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Correlation and Path analysis for Grain Yield and Quality Traits in Promising Rice Genotypes (*Oryza Sativa* L.)

Rathod AJ, Mistry PM* and Pampaniya AG

Department of Genetics and Plant Breeding, Main Rice Research Centre,
Navsari Agricultural University, Navsari-396 450. (Gujarat) India
*Corresponding author (email: drpmmistry2510@yahoo.in)

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Abstract

A study to obtain information on genetic correlation and inter-relationship of grain yield and associated characters under rainfed conditions was carried out using 54 diverse genotypes. The results of correlation studies indicated that genotypic correlation coefficients were higher in magnitude than their corresponding phenotypic correlation coefficients for most of the traits. The grain yield per plant exhibited highly significant and positive correlation with plant height, productive tillers per plant, number of grains per panicle, hulling per cent, milling per cent and amylose content at genotypic and phenotypic levels. On the contrary, it expressed negative and highly significant genotypic and phenotypic association with panicle length, L/B ratio, protein content and iron content with grain yield per plant. Path coefficient analysis revealed that days to 50 % flowering, plant height, panicle length, grains per panicle and hulling percentage had strong positive direct effects on grain yield per plant whereas, milling percentage, amylose content and zinc content showed moderate to low positive direct effects. On the contrary, negative and low to negligible direct effects were observed for productive tillers per plant and iron content.

Key words: Rice, correlation, path co-efficient, yield, yield components quality traits

Introduction

Rice (*Oryza sativa* L.) is one of the most important food crops in the world, second only to wheat in terms of annual production for human consumption. Rice belongs to family Poaceae and genus *Oryza*. In India rice accounts for about 22 per cent of the total cropped area under cereals, and about 31 per cent of the total area under food grains (Singhal, 2003). Asia is considered to be "Rice Bowl" of the world and produced more calories and carbohydrates per hectare than any other cereal (Lu and Chang 1980). In India, rice is grown in an area of 42.56 million ha of land with a production of 95.33 million tonnes and productivity of 2240 kg. Rice is grown throught India in all most all the states. In Gujarat, rice occupies about five per cent of gross cropped area of the state and it accounts about 14 per cent of total food grain production. In Gujarat, rice is cultivated in 7.88 lakh hectares with production of 16.36 lakh tones and productivity of 2076 kg per hectare (Anon., 2015). At present results of heterosis breeding in rice are not so enthusiastic. Therefore, there is urgent need to evolve short duration, high yielding and best quality genotypes of rice crop best suited to the region. Further, information on correlation co-efficient between grain yield and its component characters is essential for yield improvement, since grain yield in rice is a complex entity and is highly influenced by several component characters. Studies on path co-efficient also provide useful information regarding the direct and indirect effects of different yield component characters on grain yield and thus aid in the identification of effective selection criteria for effective yield improvement.

Material and Methods

The experiment was conducted with 54 diverse genotypes under rainfed lowland condition during *kharif* 2016 at Main Rice Research Centre, Navsari Agricultural University, Navsari (Gujarat). The material was grown in a randomized block design with three replications. Each entry was sown in a double row of three meter length with inter and intra row spacing of 20 cm and 15 cm respectively. Normal crop raised following all recommended cultural practices and plant protection measures. Five plants from each replication were selected at random and observations were recorded on 14 characters *viz.*, days to 50% flowering, plant height (cm), number of productive tillers per plant, panicle length (cm), number of grains per panicle, grain yield per plant (g), L/B ratio (kernel), hulling per cent (%), milling per cent (%), head rice recovery (%), amylose content (%), protein content (%), zinc content (ppm) and iron content (ppm).

The observation on days to 50% flowering was recorded on plot basis. The mean over replication of each character was subjected to statistical analysis. The genotypic and phenotypic correlations were calculated using the formulae suggested by Fisher and Yates (1967), while the direct and indirect contribution of each character for grain yield was estimated by path co-efficient analysis suggested by Wright (1921).

Results and Discussion

The genotypic and phenotypic correlations for yield and yield components are presented in Table 1. The results of correlation coefficients revealed that both genotypic and phenotypic correlations followed the same trend but the genotypic correlations were generally higher than the phenotypic correlations indicating that the phenotypic expression of correlations is reduced under the influence of environment. A perusal of these results revealed that grain yield per plant exhibited highly significant and positive correlation with plant height (0.251), panicle length (0.424), grains per panicle (0.332), hulling per cent (0.203), milling per cent (0.169) and amylose content (0.219) at genotypic levels indicating an increase in grain yield with an increase in these characters. Therefore, priority should be given to these traits, while making selection for yield improvement. The findings are in agreement with the reports of Gande *et al.* (2013), Santipriya *et al.* (2017), Ekka *et al.* (2015) Deepasankar *et al.* (2006), Kishore *et al.* (2015), Nagesh *et al.* (2012), Seyoum *et al.* (2012), Arulmozhi *et al.* (2013) and Alam *et al.* (2014). Furthermore, it expressed negative and highly significant genotypic and phenotypic association with panicle length, L/B ratio, protein content and iron content with grain yield per plant. A negative association between grain yield with productive tillers per plant, L/B ratio, protein content and iron content were finding similar Krishna Naik *et al.* (2005) and Nagesh *et al.* (2012).

In the present study path coefficient analysis has been conducted taking grain yield per plant as dependent variable. The persual of the results revealed that days to 50 % flowering, plant height, panicle length, grains per panicle and hulling percentage had strong positive direct effects on grain yield per plant (Table 2) This may indicate that direct selection of these characters is likely to be effective in increasing grain yield. Similar results obtained

Table 1. Genotypic (rg) and phenotypic (rp) correlation coefficients of thirteen characters in rice.

Character	C	PH	PTP	PL	GP	LBR	HP	MP	HRR	AC	PC	ZC	FC	GY
DF	rg	0.312**	-0.350**	0.227**	0.380**	-0.098	0.012	0.031	-0.076	0.095	-0.112	0.289**	0.054	0.383**
	rp	0.230**	-0.269**	0.204**	0.308**	-0.033	0.000	0.020	-0.068	0.092	-0.103	0.254**	0.049	0.251
PH	rg		0.127	0.504**	0.432**	0.055	-0.118	-0.209**	-0.001	0.123	-0.178*	0.067	-0.066	0.350**
	rp		0.083	0.305**	0.361**	0.045	-0.093	-0.156*	-0.021	0.095	-0.164*	0.052	-0.052	0.253
PTP	rg			0.266**	-0.276**	0.161*	0.069	0.038	-0.199*	-0.197*	-0.016	-0.334**	-0.198*	-0.125
	rp			0.198*	-0.206**	0.120	0.049	0.026	-0.178*	-0.177*	-0.009	-0.302**	-0.176*	-0.081
PL	rg				0.087	-0.094	0.026	0.170	-0.272	-0.270	-0.115	0.001	-0.142	0.424**
	rp				0.066	-0.041	0.059	0.092	-0.200*	-0.193*	-0.076	-0.005	0.090	0.245
GP	rg					-0.153*	0.176*	0.140	0.264**	-0.035	-0.047	0.188*	0.029	0.332**
	rp					-0.137	0.151	0.123	0.280**	-0.028	-0.050	0.177*	0.035	0.272
LBR	rg						0.109	0.018	-0.156*	-0.141	0.057	-0.151*	-0.063	-0.038
	rp						0.083	0.013	-0.139	-0.116	0.056	-0.143	-0.054	-0.038
HP	rg							0.988**	0.110	-0.376**	0.058	-0.030	-0.063	0.203**
	rp							0.827**	0.090	-0.337**	0.024	-0.031	-0.059	0.159
MP	rg								0.124	-0.414**	0.064	-0.049	0.030	0.169*
	rp								0.102	-0.361**	0.047	-0.043	0.025	0.141
HRR	rg									0.027	-0.068	0.036	0.014	0.030
	rp									0.037	-0.073	0.040	0.018	0.024
AC	rg										-0.031	-0.053	0.070	0.219**
	rp										-0.035	-0.050	0.065	0.194
PC	rg											-0.442**	0.238**	-0.089
	rp											-0.404**	0.224**	-0.046
ZC	rg												-0.065	0.133
	rp												-0.064	0.109
FC	rg													-0.248**
	rp													-0.214

*, ** Significant at P=0.05 level and P=0.01 level

DF = Days to 50 % flowering
PH = Plant height (cm)
PTP = Productive tillers per plant
PL = Panicle length (cm)
C = Correlation
GP = Grain per panicle
GY = Grain yield per plant (g)
LBR = L/B ratio (kernel)
HP = Hulling per cent (%)
MP = milling per cent (%)
HRR = Head rice recovery (%)
AC = Amylose content (%)
PC = Protein content (%)
ZC = Zinc content (ppm)
FC = Iron content (ppm)

Table 2: Path coefficient analysis showing direct and indirect effects of thirteen characters on grain yield per plant of rice.

Chara-cters	DF	PH	PTP	PL	GP	LBR	HP	MP	HR	AC	PC	ZC	FC
DF	**0.1194**	0.0373	-0.0418	0.0271	0.0455	-0.0117	0.0015	0.0038	-0.0091	0.0114	-0.0135	0.0345	0.0065
PH	0.0676	**0.2163**	0.0275	0.1092	0.0936	0.0119	-0.0257	-0.0453	-0.0002	0.0267	-0.0387	0.0146	-0.0143
PTP	0.0202	-0.0073	**-0.0577**	-0.0154	0.0159	-0.0093	-0.0040	-0.0022	0.0115	0.0114	0.0009	0.0193	0.0114
PL	0.0468	0.1041	0.0549	**0.2063**	0.0179	-0.0196	0.0054	0.0353	-0.0562	-0.0559	-0.0238	0.0004	-0.0294
GP	0.0649	0.0737	-0.0471	0.0148	**0.1703**	-0.0261	0.0300	0.0239	0.0451	-0.0061	-0.0081	0.0321	0.0050
LBR	-0.0147	0.0082	0.0242	-0.0142	-0.0229	**0.1495**	0.0164	0.0027	-0.0234	-0.0212	0.0086	-0.0227	-0.0092
HP	-0.0113	0.1046	-0.0611	-0.0230	-0.1548	-0.0964	**-0.8798**	-0.8694	-0.0972	0.3312	-0.0510	0.0270	0.0558
MP	0.0388	-0.2561	0.0465	0.2091	0.1718	0.0223	1.2088	**1.2233**	0.1523	-0.5065	0.0787	-0.0600	0.0368
HRR	-0.0003	0.0000	-0.0008	-0.0011	0.0011	-0.0006	0.0004	0.0005	**0.0040**	0.0001	-0.0003	0.0001	0.0001
AC	0.0446	0.0575	-0.0922	-0.1262	-0.0167	-0.0661	-0.1754	-0.1929	0.0127	**0.4659**	-0.0147	-0.0248	0.0330
PC	-0.0140	-0.0221	-0.0020	-0.0142	-0.0059	0.0071	0.0072	0.0079	-0.0085	-0.0039	**0.1236**	-0.0547	0.0295
ZC	0.0416	0.0097	-0.0481	0.0003	0.0271	-0.0218	-0.0044	-0.0070	0.0053	-0.0077	-0.0636	**0.1438**	-0.0094
FC	-0.0200	0.0241	0.0722	0.0519	-0.0108	0.0223	0.0231	-0.0110	-0.0053	-0.0258	-0.0871	0.0240	**-0.3645**
Correlation with GY	0.3837**	0.3500**	-0.1257*	0.4245**	0.3323**	-0.0385	0.2035**	0.1697*	0.0308	0.2197**	-0.0890	0.1397*	**-0.2486****

*, ** Significant at P =0.05 and 0.01 level. Residual effect =0.5011. Bold figures show direct effect

DF = days to 50% flowering
HP = Hulling percent (%)
MP = Milling percent (%).
HRR = Head rice recovery (%).
AC = Amylose content (%).
PC = Protein content (%)
ZC = Zinc content (ppm)
FC = Iron content (ppm)
PL = Panicle length (cm)
PH = Plant height (cm)
GP = Grains per panicle
GY = Grain yield per plant (g)
LBR = L/B ratio (kernel)

by Nagesh *et al.* (2012), Khare *et al.* (2014), Sandhya *et al.* (2014), Ekka *et al.* (2015), Kishore *et al.* (2015), Santipriya *et al.* (2017), Rahman *et al.* (2014), Dhurai *et al.* (2016), Mustafa and Elsheikh (2007) and Naseer *et al.* (2015). Whereas, milling percentage, amylose content and zinc content showed moderate to low positive direct effects as they are quality parameters. But L/B ratio and head rice recovery exhibited negligible positive direct effects. On the contrary, negative and low to negligible direct effects were observed for productive tiller per plant and iron content indicates low influence of these traits on grain yield. The indirect effects of days to 50 % flowering, plant height, panicle length, grains per panicle, hulling percentage, milling percentage, amylose content and zinc content on grain yield per plant were positive and highly significant, whereas, productive tillers per plant and iron content had negative and highly significant indirect effect on grain yield. These findings suggested that, selection pressure on panicle length, grains per panicle, hulling percentage, milling percentage, amylose content and zinc content would be effective for improvement of grain yield in rice.

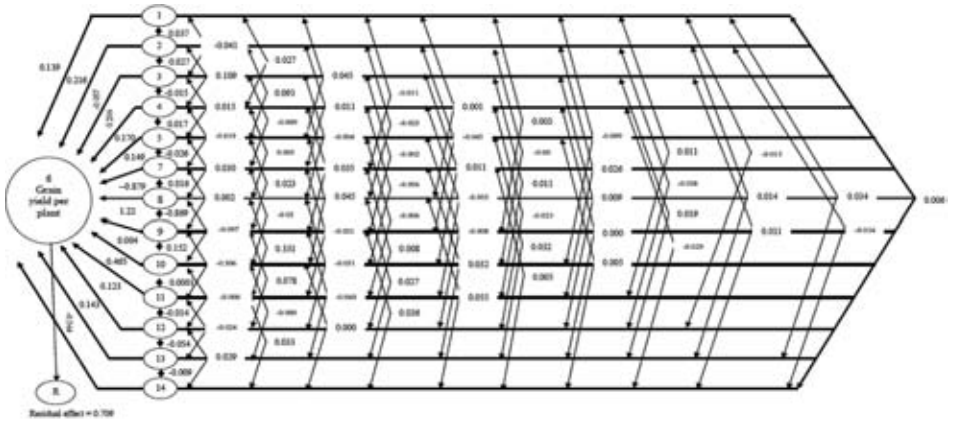

Figure 1: Diagrammatical representation of genotypic path analysis in rice: 1. Days to 50 % flowering 2.Plant height (cm) 3. Productive tillers per plant 4. Panicle length (cm) 5. Grains per panicle 6.Grain yield per plant (g) 7.L/B ratio 8. Hulling percentage (%) 9. Milling percentage (%) 10. Head rice recovery (%) 11. Amylose content (%) 12. Protein content (%) 13. Zinc content (ppm) 14. Iron content (ppm)

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