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Research Note

Correlation coefficient and path analysis study among grain quality components in rice (*Oryza sativa* L.)

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Abstract:
Correlation coefficient and path analysis study among grain quality components in rice were studied in thirty crosses. Crosses were attempted in such a way that each line was pollinated by all pollen parents in line x tester pattern. The experimental material consisted of 5 lines *viz*., B6441-F-MR-6-0-0, G 9502, F_7 10, BR 240, VL 16 and 6 testers *viz.*, IR 64, Abhaya, MTU 1010, IRBL 10, IRBL 22 and LTH. In correlation studies, the following characters were found to be of importance in selection *viz.*, hulling percentage (HP), paddy length (Pad L), head rice recovery (HRR), milling percentage (MP), brown rice length (BRL) and it also exhibited a positive interrelation among themselves. Selection based on hulling percentage (HP) is suitable, since it brings simultaneous improvement in all other quality parameter traits. Path analysis of head rice recovery (HRR) showed that brown rice length (BRL), milling percentage (MP), hulling percentage (HP) and water uptake (WU) were most important contributing characters towards the head rice recovery (HRR) based on their high positive direct effects.

Keywords: Correlation coefficient, path analysis and grain quality.

The success of any variety not only depends on its yield, but also the grain quality which is mostly acceptable by the consumer. Quality trait is complex in nature, which is influenced by the environment. Understanding the relationship between yield and its components is of the paramount importance for making the best use of the relationships in selection (Sarawgi *et al*., 1997). The data obtained from correlation coefficient can be augmented by path analysis. Path coefficient analysis splits the genotypic correlation coefficient into the measure of direct and indirect effects. In the present investigation, to study correlation and path analysis of component characters of grain qualities of thirty crosses which were produced by the line x tester (5 female x 6 male) method.

Experimental material used for this study consisted of thirty crosses. The parental material consisted of five lines viz., B6441-F-MR-6-0-0, G 9502, F_7 10, BR 240 and VL 16 and six testers *viz.,* IR 64, Abhaya, MTU 1010, IRBL 10, IRBL 22 and LTH. Thirty crosses were produced through line x tester method and planted in a Randomized Block Design with two replications at Research Farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur during *Kharif* 2007. Then, the harvested seeds were evaluated for quality traits *viz*., Hulling Percentage (HP), Milling Percentage (MP), Head Rice Recovery (HRR) (%), Paddy Length (Pad L) (mm), Brown Rice Length (BRL) (mm), Kernel Length (KL) (mm), Kernel Length after Cooking (KLAC) (mm), Kernel Breadth before Cooking (mm) (KBAC) and Water Uptake (WU) (ml).

Required quantities (100 g) of harvested seeds were used to record the HP, which were properly cleaned before starting the experiment. From that material, the (Pad L) of randomly selected ten spikelet's were measured in millimeters. The dehusking of rice was done by dehusker and hulled rice weight was recorded and the HP was calculated as

Hulling % (HP)= Weight of dehusked kernel/
Weight of the paddy x 100

After hulling percentage, randomly selected ten hulled rice (brown rice) were used to measure the brown rice length (BRL) in millimeters. The brown rice was put into standard miller for polishing and later milled rice weight was recorded and the MP was calculated as per formula

Milling % (MP)=Weight of polished kernel/
Weight of the paddy x100

From milled rice, sorted full rice (3/4 kernel was taken as whole grain) and broken rice and then recorded the weight of full rice calculated head rice recovery (HRR) by using the formula

Head Rice Recovery (HRR)
=Weight of whole polished kernel/
Weight of the paddy X 100.

The KL of randomly selected ten milled grains was measured in millimeter. The milled grains were cooked to measure the (KLAC) and (KBAC). The length and breadth of randomly selected ten grains were measured in millimeters.

To measure WU, required quantity (2g) of milled rice was taken in a graduate test tube and 10 ml of water was added. It was allowed to soak for 30 minutes and then boiled for 45 minutes at 77°C to 80° C in a constant temperature water bath. Kept 2-3 test tubes with 10 ml of water as control along with samples in water bath. The tubes were placed in beaker in graduated cylinder after cooking and noted the water level.

Water Uptake = 100/2g x actual water absorbed

Correlation coefficients were calculated for all the character combinations at genotypic, phenotypic and environmental levels as per formula given by Miller *et al*., (1958). The path coefficient analysis splits the genotypic correlation coefficient into direct and indirect effect according to Dewey and Lu (1959).

Analysis of Variance for all the traits under study presented in the Table 1. The further analysis showed highly significant variance for all the characters among the parents, hybrids, tester and line x testers. And also the variance due to parent's vs. hybrids, lines was significant for all the characters except PL, BRL, KBAC and KLAC. This suggested that sufficient variability is available in material used for present study.

Correlation coefficients among different quality parameters are shown in the Table 2. In the present investigation, most of the characters exhibit higher genotypic correlation than phenotypic correlation coefficient thereby suggesting strong inherent association under genotypic level. These results were in accordance with the findings of Sumathi and Muralidharan (2007). Grain yield had a significant positive association with KBAC at phenotypic, genotypic and environmental level. The characters like HP, MP and HRR showed a significant positive association at phenotypic and genotypic level. Grain yield was positively correlated with Pad L similar to Sarawgi *et al*., (1997), Mohan and Narayanswami (1973) and Kaul and Kumar (1982).

Head rice recovery had a significant positive association with KBAC at phenotypic, genotypic and environment level and significant positive correlation with WU at genotypic level and it showed positive correlation with Pad L and BRL at phenotypic and genotypic level. It showed positive correlation with KLAC and KL as seen by Binodh *et al*. (2007). Hulling percentage exhibited a significant positive association with MP, HRR, Pad L and BRL at both genotypic and phenotypic level. Milling percentage recorded a significant positive association with the KLAC at phenotypic, genotypic and environmental levels. Pad L expressed significant positive associations with BRL, KL and KLAC at genotypic, phenotypic and environmental levels. BRL had significant positive association with KL and KLAC at phenotypic, genotypic and environmental levels. Similar findings were reported by (Veni and Rani, 2006). KL showed significant positive association with KLAC at phenotypic, genotypic and environment levels. KLAC had a significant negative association with KBAC at genotypic level. Hence the characters to be given importance for selection are HP, Pad L, HRR, MP, BRL. Selection based on HP is suitable as it will bring simultaneous improvement of all other quality parameters.

Path coefficient analysis splits the genotypic correlation coefficient into the measures of direct and indirect effects. It measures direct and indirect effects of different characters on head rice recovery (Table 3). BRL (0.592) expressed a highest positive direct effect on HRR followed by MP (0.296), HP (0.252) and WU (0.045) whereas lowest positive direct effect on HRR was shown by KLAC (0.001). Among the negative direct effects, KL (-0.556) showed highest negative direct effect on HRR followed by Pad L (-0-043) and KBAC (-0.040). HP showed a positive indirect effect on head rice recovery through milling percentage (0.239) followed by brown rice length (0.146). MP, BRL and KBAC had a positive indirect effect on head rice recovery through hulling percentage. PL, KL, KLAC and WU exhibited a positive indirect effect on HRR through BRL. It is concluded that brown rice length, milling percentage, hulling percentage and water uptake are most important contributing characters towards the head rice recovery.

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Table 1: Analysis of Variance (ANOVA) for Line x tester analysis

Source	Degree of freedom	Mean sum of squares									
		Grain yield	HP	MP	HRR	Pad L	BRL	KL	KLAC	KBAC	WU
Replication	1	2.22	4.82*	5.78*	3.78	0.11	0.15	0.007	0.02	0.06	80.39
Parents	10	34.87**	28.29**	37.77**	31.90**	1.02*	0.57**	0.68**	1.12**	0.09**	5431.87**
Hybrids	29	34.29**	48.78**	52.00**	55.03**	1.33**	0.67**	0.65**	1.09**	0.06**	5444.71**
Parents vs. hybrids	1	178.92**	28.82**	47.76**	50.32**	0.13	0.006	0.27**	3.99**	0.03	170.00**
Lines	4	27.34**	21.34**	54.90**	30.19**	0.62	0.39**	0.17	0.32	0.09**	1908.44**
Testers	5	43.82**	39.51**	30.02**	30.39**	1.52**	0.82**	0.78**	1.65**	0.10**	3770.10**
Lines x testers	20	33.30**	56.59**	56.91**	66.15**	1.42**	0.69**	0.72**	1.10**	0.04	6570.62**
Error	40	0.75	0.89	.16	0.80	0.02	0.02	0.13	0.02	0.01	12.85

* Significant at p = 0.05; ** Significant at p = 0.01 respectively.

HP – Hulling Percentage; MP – Milling Percentage; HRR – Head Rice Recovery; Pad L – Paddy Length;
BRL – Brown Rice Length; KL – Kernel Length; KLAC – Kernel Length after Cooking;
KBAC – Kernel Breadth before Cooking; WU – Water Uptake

Table 2: Phenotypic (P), Genotypic (G) and Environmental (E) correlation for various traits

Characters	Correlation	HP	MP	HRR	Pad L	BRL	KL	KLAC	KBAC	WU
Grain yield/ plant	Phenotype	0.499**	0.472**	0.340**	-0.013	0.104	0.111	0.009	0.218*	-0.025
	Genotype	0.515**	0.487**	0.358**	-0.020	0.102	0.159	0.017	0.242*	-0.029
	Environment	0.117	0.135	-0.141	0.171	0.152	-0.129	-0.189	0.282**	0.222*
HP	Phenotype		0.778**	0.174**	0.222*	0.242*	0.198	0.158	0.188	0.117
	Genotype		0.806**	0.751**	0.232*	0.247*	0.257*	0.163	0.235*	0.118
	Environment		0.178	-0.243*	0.004	0.178	-0.045	0.037	0.077	0.137
MP	Phenotype			0.763**	0.183	0.202	0.163	0.227*	0.190	0.210
	Genotype			0.797**	0.176	0.194	0.193	0.225*	0.157	0.215*
	Environment			-0.046	0.337**	0.337**	0.181	0.264*	0.519**	0.037
HRR	Phenotype				0.211*	0.280**	0.111	0.284**	0.134	0.069
	Genotype				0.215*	0.285**	0.101	0.278**	0.151	0.068
	Environment				0.101	0.203	0.294**	0.442**	0.164	0.145
Pad L	Phenotype					0.762**	0.529**	0.349**	-0.50	0.317**
	Genotype					0.781**	0.613**	0.345**	-0.131	0.322**
BRL	Phenotype						0.633**	0.357**	-0.60	0.120
	Genotype						0.731**	0.351**	-0.173	0.118
KL	Phenotype							0.316**	0.046	0.113
	Genotype							0.326**	-0.079	0.126
KLAC	Phenotype								-0.134	-0.012
	Genotype								-0.239*	-0.018
KBAC	Phenotype									0.096
	Genotype									-0.139

* P (0.05) = 0.211; ** P (0.01) = 0.275

HP – Hulling Percentage; MP – Milling Percentage; HRR – Head Rice Recovery; Pad L – Paddy Length;
BRL – Brown Rice Length; KL – Kernel Length; KLAC – Kernel Length after Cooking;
KBAC – Kernel Breadth before Cooking; WU – Water Uptake

Table 3: Path coefficients showing direct and indirect effects of different quality character on head rice recovery

Characters	HP	MP	Pad L	BRL	KL	KLAC	KBAC	WU
HP	**0.252**	0.239	-0.010	0.146	-0.143	0.000	-0.009	0.005
MP	0.203	**0.296**	-0.008	0.115	-0.107	0.000	-0.006	0.010
Pad L	0.059	0.052	**-0.043**	0.462	-0.341	0.000	0.005	0.014
BRL	0.062	0.058	-0.034	**0.592**	-0.407	0.001	0.007	0.005
KL	0.065	0.057	-0.027	0.433	**-0.556**	0.000	0.003	0.006
KLAC	0.041	0.067	-0.015	0.208	-0.181	**0.001**	0.010	-0.001
KBAC	0.059	0.047	0.006	-0.102	0.044	0.000	**-0.040**	-0.006
WU	0.030	0.064	-0.014	0.070	-0.070	0.000	0.006	**0.045**

Residual effect: 0.77

HP – Hulling Percentage; MP – Milling Percentage; HRR – Head Rice Recovery; Pad L – Paddy Length;
BRL – Brown Rice Length; KL – Kernel Length; KLAC – Kernel Length after Cooking;
KBAC – Kernel Breadth before Cooking; WU – Water Uptake