Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(4): 1490-1494
Received: 13-05-2018
Accepted: 18-06-2018

Neha Singh
N.D. University of Agriculture and Technology, Uttar Pradesh, India

OP Verma
N.D. University of Agriculture and Technology, Uttar Pradesh, India

Correspondence
Neha Singh
N.D. University of Agriculture and Technology, Uttar Pradesh, India

Correlation and path coefficient studies for grain yield and quantitative traits in rice (*Oryza sativa* L.)

Neha Singh and OP Verma

Abstract
The present experiment was carried out to evaluate correlation and path coefficient between grain yield and other quantitative traits in 19 lines, 3 testers and 57 F_1 hybrids at Research farm of Department of Genetics and Plant Breeding, Narendra Deva University of Agriculture and Technology, Kumarganj Faizabad. The experiment design was randomized block design with three replications. Genotypic correlations were high and same in magnitude as phenotypic correlation. Grain yield showed highly significant and positive correlation with biological yield per plant, grains per panicle, flag leaf area and spikelets per panicle while significant and positive correlation with panicle bearing tillers per plant, panicle length, spikelets and harvest index area. Biological yield per plant, harvest index and grain per panicle showed higher direct effect on grain yield per plant in saline conditions. Plant height and 1000 grain weight showed indirect effect on grain yield per plant via harvest index. Panicle bearing tillers per plant, plant height, flag leaf area and 1000 grain weight showed indirect effect on grain yield per plant via biological yield per plant. Spikelets per panicle showed maximum indirect effect on grain yield per plant via grains per panicle.

Keywords: correlation, path coefficient, grain yield, harvest index

Introduction
Rice is world's most important crop after wheat and maize. More than 90% to 95% of rice is produced and consumed is Asia (Virmani, 1996) [17] and is the leader in rice production thus rice is of immense importance to food security of Asia. India stands first in rice area and second in rice production (180.10 million tonnes), after China (184.25 million tonnes). India contributes 30% of global rice production. However, rapidly increasing demand due to ever increasing Indian population, has forced us to led continuous crop improvement programme to jump in rice yield. Hence, rice breeders are interested in developing cultivars with improved yield and other desirable agronomic characters.
Grain yield or economic yield, in almost all the crops, is the complex character which manifests from multiplicative interactions of several other characters that are termed as yield components. The genetic architecture of grain yield in rice as well as other crops is based on the balance or overall net effect produced by various yield components directly or indirectly by interacting with one another. Correlation coefficient determines the degree and direction of association between traits, which forms the basis for selecting the desirable plant, aiding in evaluation of relative influence of various component characters on grain yield. Path coefficient analysis decides direct and indirect effects employed by different traits on grain yield due to correlation. In the present study, an attempt was made to understand the association and path analysis of component characters for grain yield with other traits in rice.

Material and Methods
The present experiment was conducted at Research Farm of Department of Genetics and Plant Breeding, N.D. University of Agriculture and Technology, Kumarganj, Faizabad. The experimental material consisted 22 parental lines and 57 F_1 hybrids grown in Randomized block design during kharif season of 2014. The 57 hybrids were obtained through crossing 19 lines with three testers (22 parents) i.e., Narendra 359, Sarjoo 52 and Narendra Usar-3 in line x tester manner. All the recommended package of practices was followed and need based plant protection was done. Observations on 15 morphological and quality characters were recorded based on ten randomly selected plants in each genotype in each replication. The traits were days to 50 % flowering, plant height (cm), flag leaf area, (cm2), panicle bearing tillers per plant, panicle length (cm), spikelets per panicle, grains per panicle, spikelet fertility (%),

biological yield per plant (g), harvest index (%), L:B ratio, 1000-grains wt. (g) Kernel length (mm), Kernel width (mm)and grain yield per plant (g).

Simple correlation coefficient analysis for yield and yield related characters was carried out according to the formula suggested by Al-jibouri *et al.,* (1985) [1]. Path coefficient analysis for yield was done following Dewey and Lu (1959) [4].

Result and Discussion

Knowledge about magnitude and direction of association between yield and its related quantitative traits is an important statistical parameter for identification of key traits which can be exploited in crop improvement programme. Genotypic and Phenotypic correlations between 15 quantitative traits is present in Table 1 and 2. The results revealed that genotypic correlation coefficient values were higher than their respective phenotypic correlation coefficient values indicating strong interrelationship between characters which might be due to the modified effect of environment on character association at the genetic level. Grain yield per plant showed highly significant and positive correlation with biological yield per plant, grains per panicle, spikelets per panicle, flag leaf area, panicle bearing tillers per plant, harvest index, panicle length, spikelets fertility, 1000 grain weight and days to 50% flowering at phenotypic and genotypic levels. Therefore, these characters emerged as most important associates of grain yield in rice. The strong positive association of grain yield with the characters mentioned above has also being reported in rice by earlier workers (Nandan *et al.,* 2010; Bhadru *et al.,* 2011; Rangare *et al.,* 2012; Krishnamurthy and Kumar, 2012; Pankaj *et al.,* 2013; Laxmi *et al.,* 2014; Gopikannan and Ganesh 2014 and Venkann *et al.,* 2014) [11, 3, 5, 8, 16].

Days to 50% flowering showed highly significant and positive association with flag leaf area, panicle length, kernel length and L:B ratio. Plant height had significant and positive association with flag leaf area, panicle bearing tillers per plant, panicle length and 1000 grain weight. This indicated that the taller genotypes possessed greater harvest-index besides having late flowering which appears logical. The association of plant height with different morphological and physiological traits has also been reported in rice by Bhadru *et al.* (2011) [3]. The physiological trait biological yield per plant recorded positive and significant correlation with only grain yield per plant. The seed trait 1000 grain weight had non-significant and positive association with other characters. Positive associations between these characters have also been reported by Zahid *et al*., 2006; Kishore *et al*., 2007; Rangare *et al.,* 2012; Krishnamurthy and Kumar 2012; Laxmi *et al.,* 2014; Gopikannan and Ganesh 2014 and Venkann *et al.,* 2014) [18, 7, 5, 8, 16].

In the present study, majority of significant estimates of correlations between yield and yield components were positive in nature. Out of total correlations between different character pairs, 45 estimates were positive and significant. This represents high situation for obtaining high response to selection in improving yield and yield components in rice. Thus, selection practiced for improving these traits individually or simultaneously would bring improvement in other due to correlated response. This suggested that selection would be quite efficient in improving yield and yield components.

The trait grain yield in rice is directly or indirectly influenced by several other characters therefore, selection based on simple correlation without taking into consideration the interaction between the different component characters can be misleading. Path analysis partitioned the genotypic correlation into direct and indirect effect on yield through other traits. The high positive direct effects on grain yield per plant were exerted by L:B ratio, biological yield per plant and grains per panicle,(Table 3). Thus, L:B ratio, biological yield per plant and grains per panicle emerged as most important direct yield components on which emphasis should be given during simultaneous selection aimed at improving grain yield in rice. Bhadru *et al*., (2011) [3]; Rangare *et al., (*2012) [5]; Krishnamurthy and Kumar (2012) [8]; Laxmi *et al.,* (2014); Gopikannan and Ganesh (2014) and Venkann *et al.,* (2014) [16]. The direct effects of remaining characters were too low to be considered important.

The characters, 1000 grain weight, panicle length and L:B ratio exhibited high and positive indirect effect on grain yield *via* biological yield per plant. Plant height and 1000 grain weight possessed high and positive indirect effect on grain yield *via* harvest index. 1000 grain weight, panicle length, flag leaf area, and panicle bearing tillers per plant exhibited high and positive indirect effect on grain yield *via* biological yield per plant. Spikelets per panicle showed positive and indirect effect on grain yield *via* grains per panicle. Harvest-index and grains per panicle exhibited high and negative indirect effect on grain yield *via* spikelet fertility. Janardanam *et al.,* (2002) [6], Mahto *et al.,* (2003) [10], Qamar *et al.,* (2005) [14], Patil and Sarawgi (2003) [13], Zahid *et al.,* (2006) [18], Kishore *et al.,* (2007) [7] and Babar *et al.,* (2009) [2] have also identified biological yield and harvest-index as important direct and indirect yield contributing characters. The indirect effects of remaining characters were too low to be considered important.

In the present study, path analysis identified grain yield per plant followed by L:B ratio, biological yield per plant, grains per panicle and panicle bearing tillers per plants most important direct as well as indirect yield contributing traits or components which merit due consideration at time of devising selection strategy aimed at developing high yielding varieties/hybrids in rice.

Conclusion

In contrary to most of the previous reports in rice, comparatively small proportion of direct and indirect effects of different characters attained high order values in the present study. Majority of the estimates of direct and indirect effects were too low to be considered of any consequence. This may be attributed to presence of very high genetic variability and diversity in the rice genotypes. The existence of different character combinations in diverse rice genotypes might have led to different types of character association in different lines. Thus, presence of several contrasting types of character associations or inter-relationships might have resulted into cancellation of contrasting associations by each other ultimately leading to lowering of the net impact or effect.

Table 1: Estimate of genotypic correlation coefficients among 15 characters in rice

Character	Days to 50% Flowering	Plant Height (cm)	Flag Leaf Area (cm ²)	Panicle Bearing Tillers/ Plant	Panicle Length (cm)	Spikelets/ Panicle	Grains/ Panicle	Spikelet Fertility (%)	1000-grain Weight (g)	Biological Yield/ Plant (g)	harvest Index (%)	Kernel Length (mm)	Kernel Width (mm)	L:B Ratio	Grain Yield/ Plant (g)
Days to 50% Flowering	1.0000	0.2462*	0.3356**	0.3000*	0.4107**	0.2402*	0.1907	-0.0642	0.1790	0.1169	0.0264	0.4340**	-0.0787	0.3841**	0.1169
Plant Height (cm)		1.0000	0.4763**	0.4604**	0.4817**	0.2331*	0.1888	-0.0938	0.3644**	0.0460	-0.1734	0.2192	-0.0736	0.2081	-0.0155
Flag Leaf Area (cm ²)			1.0000	0.6858**	0.6450**	0.6543**	0.6108**	0.1126	0.2432*	0.5828**	-0.0448	0.1006	0.0309	0.0494	0.5248**
Panicle Bearing Tillers/ Plant				1.0000	0.4751**	0.4695**	0.4482**	0.1619	0.2164	0.4786**	-0.0828	0.1687	-0.1338	0.1966	0.4168**
Panicle Length (cm)					1.0000	0.3978**	0.3595**	-0.0110	0.1691	0.3905**	0.0302	0.4126**	0.0309	0.3029**	0.3634**
Spikelets/ Panicle						1.0000	0.9764**	0.3241**	-0.0077	0.5548**	-0.0161	0.0069	0.0192	-0.0254	0.5104**
Grains/ Panicle							1.0000	0.5162**	0.0404	0.5646**	0.0018	-0.0003	-0.0360	0.0013	0.5261**
Spikelet Fertility (%)								1.0000	0.2277	0.3127**	0.0548	-0.0122	-0.2215	0.1144	0.3086**
1000-grain Weight (g)									1.0000	0.1814	0.0875	0.1310	-0.0709	0.1261	0.1992
Biological Yield/ Plant (g)										1.0000	-0.0107	-0.0160	-0.1810	0.0622	0.9375**
harvest Index (%)											1.0000	0.0389	-0.0061	-0.0040	0.3676**
Kernel Length (mm)												1.0000	-0.1153	0.8382**	-0.0011
Kernel Width (mm)													1.0000	-0.6338**	-0.1856
L:B Ratio														1.0000	0.0653
GYP (g)															1.0000

Table 2: Estimate of phenotype correlation coefficients among 15 characters in rice

Character	Days to 50% Flowering	Plant Height (cm)	Flag Leaf Area (cm ²)	Panicle Bearing Tillers/ Plant	Panicle Length (cm)	Spikelets/ Panicle	Grains/ Panicle	Spikelet Fertility (%)	1000-grain Weight (g)	Biological Yield/ Plant (g)	harvest Index (%)	Kernel Length (mm)	Kernel Width (mm)	L:B Ratio	Grain Yield/ Plant (g)
Days to 50% Flowering	1.0000	0.2383*	0.3170**	0.2729*	0.3722**	0.2292	0.1856	-0.0455	0.1595	0.1011	0.0128	0.4073**	-0.0733	0.3498**	0.1053
Plant Height (cm)		1.0000	0.4688**	0.4416**	0.4421**	0.2308*	0.1903	-0.0673	0.3429**	0.0478	-0.1463	0.2099	-0.0680	0.1944	-0.0143
Flag Leaf Area (cm ²)			1.0000	0.6633**	0.5934**	0.6405**	0.5992**	0.0934	0.2430*	0.5666**	-0.0431	0.0930	0.0354	0.0381	0.4998**
Panicle Bearing Tillers/ Plant				1.0000	0.4424**	0.4497**	0.4336**	0.1464	0.1991	0.4575**	-0.0571	0.1565	-0.0832	0.1589	0.3966**
Panicle Length (cm)					1.0000	0.3765**	0.3376**	-0.0227	0.1603	0.3562**	0.0372	0.3814**	0.0879	0.2177	0.3470**
Spikelets/ Panicle						1.0000	0.9691**	0.2339*	-0.0032	0.5291**	0.0008	0.0145	0.0252	-0.0221	0.4890**
Grains/ Panicle							1.0000	0.4502**	0.0352	0.5421**	0.0013	0.0015	-0.0239	-0.0004	0.5027**
Spikelet Fertility (%)								1.0000	0.1533	0.2589*	-0.0177	-0.0218	-0.1850	0.0968	0.2394*
1000-grain Weight (g)									1.0000	0.1761	0.0665	0.1199	-0.0281	0.0925	0.1882
Biological Yield/ Plant (g)										1.0000	-0.0141	-0.0190	-0.1399	0.0475	0.9015**
harvest Index (%)											1.0000	0.0200	-0.0019	-0.0141	0.3622**
Kernel Length (mm)												1.0000	-0.0726	0.7580**	-0.0057
Kernel Width (mm)													1.0000	-0.6505**	-0.1257
L:B Ratio														1.0000	0.0345
Grain Yield/ Plant (g)															1.0000

Table 3: Estimate of genotypic direct and indirect effect of 14 characters on grains yield per plant in rice

Character	Days to 50% Flowering	Plant Height (cm)	Flag Leaf Area (cm ²)	Panicle Bearing Tillers/ Plant	Panicle Length (cm)	Spikelets/ Panicle	Grains/ Panicle	Spikelet Fertility (%)	1000-grain Weight (g)	Biological Yield/ Plant (g)	harvest Index (%)	Kernel Length (mm)	Kernel Width (mm)	L:B Ratio	Grain Yield/ Plant (g)
Days to 50% Flowering	-0.0056	-0.0014	-0.0019	-0.0017	-0.0023	-0.0013	-0.0011	0.0004	-0.0010	-0.0007	-0.0001	-0.0024	0.0004	-0.0022	0.1169
Plant Height (cm)	0.0114	0.0462	0.0220	0.0213	0.0223	0.0108	0.0087	-0.0043	0.0168	0.0021	-0.0080	0.0101	-0.0034	0.0096	-0.0155
Flag Leaf Area (cm ²)	-0.0032	-0.0046	-0.0096	-0.0066	-0.0062	-0.0063	-0.0058	-0.0011	-0.0023	-0.0056	0.0004	-0.0010	-0.0003	-0.0005	0.5248
Panicle Bearing Tillers/ Plant	0.0019	0.0029	0.0044	0.0064	0.0030	0.0030	0.0029	0.0010	0.0014	0.0031	-0.0005	0.0011	-0.0009	0.0013	0.4168
Panicle Length (cm)	-0.0379	-0.0445	-0.0595	-0.0438	-0.0923	-0.0367	-0.0332	0.0010	-0.0156	-0.0360	-0.0028	-0.0381	-0.0029	-0.0280	0.3634
Spikelets/ Panicle	-0.1916	-0.1860	-0.5222	-0.3746	-0.3175	-0.7980	-0.7792	-0.2586	0.0061	-0.4427	0.0128	-0.0055	-0.0153	0.0202	0.5104
Grains/ Panicle	0.1739	0.1721	0.5569	0.4086	0.3277	0.8901	0.9117	0.4706	0.0368	0.5147	0.0017	-0.0003	-0.0328	0.0012	0.5261
Spikelet Fertility (%)	0.0160	0.0233	-0.0280	-0.0403	0.0027	-0.0806	-0.1283	-0.2486	-0.0566	-0.0777	-0.0136	0.0030	0.0551	-0.0284	0.3086
1000-grain Weight (g)	0.0013	0.0026	0.0017	0.0016	0.0012	-0.0001	0.0003	0.0016	0.0072	0.0013	0.0006	0.0009	-0.0005	0.0009	0.1992
Biological Yield/ Plant (g)	0.1193	0.0470	0.5950	0.4886	0.3986	0.5664	0.5764	0.3192	0.1852	1.0209	-0.0109	-0.0163	-0.1848	0.0635	0.9375
harvest Index (%)	0.0117	-0.0767	-0.0198	-0.0366	0.0134	-0.0071	0.0008	0.0243	0.0387	-0.0047	0.4426	0.0172	-0.0027	-0.0018	0.3676
Kernel Length (mm)	-0.4872	-0.2460	-0.1129	-0.1894	-0.4632	-0.0077	0.0003	0.0137	-0.1471	0.0179	-0.0437	-1.1226	0.1294	-0.9409	-0.0011
Kernel Width (mm)	-0.0642	-0.0601	0.0252	-0.1092	0.0252	0.0156	-0.0294	-0.1807	-0.0578	-0.1477	-0.0050	-0.0940	0.8158	-0.5171	-0.1856
L:B Ratio	0.5713	0.3095	0.0735	0.2924	0.4505	-0.0377	0.0019	0.1701	0.1875	0.0926	-0.0059	1.2466	-0.9427	1.4873	0.0653

References

1. Al-jibouri HA, Miller PA, Robinson HP. Genotypic and environmental variances and covariances in upland cotton cross of interspecific origin. Agronomy Journal. 1985; 50:633-636.
2. Babar M, Khan AA, Arif A, Zafar Y, Arif M. Path analysis of some leaf and panicle traits affecting grain yield in double haploid lines of rice (*Oryza sativa* L.). Journal of Agricultural Research. 2009; *5*(4):245-252.
3. Bhadru D, Reddy DL, Ramesha MS. Correlation and path coefficient analysis of yield and yield contributing traits in rice hybrids and their parental lines. Electronic Journal of Plant Breeding. 2011; 2(1):112-116.
4. Dewey DR, Lu KH. A correlation and path coefficient analysis of components of crested wheat grass seed production. Agronomy Journal. 1959; 51:515-518.
5. Gopikannan M, Ganesh SK. Investigation on combining ability and heterosis for sodicity tolerance in rice (*Oryza sativa* L.). African Journal of Agricultural Research. 2013; 8(32):4326-4333.
6. Janardanam V, Nadarajan N, Jebaraj S. Correlation and path analysis in rice (*Oryza sativa* L.). Madras Agriculture Journal. 2002; 88(10-12):719-720.
7. Kishore NS, Ansari NA, Babu VR, Rani NS, Rao LV, Subba R. Correlation and path analysis in aromatic and non-aromatic rice genotypes. Agriculture Science Digest. 2007; 27(2).
8. Krishnamurthy HT, Kumar HDM. Correlation and path coefficient studies of some physiological traits among indigenous aromatic rice (*Oryza sativa* L) cultivars. Agriculture Biology Research. 2012; 28(2):120-127.
9. Lakshmi VM, Suneetha Y, Yugandhar G, Lakshmi VN. Correlation studies in rice (*Oryza sativa* L.). International Journal of Genetic Engineering and Biotechnology. 2014; 5(2):121-126.
10. Mahto RN, Yadav MS, Mohan KS. Genetic variation, character association and path analysis in rainfed upland rice. Indian Journal of Dryland Agriculture Research and Development. 2003; 18(2):196-198.
11. Nandan R, Sweta, Singh SK. Character association and analysis in rice (*Oryza sativa* L.) genotypes. World Journal of Agricultural Sciences. 2010; 6(2):201-206.
12. Bhatia P, Jain RK, Chowdhury VK. Genetic variability, correlation and path coefficient analysis for grain yield and its components in rice (*Oryza sativa* L.) Annals of Biology. 2013; 29(3):282-287.
13. Patil PV, Sarawgi AK, Shrivastava MN. Genetic analysis of yield and quality traits in traditional aromatic accessions of rice. Journal of Maharashtra Agriculture University. 2003; 28(3):225-258.
14. Qamar Zia-Ul, Cheema AA, Ashraf M, Rashid M, Tahir GR. Association analysis of some yield influencing traits in aromatic and non-aromatic rice. Pakistan Journal of Botany. 2005; 37(3):613-627.
15. Rangare NR, Krupakar A, Ravichandra K, Shukla AK, Mishra AK. Estimation of character association and direct and indirect effects of yield contributing traits on grain yield in exotic and Indian rice (*Oryza sativa* L.) germplasm. International Journal of Agriculture Sciences. 2012; 2(1):54-61.
16. Venkanna V, Lingaiah N, Raju CS, Rao VT. Genetic studies for quality traits of F_2 population in rice (*Oryza sativa* L.). International Journal of Applied Biology and Pharmaceutical Technology. 2014; 5(2):125-127.
17. Virmani SS, Hybrid Rice. Advances in Agronomy. 1996; 57:328-462.
18. Zahid MA, Akhtar M, Sabir M, Manzoor Z, Awan TH. Correlation and path analysis studies of yield and economic traits in Basmati rice (*Oryza sativa* L.). Asian Journal of Plant Sciences. 2006; 5:643-645.