertility (%)	Filled grains per Panicle	1000 Grain Weight (g)	Productivity per day (kg/ha)	Grain yield Plant
Days to 50% Flowering	P 0.227	0.001	-0.004	0.001	0.001	-0.004	0.001	0.001	0.003	0.003	0.002	-0.102	0.12
Flowering	G 0.258	0.001	-0.013	0.011	0.0013	-0.001	0.005	-0.001	-0.001	-0.001	0.002	-0.127	0.12
Plant Height (cm)	P 0.025	0.008	-0.013	0.001	0.0014	-0.003	0.003	-0.002	0.001	0.003	0.001	0.098	0.12
	G 0.032	0.009	-0.055	0.007	0.0183	-0.001	0.005	0.002	-0.001	-0.002	0.004	0.142	0.16
	P 0.030	0.004	-0.025	0.001	0.002	-0.001	0.002	0.001	-0.001	0.005	-0.001	0.079	0.09
Panicle Length (cm)	G 0.063	0.007	-0.075	0.016	0.024	-0.002	0.005	-0.002	0.001	-0.004	-0.002	0.161	0.19
	P 0.038	0.001	-0.005	0.002	0.001	0.001	0.001	-0.003	-0.003	0.015	-0.001	0.211	0.25
Panicle Weight (g)	G 0.064	0.002	-0.028	0.043	0.011	0.002	-0.001	-0.005	0.002	-0.012	0.001	0.148	0.22
Flag Leaf Length (cm)	P 0.005	0.002	-0.009	0.001	0.004	-0.003	0.001	0.003	-0.002	0.005	0.001	0.062	0.00
	G 0.008	0.004	-0.044	0.010	0.040	-0.001	0.011	-0.002	0.001	-0.006	0.002	0.066	0.09
	P 0.054	0.001	-0.001	-0.001	0.001	-0.018	0.001	-0.001	0.002	-0.001	0.001	-0.186	-0.14
Flag Leaf Width (cm)	G 0.081	0.002	-0.005	-0.002	0.009	-0.003	0.008	0.002	-0.001	0.002	0.004	-0.339	-0.24
Productive tillers per Plant	P 0.026	0.001	-0.003	0.000	0.009	-0.004	0.002	-0.005	0.003	0.003	0.001	0.062	0.00
	G 0.056	0.002	-0.014	-0.002	0.015	-0.001	0.025	0.007	-0.002	0.001	0.005	-0.143	-0.00
Unproductive tillers per Plant	P -0.006	0.001	0.001	0.000	-0.0006	-0.0002	0.0004	-0.0233	0.0043	0.0024	0.0001	0.0385	0.01
	G -0.015	0.001	0.008	-0.016	-0.0031	0.0000	0.0081	0.0213	-0.0033	0.0036	0.0002	-0.1869	-0.17
	P -0.004	-0.001	-0.002	0.005	0.0004	0.0017	-0.0003	0.0062	-0.0163	0.0095	0.0001	-0.0232	-0.02
Spikelet Fertility (%)	G -0.008	-0.0001	-0.011	0.011	0.0088	0.0005	-0.0091	-0.0105	0.0066	-0.0091	0.0012	-0.0097	-0.00
Filled grains per Panicle	P 0.019	0.001	-0.003	0.001	0.0006	0.0007	0.0002	-0.0016	-0.0045	0.0344	0.0005	0.2176	0.265
	G 0.013	0.001	-0.013	0.025	0.0113	0.0003	-0.0010	-0.0036	0.0028	-0.0213	0.0036	0.3303	0.348
1000 Grain Weight (g)	P -0.006	-0.00	-0.001	0.000	-0.0003	0.0022	-0.0002	0.0005	0.0002	-0.0030	-0.0062	0.0424	0.02
	G -0.018	-0.001	-0.005	-0.002	-0.0039	0.0005	-0.0053	-0.0002	-0.0003	0.0031	-0.0247	0.1050	0.04
Productivity per day (g)	P -0.024	0.001	-0.002	0.0005	0.0003	0.0035	0.0001	-0.0009	0.0004	0.0078	-0.0003	0.9647	0.950
	G -0.032	0.001	-0.012	0.006	0.0026	0.0011	-0.0035	-0.0039	-0.0001	-0.0069	-0.0025	1.0184	0.968

Phenotypic residual effect =0.2087, Genotypic residual effect =0.2646