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Correlation and path coefficient analysis for grain yield and yield components in rice (*Oryza sativa* L.) under aerobic condition

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Abstract

An experiment was conducted during *kharif* season of year 2018 to study correlation and path coefficient analysis in 50 diverse rice genotypes under aerobic condition at Regional Research Station, Anand Agricultural University, Anand. Analysis of variance showed significant differences among genotypes for all the 12 characters studied. Correlation studies revealed that grain yield per plant had positive and significant association with spikelet fertility percent, 1000 grain weight, plant height and straw yield per plant at both genotypic and phenotypic levels. Hence, these characters should be given due consideration while applying selection for increasing yield. Results of path analysis indicated that the maximum direct effects as well as appreciable indirect effects were exerted by straw yield per plant, harvest index followed by spikelet fertility percent towards grain yield per plant. These characters also exhibited significant positive correlation with grain yield per plant. Therefore, selection pressure imposed on these characters would bring improvement in grain yield of rice.

Keywords: Correlation, path coefficient analysis, aerobic condition

1. Introduction

Rice (*Oryza sativa* L.) is the most valuable crop in the world and the prime staple food of Asia, for more than 2/3rd of its population. Rice is the oldest domesticated grain (~10,000 years) and most important primary source of food for more than three billion people. Rice cultivated primarily in low land condition which required almost half of the water utilized for agricultural production. The depleting water resource demands others alternative approaches without compromising the productivity. Aerobic cultivation of rice is one of the most promising options among others such approaches. There are no specific genotypes available for aerobic cultivation of rice so breeder should pay attention in this direction. To boost the yield potential of upland rice, it is necessary to identify cultivars with improved yield and other desirable agronomic characters. Yield, being a complex trait, is composed of several components some of which affect the yield directly, while other affect indirectly. Hence, knowledge of association between yield and its components is necessary. Selection directly based on the performance of seed yield, may not be very effective but selection based on its component characters would prove more effective as reported in other plants (Fisher, 1918) [2]. Correlation studies would provide estimates of degree of association between seed yield, its various components and also among the components. Although studies on correlation are helpful in determining the components of complex characters like seed yield, these estimates do not provide an exact information about the relative magnitude of direct and indirect influences of each of the component character on seed yield. In this context Wright (1921) [14] proposed estimation of path coefficient analysis as an important tool in partitioning the correlation coefficient into two parts, direct and indirect effects which will be useful in identifying biometrical characters to achieve desirable goal. Therefore, path-coefficient analysis is important to elucidate the intrinsic nature of association of component traits by determining the direct or indirect contribution of these traits to yield.

2. Materials and methods

The experimental material comprised of fifty selected genetically diverse true breeding genotypes of rice (*Oryza sativa* L.) obtained from different geographical regions.

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All the genotypes were grown in randomized block design with 3 replications under aerobic conditions in the kharif season of year 2018. Each genotype was grown in 2.0 m x 0.9 m plot with 30 x 10 cm spacing at the Regional Research Station, Anand Agricultural University Anand, India. Standard agronomic practices and plant protection measures were followed.

Replication-wise data on the basis of five randomly taken competitive plants were recorded on following traits: days to 50 per cent flowering (DFF), plant height, number of grains per panicle, spikelet fertility per cent, effective tillers per plant, grain yield per plant, straw yield per plant, harvest index, 1000-grain weight, grain length, grain breadth and grain L/B ratio.

The replicated data were subjected to statistical analysis. The estimates of covariances were worked out as per Singh and Choudhary (1985) [11]. The estimates of covariances and variances were utilized in computing genotypic and phenotypic correlation coefficient, while genotypic and phenotypic path coefficient was worked out as suggested by Wright (1921) [14]. Data were analyzed using the computer facility available with the Department of Agricultural Statistics, B.A. College of Agriculture, Anand Agricultural University, Anand.

3. Results and Discussions

For the improvement of crop for higher yield prior to any breeding program, it is commendable to obtain information regarding the inter-relationship of different characters with yield and among themselves, since it facilitates the quicker assessment of high yielding and better performing genotypes in selection programmes. The phenotypic and genotypic correlation coefficients were estimated among 12 characters of 50 rice genotypes, to find out the association of grain yield and other yield contributing characters (Table 1).

The data showed that correlation at genotypic and phenotypic levels had the same trend. The values of genotypic correlation coefficients were higher than those of their respective phenotypic correlation coefficients in most of the cases, suggesting that there was a strong and inherent association between two characters. In some cases, however, the phenotypic correlation was slightly higher than their genotypic counterpart, which implied that the non-genetic causes inflated the value of genotypic correlation because of the influence of environmental factors. Correlation studies revealed that grain yield per plant had positive and significant association with spikelet fertility percent. The similar results were earlier reported by Jayasudha *et al.* (2010) [4], Sravan *et al.* (2012) [12] and Ketan and Sarkar (2014) [5]. There was positive and significant correlation of 1000 grain weight with grain yield per plant in conformity with the findings of Akhtar *et al.* (2011) [1] and Naseem *et al.* (2014) [9]. Plant height and straw yield per plant had positive and significant association with grain yield per plant at both genotypic and phenotypic levels in agreement with earlier reports of Patel *et al.* (2018) [10]. Days to 50 percent flowering and effective tillers per plant showed non-significant negative correlation with grain yield per plant at both genotypic and phenotypic levels in accordance with Sravan *et al.* (2012) [12] and Patel *et al.* (2018) [10]. Hence, simultaneous improvement of days to 50 percent flowering, effective tillers per plant and grain yield per plant is not possible, which suggested that the breeding methodology has to be suitably framed for improving the grain yield in rice. On the other hand, correlation of number of grains per panicle, grain length and grain L/B ratio with

grain yield per plant was found positive and non-significant at both the levels. Similar result reported by Idris *et al.* (2012) [3], Nandan *et al.* (2010) [7], Kumar *et al.* (2015) [6] and Ketan and Sarkar (2014) [5] respectively. Harvest index had positive non-significant association with genotypic level and significant at phenotypic level. The similar results were earlier reported by Idris *et al.* (2012) [3] and Patel *et al.* (2018) [10]. Hence, simultaneous selection of these characters may lead to improvement in grain yield per plant.

Path coefficient analysis could provide a more realistic picture of the interrelationship, as it considers direct as well as indirect effects of the variables by partitioning the correlation coefficient. The results obtained for direct and indirect effects of different characters on grain yield per plant are presented in Table 2 and path diagram represented in Figure 1. Path coefficient analysis result revealed that straw yield per plant and harvest index were the major characters having high positive direct effects (1.192, 1.152) and highly significant correlation with grain yield per plant. The results are in accordance with the findings of Surek and Basir (2003) [13], Jayasudha *et al.* (2010) [4] and Nandan *et al.* (2010) [7] for harvest index; Surek and Basir (2003) [13] and Patel *et al.* (2018) [10] for straw yield per plant. Therefore, selection pressure imposed on these characters would bring improvement in grain yield of rice. Spikelet fertility percent and grain breadth had moderate direct effects (0.188, 0.305) and supplemented yield through straw yield per plant as indirect effects, thus giving rise to positive correlation of these traits with grain yield per plant. The results are in accordance with the findings of Jayasudha *et al.* (2010) [4] and Nandeshar *et al.* (2010) for spikelet fertility percent; Ketan and Sarkar (2014) [5] and Kumar *et al.* (2015) [6] for grain breadth. Similarly, number of grains per panicle had also moderate positive direct effects (0.101) and contributed indirectly via harvest index and days to 50 percent flowering, which resulted into low and positive genotypic correlation of this trait with grain yield per plant. The direct effect of 1000 grain weight was low in magnitude and negative in direction (-0.013), but their indirect effect via straw yield per plant was high and positive, which resulted into positive and significant genotypic correlation of this trait with grain yield per plant. Similar results were reported by Surek and Basir (2003) [13], Jayasudha *et al.* (2010) [4] and Nandan *et al.* (2010) [7]. The study also revealed that the character plant height expressed very low direct effect for grain yield (0.004), however due to high and positive indirect effect through straw yield per plant resulted in positive and significant genotypic correlation with grain yield. The results are in correspondence to the findings of Jayasudha *et al.* (2010) [4] and Nandan *et al.* (2010) [7]. In the present study, the residual effect was found positive and moderate (0.146), which indicated that the variability exhibited by the character grain yield per plant cannot be totally attributed to the characters considered under this investigation. Therefore, it is imperative that other morpho-physiological characters should be investigated which may contribute to the higher yield in rice.

4. Conclusion

The estimates of correlation coefficient revealed that four characters viz., spikelet fertility per cent, 1000 grain weight, plant height and straw yield per plant showed significant and positive association with grain yield and were most important yield contributing characters for increasing the grain yield of rice. Path analysis based on genotypic correlation showed high direct effect of straw yield per plant and harvest index

and moderate direct effects of spikelet fertility percent, number of grains per panicle and grain breadth on grain yield, revealing scope for considering these characters for imposing selection pressure for bringing out an improvement in rice yield. On the basis of all the above findings, it can be

concluded that, while imposing selection for genetic improvement of grain yield in rice, due weightage should be given to harvest index, straw yield per plant, spikelet fertility percent, number of grains per panicle and grain breadth.

Table 1: Genotypic and phenotypic correlation coefficients among different characters in rice

		TW	ETP	GP	PH	SF	SYP	GL	GB	L/B	HI	GYP
DFP	Rg	-0.416	0.176	0.132	-0.402**	-0.572**	-0.169	-0.24	-0.093	-0.034	0.103	-0.081
	Rp	-0.198*	0.06	0.076	-0.269**	-0.121	-0.115	-0.057	-0.096	0.044	0.119	-0.01
TW	Rg		-0.227	-0.287*	0.503**	0.53**	0.408**	0.516**	0.361**	-0.042	-0.197	0.353*
	Rp		-0.19*	-0.263**	0.462**	0.351**	0.371**	0.199*	0.188*	-0.044	-0.14	0.314**
ETP	Rg			-0.058	0.022	-0.118	0.135	0.038	-0.283*	0.229	-0.238	-0.098
	Rp			-0.049	0.014	-0.11	0.109	0.007	-0.07	0.073	-0.16*	-0.073
GP	Rg				-0.339*	-0.267	-0.159	-0.209	-0.17	0.024	0.224	0.086
	Rp				-0.286**	-0.146	-0.134	-0.084	-0.099	0.03	0.166*	0.055
PH	Rg					0.402**	0.403**	0.278	0.263	-0.066	-0.137	0.385**
	Rp					0.286**	0.388**	0.139	0.136	-0.037	-0.089	0.390**
SF	Rg						0.304*	0.320*	0.022	0.122	-0.13	0.318*
	Rp						0.167*	0.109	-0.048	0.097	0.029	0.259**
SYP	Rg							0.119	0.317*	-0.151	-0.73**	0.455**
	Rp							0.092	0.116	-0.04	-0.69**	0.383**
GL	Rg								-0.56**	0.785**	0.093	0.196
	Rp								0.021	0.535**	0.061	0.157
GB	Rg									-0.955**	-0.38**	0.053
	Rp									-0.829**	-0.186*	-0.027
L/B	Rg										0.289*	0.045
	Rp										0.187*	0.107
HI	Rg											0.207
	Rp											0.322**

*, ** significant at 0.05 and 0.01 level of probability respectively.

Table 2: Genotype path coefficient analysis showing direct and indirect effects of different characters on grain yield

	DFP	TW	ETP	GP	PH	SF	SYP	GL	GB	L/B	HI	Rg
DFP	0.108	0.005	0.013	0.013	-0.002	-0.108	-0.201	0.004	-0.028	-0.005	0.119	-0.081
TW	0.045	-0.013	-0.016	-0.029	0.002	0.100	0.486	-0.009	0.110	-0.007	-0.227	0.353*
ETP	0.019	0.003	0.072	-0.006	0.0002	-0.022	0.161	-0.001	-0.086	0.036	-0.274	-0.098
GP	0.014	0.004	-0.004	0.101	-0.001	-0.050	-0.190	0.004	-0.052	0.004	0.258	0.086
PH	-0.044	-0.006	0.002	-0.034	0.004	0.076	0.481	-0.005	0.080	-0.010	-0.158	0.385**
SF	-0.062	-0.007	-0.008	-0.027	0.002	0.188	0.362	-0.005	0.007	0.019	-0.150	0.318*
SYP	-0.018	-0.005	0.01	-0.016	0.002	0.057	1.192	-0.002	0.097	-0.024	-0.837	0.455**
GL	-0.026	-0.007	0.003	-0.021	0.001	0.060	0.141	-0.017	-0.171	0.124	0.107	0.196
GB	-0.010	-0.005	-0.02	-0.017	0.001	0.004	0.378	0.010	0.305	-0.151	-0.442	0.053
L/B	-0.004	0.001	0.017	0.002	0.0001	0.023	-0.180	-0.013	-0.292	0.158	0.333	0.045
HI	0.011	0.002	-0.017	0.023	-0.001	-0.025	-0.866	-0.002	-0.117	0.046	1.152	0.207

Residual effect: 0.146

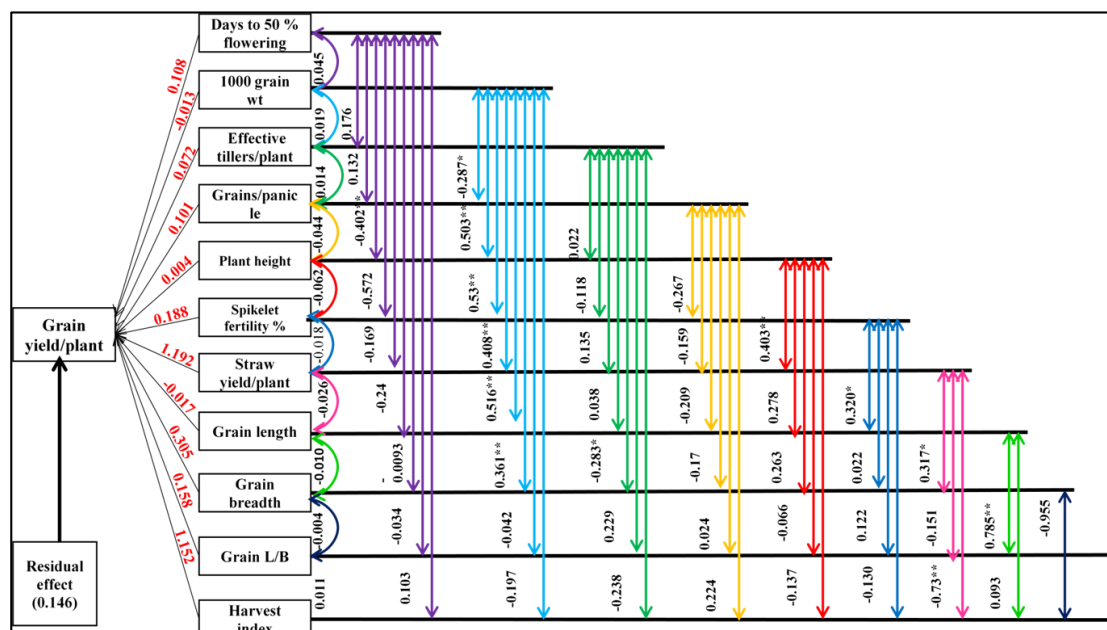


Fig 1: Path diagram showing direct and indirect effect of various traits on grain yield per plant

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