



Correlation and Path Coefficient Analysis in F₃ Generation of Rice (*Oryza sativa* L.)

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ABSTRACT

Correlation and path coefficient analysis were computed to assess the association for yield, yield contributing characters and physico-chemical quality characteristics in sixteen F₃ population of rice. The results of phenotypic and genotypic correlation analysis revealed that plant height, productive tillers per plant, panicle length, kernel breadth and elongation ratio were significantly and positively correlated with grain yield per plant. Path analysis indicated that plant height, productive tillers per plant and panicle length had high direct positive effect on grain yield per plant signifying the importance of these traits in improvement of grain yield per plant.

Key words : Correlation, Path analysis, Rice.

Rice is an important staple food crop of the world in general and eastern India in particular. Most of the people in Asia, particularly in developing countries like India, meet their major calorific requirement through rice. Grain yield is a complex trait and is the result of many variables. While selecting for yield, the nature of correlation between yield and component traits and their direct and indirect effects on yield in the early segregating generation of different cross combinations are of great importance in any breeding programme towards crop improvement. In rice, numbers of findings based on fixed genotypes have been reported but such information are lacking in segregating populations. Rice improvement for grain yield has been achieved, through effective use of F₃ segregating populations and fixing desirable character combinations. Therefore the present investigation was undertaken to have information on association as well as direct and indirect effect of sixteen traits in F₃ populations of rice.

MATERIAL AND METHODS

The F₃ populations of the sixteen cross combinations were raised in a randomized block design with two replications during *kharif* 2009-10 at Agricultural College Farm, Bapatla. The inter and intra-row spacing adapted was 20cm x 15cm. Each plot consisted of ten rows of 5m length and observations were recorded on twenty

randomly selected plants from each population per replication for characters *viz.*, plant height (cm), days to 50% flowering, productive tillers per plant, panicle length (cm), days to maturity, kernel length (mm), kernel breadth (mm), test weight (g), amylose content (%), gel consistency (mm), kernel length after cooking (mm), hulling percentage (%), milling percentage (%), head rice recovery (%), elongation ratio and grain yield per plant (g). The data were statistically analyzed to estimate genotypic and phenotypic correlation coefficients (Falconer, 1964) and path coefficient analysis (Dewey and Lu, 1959).

RESULTS AND DISCUSSION

The analysis of variance revealed significant differences among the populations for all the characters studied indicating the presence of genetic variability in the material. Genotypic correlation coefficients in general were higher than phenotypic correlation coefficients (Table 1). Plant height, productive tillers per plant, panicle length, kernel breadth and elongation ratio showed significant positive correlation with grain yield per plant at both phenotypic and genotypic levels. Similar results in rice were earlier reported by Kannan Babu and Soundrapandian (1993), Nayak (2008) and Anil Kumar *et al.* (2009). Plant height had significant positive association with panicle length, kernel breadth and grain yield per plant at

Table 1: Phenotypic (above diagonal) and genotypic (below diagonal) correlations of 16 characters in F₃ populations of rice

Character	Plant height (cm)	Days to 50% flowering	Days to productive tillers plant ⁻¹	Panicle length (cm)	Days to maturity	Kernal length (mm)	Kernal breadth (mm)	Test weight (g)	Amylose content (%)	Gel consistency (mm)	KLAC (mm)	Hulling (%)	Milling (%)	Head rice recovery (%)	Elongation ratio	Grain yield plant ⁻¹ (g)
Plant height (cm)	1.0000	-0.0301	0.2720	0.6139**	0.0257	-0.1760	0.4592**	0.2704	-0.0784	-0.1354	0.2520	0.1676	0.0464	0.1949	0.2272	0.5614**
Days to 50% flowering	0.0203	1.0000	0.3034	0.2211	0.0629	-0.1810	0.1615	0.3034	-0.3462*	-0.0663	0.1918	-0.4146*	0.0189	0.1184	0.1628	0.1063
Productive tillers plant ⁻¹	0.3267	0.2372	1.0000	0.3184	0.1551	-0.4113*	0.4089*	0.2429	0.1013	0.1917	0.3917*	-0.1658	-0.1641	0.3661*	0.4685**	0.6078**
Panicle length (cm)	0.8252**	0.4446**	0.5389**	1.0000	0.0262	-0.2981	0.6834**	0.3587*	-0.2025	0.0860	0.1769	-0.2686	-0.0413	0.0432	0.2967	0.7378**
Days to maturity	-0.0855	0.2864	0.3725*	-0.0180	1.0000	0.0940	-0.0426	-0.1298	0.3400*	0.3162	-0.0549	0.0294	-0.0662	0.2500	-0.0075	0.0217
Kernal length (mm)	-0.0857	-0.0346	-0.6380**	-0.5817*	0.0504	1.0000	-0.3904*	0.2390	-0.0043	-0.1459	-0.2632	0.3005	0.3045	0.1558	-0.7070**	-0.5561**
Kernal breadth (mm)	0.6473**	0.2535	0.5434**	0.8304**	0.0002	-0.6615**	1.0000	0.4635**	-0.2770	-0.0342	-0.1304	-0.2476	-0.0411	0.0386	0.1210	0.7567**
Test weight (g)	0.3656*	0.4021*	0.3262	0.3915*	-0.0765	0.3093	0.5928**	1.0000	-0.1696	-0.1470	0.0513	-0.1472	0.2062	0.5107**	-0.0884	0.1081
Amylose content (%)	-0.1566	-0.5650**	0.3542*	-0.1129	0.7545**	0.2490	0.0028	-0.1899	1.0000	0.6137**	0.1983	0.2895	0.0289	0.2698	0.1697	-0.1717
Gel consistency (mm)	-0.2065	-0.0658	0.3898*	0.1326	0.4812**	-0.1973	0.2198	-0.1603	0.5984**	1.0000	0.0782	-0.0719	0.0695	0.2538	0.2014	0.0168
KLAC (mm)	0.3901*	0.2152	0.6640**	0.3020	0.1177	-0.2836	0.1492	0.0658	-0.0439	-0.0561	1.0000	-0.0613	0.1580	0.2158	0.7824**	0.0756
Hulling (%)	0.2394	-0.4553**	0.0882	-0.5950*	0.2753	0.4004**	-0.2600	-0.1790	0.2165	-0.4618**	-0.2072	1.0000	0.1557	0.2298	-0.1591	-0.1966
Milling (%)	-0.0176	0.0939	-0.0772	-0.0792	-0.0737	0.5594**	0.0770	0.2457	-0.2798	-0.1280	0.0797	-0.1066	1.0000	0.3894*	-0.0621	-0.3121
Head rice recovery (%)	0.3690*	0.0681	0.6186**	0.1995	0.2133	0.4244**	0.5864**	0.8032**	0.0971	0.0041	0.0608	0.0653	0.4704**	1.0000	0.1159	-0.0899
Elongation ratio (mm)	0.3445*	0.2399	0.8994**	0.5089**	0.0320	-0.9503**	0.5575**	-0.1486	-0.1696	0.0062	0.8163**	-0.5081**	-0.4252*	-0.2741	1.0000	0.3569*
Grain yield plant ⁻¹ (g)	0.7967**	0.1686	0.7468**	0.9745**	0.0908	-0.7942**	0.6532**	0.0838	0.2886	0.3507*	0.5802**	-0.0599	-0.3314	0.3651*	0.9132**	1.0000

*, ** Significant at 5% and 1% level, respectively. KLAC: Kernel length after cooking

Table 2. Direct and indirect effects (phenotypic) of 15 traits on grain yield per plant in F₃ populations of rice

Character	Plant height (cm)	Days to 50% flowering	Pro-ductive tillers plant ⁻¹	Panicle length (cm)	Days to maturity	Kernal length (mm)	Kernal breadth (mm)	Test weight (g)	Amylose content (%)	Gel consistency (mm)	KLAC (mm)	Hulling (%)	Milling (%)	Head rice recovery (%)	Elongation ratio
Plant height (cm)	0.1472	-0.0044	0.0400	0.0904	-0.0038	-0.0259	0.0676	0.0398	-0.0115	-0.0199	0.0371	0.0247	0.0068	0.0287	0.0334
Days to 50% flowering	0.0013	-0.0431	-0.0131	-0.0095	-0.0027	0.0078	-0.0070	-0.0131	0.0149	0.0029	-0.0083	0.0179	-0.0008	-0.0051	-0.0070
Productive tillers plant ⁻¹	0.1257	0.1402	0.4621	0.1471	0.0717	-0.1901	0.1890	0.1123	0.0468	0.0886	0.1810	-0.0766	-0.0758	0.1692	0.2165
Panicle length (cm)	0.2494	0.0898	0.1293	0.4063	0.0106	-0.1211	0.2777	0.1457	-0.0823	0.0349	0.0719	-0.1091	-0.0168	0.0176	0.1205
Days to maturity	0.0013	-0.0033	-0.0081	-0.0014	-0.0526	-0.0049	0.0022	0.0068	-0.0179	-0.0166	0.0029	-0.0015	0.0035	-0.0131	0.0004
Kernal length (mm)	-0.0105	-0.0108	-0.0246	-0.0178	0.0056	0.0598	-0.0233	0.0143	-0.0003	-0.0087	-0.0157	0.0180	0.0182	0.0093	-0.0423
Kernal breadth (mm)	0.1469	0.0517	0.1308	0.2187	-0.0136	-0.1249	0.3200	0.1483	-0.0886	-0.0109	-0.0417	-0.0792	-0.0131	0.0124	0.0387
Test weight (g)	-0.0699	-0.0784	-0.0628	-0.0927	0.0335	-0.0618	-0.1198	-0.2585	0.0438	0.0380	-0.0133	0.0381	-0.0533	-0.1320	0.0229
Amylose content (%)	-0.0019	-0.0084	0.0025	-0.0049	0.0083	-0.0001	-0.0067	-0.0041	0.0244	0.0150	0.0048	0.0071	0.0007	0.0066	0.0041
Gel consistency (mm)	0.0128	0.0063	-0.0181	-0.0081	-0.0299	0.0138	0.0032	0.0139	-0.0580	-0.0946	-0.0074	0.0068	-0.0066	-0.0240	-0.0190
KLAC (mm)	-0.0633	-0.0482	-0.0984	-0.0444	0.0138	0.0661	0.0327	-0.0129	-0.0498	-0.0196	-0.2512	0.0154	-0.0397	-0.0542	-0.1965
Hulling (%)	0.0014	-0.0033	-0.0013	-0.0022	0.0002	0.0024	-0.0020	-0.0012	0.0023	-0.0006	-0.0005	0.0081	0.0013	0.0019	-0.0013
Milling (%)	-0.0041	-0.0017	0.0144	0.0036	0.0058	-0.0266	0.0036	-0.0180	-0.0025	-0.0061	-0.0138	-0.0136	-0.0875	-0.0341	0.0054
Head rice recovery (%)	-0.0185	-0.0113	-0.0348	-0.0041	-0.0238	-0.0148	-0.0037	-0.0486	-0.0257	-0.0241	-0.0205	-0.0219	-0.0370	-0.0951	-0.0110
Elongation ratio (mm)	0.0436	0.0313	0.0900	0.0570	-0.0014	-0.1358	0.0232	-0.0170	0.0326	0.0387	0.1503	-0.0306	-0.0119	0.0223	0.1920
Correlation with Grain yield plant ⁻¹ (g)	0.5614**	0.1063	0.6078**	0.7378**	0.0217	-0.5561**	0.7567**	0.1078	-0.1717	0.0168	0.0756	-0.1966	-0.3121	-0.0899	0.3569*

* = Significant at 5% level **=Significant at 1% level, Bold & diagonal values indicate direct effects, Residual effect = 0.2888

Table 3. Direct and indirect effects (genotypic) of 15 traits on grain yield per plant in F₃ populations of rice

Character	Plant height (cm)	Days to 50% flowering	Productive tillers plant ⁻¹	Panicle length (cm)	Days to maturity	Kernal length (mm)	Kernal breadth (mm)	Test weight (g)	Amylose content (%)	Gel consistency (mm)	KLAC (mm)	Hulling (%)	Milling (%)	Head rice recovery (%)	Elongation ratio
Plant height (cm)	0.4348	0.0088	0.1421	0.3588	-0.0372	-0.0373	0.2815	0.1590	-0.0681	-0.0898	0.1696	0.1041	-0.0076	0.1605	0.1498
Days to 50% flowering	-0.0131	-0.6457	-0.1532	-0.2871	-0.1849	0.0223	-0.1637	-0.2596	0.3648	0.0425	-0.1390	0.2940	-0.0607	-0.0440	-0.1549
Productive tillers plant ⁻¹	0.3791	0.2753	1.1604	0.6253	0.4322	-0.7403	0.6306	0.3785	0.4110	0.4524	0.7705	0.1023	-0.0896	0.7178	1.0437
Panicle length (cm)	0.5750	0.3098	0.3755	0.6968	-0.0125	-0.4054	0.5786	0.2728	-0.0787	0.0924	0.2104	-0.4146	-0.0552	0.1390	0.3546
Days to maturity	-0.0298	0.0998	0.1299	-0.0063	0.3486	-0.0176	0.0001	-0.0267	0.2630	0.1678	0.0410	-0.0960	-0.0257	0.0744	0.0112
Kernal length (mm)	0.0158	0.0064	0.1177	0.1073	0.0093	-0.1844	0.1220	-0.0570	-0.0459	0.0364	0.0523	-0.0738	-0.1032	-0.0783	0.1752
Kernal breadth (mm)	-0.3394	-0.1329	-0.2849	-0.4353	-0.0001	0.3468	-0.5243	-0.3108	-0.0015	-0.1152	-0.0782	0.1363	-0.0403	-0.3074	-0.2923
Test weight (g)	-0.0345	-0.0380	-0.0308	-0.0370	0.0072	-0.0292	-0.0560	-0.0945	0.0179	0.0151	-0.0062	0.0169	-0.0232	-0.0759	0.0140
Amylose content (%)	0.0951	0.3431	-0.2151	0.0686	-0.4582	-0.1512	-0.0017	0.1154	-0.6073	-0.3634	0.0267	-0.1315	0.1699	-0.0590	0.1030
Gel consistency (mm)	0.0003	0.0001	-0.0005	-0.0002	-0.0006	0.0003	-0.0003	0.0002	-0.0008	-0.0013	0.0001	0.0006	0.0002	0.0000	0.0000
KLAC (mm)	-0.1175	-0.0648	-0.2000	-0.0909	-0.0355	0.0854	-0.0449	-0.0198	0.0132	0.0169	-0.3012	0.0624	-0.0240	-0.0183	-0.2458
Hulling (%)	-0.0431	0.0820	-0.0159	0.1072	0.0496	-0.0721	0.0468	0.0322	-0.0390	0.0832	0.0373	-0.1801	0.0192	-0.0118	0.0915
Milling (%)	0.0022	-0.0116	0.0095	0.0098	0.0091	-0.0691	-0.0095	-0.0303	0.0346	0.0158	-0.0098	0.0132	-0.1235	-0.0581	0.0525
Head rice recovery (%)	-0.0502	-0.0093	-0.0841	-0.0271	-0.0290	-0.0577	-0.0798	-0.1092	-0.0132	-0.0006	-0.0083	-0.0089	-0.0640	-0.1360	0.0373
Elongation ratio (mm)	-0.0781	-0.0544	-0.2039	-0.1154	-0.0073	0.2154	-0.1264	0.0337	0.0384	-0.0014	-0.1850	0.1152	0.0964	0.0621	-0.2267
Correlation with Grain yield plant ⁻¹ (g)	0.7967**	0.1686	0.7468**	0.9745**	0.0908	-0.7942**	0.6532**	0.0838	0.2886	0.3507*	0.5802**	-0.0599	-0.3314	0.3651*	0.9132**

* = Significant at 5% level **=Significant at 1% level, Bold & diagonal values indicate direct effects, Residual effect = 0.2566

both phenotypic and genotypic levels and it had significant positive association with kernel length after cooking, head rice recovery, test weight and elongation ratio. Productive tillers per plant had significant positive association with kernel breadth, kernel length after cooking, head rice recovery, elongation ratio and grain yield per plant at both phenotypic and genotypic levels, while it had significant positive association with panicle length, days to maturity, amylose content and gel consistency at genotypic level. Whereas, panicle length had significant positive association with kernel breadth, test weight and grain yield per plant at both phenotypic and genotypic levels and with elongation ratio it had significant positive association at genotypic level.

Path coefficient analysis (Table 2) revealed that plant height, productive tillers per plant and panicle length had highest positive direct effects on grain per plant at both phenotypic and genotypic levels. These results are in accordance with the reports of Ananda Kumar (1992) and Shanti and Singh (2000). Plant height had positive indirect effects through productive tillers per plant, panicle length and gel consistency at both phenotypic and genotypic levels. Productive tillers per plant also exerted positive indirect effects on grain yield per plant mainly through plant height, panicle length and milling percentage at both the levels and panicle length had positive indirect effects through plant height, productive tillers per plant and milling percentage at both phenotypic and genotypic levels.

The results of correlation and path coefficient analysis indicated that plant height, productive tillers per plant and panicle length were the major yield contributing characters as these characters are not only showed positive and significant association with grain yield per plant, but also had high positive direct effects. They also

had positive indirect effects *via* each other. Thus plant height, productive tillers per plant and panicle length could be considered as the most important characters for selection in order to improve the grain yield in rice. Hence, in the improvement programmes due importance may be given for these traits to improve genetic yield potential in rice.

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