

Original Research Article

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Studies on Correlation and Path Coefficient Analysis in Rice (*Oryza Sativa L.*)

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The experiment was carried out to explore correlation and path coefficient analysis in 48 rice genotypes for nine characters viz., days to first flower, plant height, number of tillers per plant, number of panicles per plant, number of grains per panicle, panicle length, thousand grain weight, grain L/B ratio and grain yield per plant. The genotypic correlation coefficients showed higher magnitude than phenotypic correlation coefficients which indicated masking or modifying effect of environment. The genetic correlation revealed that grain yield per plant had strong negative and significant association with days to first flower at both genotypic and phenotypic levels. So it could be inferred that grain yield and days to first flower could be used as selection criteria for the improvement of grain yield per plant. Scrutiny in path analysis indicated that maximum direct effect on grain yield was exhibited by number of panicles per plant. Hence the trait should be taken in account of breeding programme to develop the maximum of threshold yield obtaining new rice varieties or hybrids.

Introduction

Rice is a cereal crop belonging to genus *Oryza* of family *Poaceae* and tribe *Oryzeae*. The two cultivated rice species, *Oryza sativa* L. (Asian Rice) and *Oryza glaberrima* Steud. (African Rice), belongs to a species group called *Oryza sativa* complex together with the five wild taxa, *O. rufipogon*, *O. longistaminata* Chev. et Roehr., *O. barthii* A. Chev., *O. glumaepatula* Steud., and *O. meridionalis* Ng.

The two major rice varieties grown world – wide today are *Oryza sativa indica* and *Oryza sativa japonica*. Together with all circumstantial evidence, it is suggested that *O. rufipogon* is the ancestor of *O. sativa*.

Similarly, it leaves no doubt that *O. barthii* is the ancestor of African rice *O. glaberrima*.

It is an important cereal crop, grown under diverse agro – ecological conditions. It is also a major food crop, as it ranks second to wheat among the most cultivated cereals in the world. To feed the ever growing population, the targeted rice production of World, China and India for the year 2030 were envisaged as 771.02, 168.90 and 130.02 million tonnes respectively.

Correlation coefficient analysis measures the mutual relationship between various plant characters and determines the component

characters on which selection can be based for genetic improvement in yield. Grain yield is a complex character and is the end – product of various traits. Therefore knowledge regarding the correlation of grain yield with other component characters is valuable for understanding the correlated response to selection for yield. Path coefficient analysis is helpful to recognize direct and indirect causes of correlation and also enables us to compare the causal factors on the genetic basis of their relative contributions. Hence the present study of correlation and path analysis would serve path for future breeding programmes.

Materials and Methods

The present day investigation was conducted at the Plant Breeding Farm, Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Tamil Nadu, India during 2015 – 2017. Seeds of forty eight genotypes (Table 1) were sown in raised nursery beds during February, 2016. In each genotype, one seedling per hill was transplanted in the main field after 25 days with spacing of 20 cm X 20 cm. The experiment was carried out in Randomized Block Design with three replications. As recommended, agronomic and plant protection measures were followed during the crop period. A uniform population of 12 plants in a row was maintained. Nine productive and quality characters *viz.*, days to first flower, plant height, number of tillers per plant, number of panicles per plant, number of grains per panicle, panicle length, thousand grain weight, grain L/B ratio and grain yield per plant were recorded on single plant basis in eight randomly selected plants of each genotype per replication. The mean data were utilized for the statistical studies.

Results and Discussion

Direct selection for yield is not effective as yield is a complex and quantitatively inherited

character with low heritability. Therefore, indirect selection could be made for the component characters contributing to yield through character association as it provides information about the characters that are correlated with each other in improving yield. Estimates of correlation between yield and yield component characters in rice genotypes are presented in table 2.

A positive value of correlation shows that the changes of two variables are in the same direction, i.e., high value of one variable are associated with high values of the other and *vice versa*. The breeder is always concerned for the selection of superior genotypes on the basis of phenotypic expression. However, for the quantitative characters, genotypes are influenced by environment, thereby affecting the phenotypic expression. Information regarding the nature and extent of association of morphological characters would be helpful in developing suitable plant type, in addition to the improvement of yield a complex character for which direct selection is not effective. In general, the genotypic and the phenotypic correlation coefficients showed similar trend but genotypic correlation coefficients were of higher in magnitude than the corresponding phenotypic correlation coefficients which might be due to masking or modifying effect of environment (Singh, 1980).

In the present investigation, there was strong negative and significant correlation between grain yield per plant and days to first flower at both genotypic and phenotypic levels (Table 2). Thus negative correlation between grain yield and days to first flower indicated that grain yield per plant would be reduced when the genotypes had late flowering nature. Contrary findings were reported by Mohan *et al.*, (2015) and Thippeswamy *et al.*, (2016) in which they reported positive significant correlation between grain yield per plant and days to first flower at both levels.

Also, days to first flower had positive significant correlation with plant height and negative significant correlation with grain yield per plant at genotypic and phenotypic levels. The results clearly indicated that long duration genotypes would be tall yet contribute less grain yield. Similar result was reported by Mohan *et al.*, (2015) and Thippeswamy *et al.*, (2016) reported that days to first flower had positive significant correlation with plant height at both levels.

Plant height had maximum correlations among all the characters studied for correlation coefficients. It had positive and significant correlation with number of tillers per plant, number of panicles per plant, number of grains per panicle and panicle length at both genotypic and phenotypic

levels. Similar reports were reported by Vijay Kumar (2015) for significance and positive correlation in panicle length at phenotypic level, Thippeswamy *et al.*, (2016) for positive significant correlation in panicle length and number of grains per panicle at both phenotypic and genotypic levels, Mohan *et al.*, (2015) for positive significant correlation in panicle length at both levels whereas only at phenotypic level for number of grains per panicle, Ravindra Babu *et al.*, (2012) for positive significant correlation in panicle length at both levels and number of panicles per plant at genotypic level, Yadav *et al.*, (2011) for positive significant correlation in panicle length at both levels and Singh *et al.*, (2014) for positive significant correlation in panicle length, number of tillers per plant and number of grains per panicle at both levels.

Table.1 List of genotypes selected for analysis

SL. No	Name of genotype	SL. No	Name of genotype
1.	ADT 47	2.	Geetanjali
3.	ADT 41	4.	IET 14348
5.	ADT 37	6.	Jaya Mathi
7.	ADT 36	8.	Samba Mashuri
9.	ADT 45	10.	MTU 1156
11.	ADT 48	12.	MTU 7029
13.	ADT 43	14.	MTU 1121
15.	ADT 42	16.	Super Amman
17.	ASD 16	18.	AngurSelam
19.	ASD 18	20.	ASD 1
21.	IR 66	22.	STBN 18
23.	IR 64	24.	Bhavani
25.	IR 72	26.	PLA 1100
27.	IR 50	28.	MTU 1010
29.	TPS 5	30.	K. Sona
31.	PMK 3	32.	AVT 1303
33.	AVT 1320	34.	CO 47
35.	AVT 1302	36.	TRY 2
37.	AVT 1321	38.	TKM 9
39.	Kullakar	40.	MDU 5
41.	Pooughar	42.	PY 3
43.	IR 36	44.	Dhanya Lakshmi
45.	NLR 34449	46.	IR 20
47.	Akshaya	48.	CO 51

Table.2 Phenotypic and genotypic correlation coefficients among yield attributing characters in rice genotypes

Sl. No	Characters		Days to first flower (days)	Plant height (cm)	Number of tillers per plant	No. of panicles per plant	No. of grains per panicle	Panicle length (cm)	Thousand grain weight (g)	Grain L/B ratio	Grain yield per plant (g)
1.	Days to first flower (days)	P	1.000	0.428**	0.102	- 0.024	0.223	0.181	- 0.148	- 0.099	- 0.342*
		G	1.000	0.478**	0.104	- 0.022	0.250	0.247	- 0.160	- 0.112	- 0.360*
2.	Plant height (cm)	P		1.000	0.321*	0.292*	0.349*	0.446**	- 0.021	0.087	- 0.084
		G		1.000	0.333*	0.309*	0.383**	0.501**	- 0.021	0.088	- 0.086
3.	Number of tillers per plant	P			1.000	0.849**	0.027	0.151	- 0.064	0.244	- 0.189
		G			1.000	0.867**	0.019	0.167	- 0.065	0.254	- 0.192
4.	No. of panicles per plant	P				1.000	- 0.057	0.242	0.129	0.112	0.118
		G				1.000	- 0.066	- 0.284	0.131	- 0.111	0.123
5.	No. of grains per panicle	P					1.000	0.018	- 0.010	- 0.110	- 0.159
		G					1.000	- 0.001	- 0.011	- 0.115	- 0.173
6.	Panicle length (cm)	P						1.000	- 0.016	0.271	0.148
		G						1.000	- 0.029	0.296*	0.169
7.	Thousand grain weight (g)	P							1.000	0.071	0.235
		G							1.000	0.071	0.236
8.	Grain L/B ratio	P								1.000	- 0.150
		G								1.000	- 0.152
9.	Grain yield per plant (g)	P									1.000
		G									1.000

*Significant at 5 per cent level

**Significant at 1 per cent level

P – Phenotypic correlation coefficient

G – Genotypic correlation coefficient

Table.3 Path coefficient analysis showing direct and indirect effects of yield attributing characters on Grain yield per plant in rice genotypes

Sl. No	Characters	Days to first flower (days)	Plant height (cm)	Number of tillers per plant	No. of panicles per plant	No. of grains per panicle	Panicle length (cm)	Thousand grain weight (g)	Grain L/B ratio	Grain yield per plant (g)
1.	Days to first flower (days)	-0.307	0.024	-0.094	-0.018	-0.014	0.041	-0.005	0.013	-0.360
2.	Plant height (cm)	-0.147	0.050	-0.299	0.258	-0.020	0.083	0.000	-0.010	-0.086
3.	Number of tillers per plant	-0.032	0.017	-0.897	0.724	-0.001	0.028	-0.002	-0.029	-0.192
4.	Number of panicles per plant	0.007	0.015	-0.778	0.836	0.004	0.047	0.004	-0.013	0.123
5.	Number of grains per panicle	-0.077	0.019	-0.017	-0.055	-0.055	0.000	0.000	0.013	-0.173
6.	Panicle length (cm)	-0.076	0.025	-0.150	0.237	0.000	0.167	0.000	-0.033	0.169
7.	Thousand grain weight (g)	0.049	-0.001	0.058	0.110	0.000	-0.005	0.032	-0.008	0.236
8.	Grain L/B ratio	0.034	0.004	-0.228	0.093	0.006	0.049	0.002	-0.113	-0.152

Residual effect = 0.745908

Direct effect – diagonal bold values

Indirect effect – unbold values

From the investigation, number of tillers per plant showed significant positive correlation with number of panicles per plant at both genotypic and phenotypic levels. Yadav *et al.*, (2011) also conveyed the same result.

Panicle length showed significant positive correlation with grain L/B ratio at genotypic level only. From the above discussion, it may be seen that selection of these characters would ultimately help in identifying genotypes with high yield potential.

Path coefficient analysis allows separating the direct and indirect effects through other contributes by apportioning the correlations (Wright, 1921) for better interpretation of cause and effect relationship. The results clearly showed significant difference in genotypic and phenotypic direct and indirect effects, indicating the predominance of environmental influence in expression of the traits. The direct and indirect contribution of various characters on yield in rice genotypes are measured and are presented in table 3.

In the present investigation, the residual effect was 0.745908. Perusal of results obtained in path analysis revealed that high direct effect on grain yield was exhibited by number of panicles per plant. Similar result was reported by Ravindra Babu *et al.*, (2012) whereas contrary reports were given by Thippeswamy *et al.*, (2016), Mohan *et al.*, (2015), Yadav *et al.*, (2011) and Akhtar *et al.*, (2011).

Panicle length recorded low positive direct effect on grain yield per plant, which was reported as same by Ravindra Babu *et al.*, (2012).

The trait, number of tillers per plant and days to first flower had high negative direct effect on grain yield per plant. Similar report was given by Mohan *et al.*, (2015) and Rajamadhan *et al.*, (2011) for days to first

flower and Akhtar *et al.*, (2011) for number of tillers per plant.

In addition to the direct effects, indirect effect of number of tillers per plant via number of panicles per plant was high and positive on grain yield per plant was also observed. Similar finding was reported by Yadav *et al.*, (2011).

Moderate positive indirect effect was observed by plant height through number of panicles per plant on grain yield per plant. But Ravindra Babu *et al.*, (2012) and Yadav *et al.*, (2011) reported positive low indirect effect on grain yield for the same.

Plant height also had moderate negative indirect effect on grain yield through number of tillers per plant yet it was recorded as negligible effect by Yadav *et al.*, (2011).

Also, panicle length was detected to have moderate positive indirect through number of panicles per plant on grain yield. Similar reports were reported by Basavaraj *et al.*, (2011) and Rajamadhan *et al.*, (2011). Grain L/B ratio had also observed moderate negative indirect effect through number of tillers per plant on grain yield per plant.

From the above discussion, it was inferred that the pattern of path coefficient observed in the present study was in agreement with the correlation obtained. In general, the character days to first flower recorded negative significant correlation and high negative direct effect with grain yield per plant. Hence it could be used as selection criteria in breeding programme to develop high yielding new plant type rice varieties.

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