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Character association and path coefficient studies in rice (*Oryza sativa* L.)

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Abstract
Genetic parameters, correlation coefficients among yield and yield components, direct and indirect effect of yield components on yield were studied in one hundred and one rice genotypes for seven quantitative traits. The analysis of variance revealed that there were highly significant differences for all the characters among the genotypes. The estimate of GCV and PCV was found to be highest for number of filled grains per panicle followed by grain yield per plant and ear bearing tillers. The broad sense heritability was highest for plant height (99.6%) followed by grain yield per plant (98.8%) and days to flowering (98.2). The estimate of genetic advance was found to be highest for number of filled grains per panicle and grain yield per plant. The number of filled grains per panicle and grain yield per plant had high heritability as well as high genetic advance. A significant positive association of grain yield with number of panicles and test weight was observed in character association studies. Path coefficient analysis revealed that plant height, ear bearing tillers, panicle length, number of filled grains per panicle and test weight (g) exhibited positive direct effect on yield. Among these characters, ear bearing tillers and test weight possessed both positive association and high direct effects. Hence, selection for these character could bring improvement in yield and yield components.

Keywords: Genetic parameters, correlation, path analysis, rice, yield, yield components

Introduction

Rice (*Oryza sativa* L.) is the most important crop providing food to over 75 percent of asian population and more than three billion of world population which represents 50 to 80% of their daily calorie intake (Khush *et al.*, 2005) [15]. Over 90 percent of the world's rice is produced and consumed in the Asian Region by six countries (China, India, Indonesia, Bangladesh, Vietnam and Japan) comprising 80% of the world's production and consumption (Abdullah *et al.*, 2006) [1]. The economic product of rice is the grain yield, which exhibits complex genetics as it is influenced by various yield contributing characters. These yield contributing components are interrelated with each other showing a complex chain of relationship and also highly influenced by the environmental conditions (Prasad *et al.*, 2001) [25]. Yield enhancement is the major breeding objective in rice breeding programmes and knowledge on the nature and magnitude of the genetic variation governing the inheritance of quantitative characters like yield and its components is essential for effective genetic improvement. A critical analysis of the genetic variability parameters, namely, Genotypic Coefficient of Variability (GCV), Phenotypic Coefficient of Variability (PCV), heritability and genetic advance for different traits of economic importance is a major pre-requisite for any plant breeder to work with crop improvement pogrammes. Breeding strategy in rice mainly depends upon the degree of association among characters as well as its magnitude and nature of variation (Zahid *et al.*, 2006 and Prasad *et al.*, 2001) [33, 25]. Therefore, the knowledge of association of component characters with yield has great importance to plant breeders, as it helps in their selection with more precision and accuracy. The degree of association of these components with yield can be measured by correlation coefficients. Path coefficient analysis provides an exact picture of the relative importance of direct and indirect effects of each of the component character towards yield. The present investigation was undertaken in this context to elucidate information on variability, heritability, genetic advance, character associations and path of effect in promising set of one hundred and one rice genotypes of Professor Jaya Shanker Telangana State Agriculture University, Telangana, India.

Materials and Methods

The experimental materials for the present study consisted of 101 Rice germplasm lines from PJTSAU and major breeding centres in India. The current experiment was carried out in the experimental fields of Rice Research Center at Agriculture Research Institute, Rajendranagar during *Kharif,* 2017. The experiment was laid out in Randomized Block Design (RBD) with 101 genotypes as treatments and two replications. Twenty-five day old seedlings of each genotype were transplanted in two rows, each 2m length with a spacing of 20 x 15 cm cm. All necessary precautions were taken to maintain uniform plant population in each treatment per replication. All the recommended package of practices were followed along with necessary prophylactic plant protection measures to raise a good crop. Observations were recorded for grain yield and yield component characters, namely, days to 50 per cent flowering, plant height, ear bearing tillers, panicle length, number of filled grains per panicle, 1000 grain weight and grain yield per plant. The observations on plant height, ear bearing tillers, panicle length, number of filled grains per panicle and 1000 grain weight were recorded from five randomly selected plants for each entry in each replication. However, days to 50 per cent flowering and grain yield were recorded on plot basis i.e., flowering five plants out of ten in a row. In contrast, observations for 1000-grain weight were obtained from a random grain sample drawn from each row in each entry and replication. The data obtained was subjected to standard statistical procedures. Genotypic and phenotypic co-efficients of variation were computed following the methodology given by Burton (1952) [6], while the estimates of heritability and genetic advance were obtained as per the procedures outlined by Burton and Devane (1953) [7], and Johnson *et al.,* (1955) [14], respectively. The genotypic and phenotypic correlations were calculated using the formulae suggested by Fisher and Yates (1967) [11], while the direct and indirect contribution of each character for grain yield was estimated by path co-efficient analysis suggested by Wright (1921) [31].

Results and Discussion

The numerical data collected on seven agro-morphological characters were statistically analysed and the analysis of variance (Table. 1) showed significant differences among the genotypes of rice under study for all the seven traits *viz.*, days to flowering, plant height, panicle length, ear bearing tillers, number of filled grains per panicle, 1000 grain weight and grain yield per plant, indicating the presence of considerable genetic variability among the experimental material under study.

Information on mean, PCV, GCV, heritability, genetic advance and genetic advance in per cent of mean for yield and yield component traits are furnished in table 2. A perusal of these results revealed higher phenotypic co-efficients of variation compared to genotypic co-efficients of variation for all the traits studied in the present investigation, indicating the influence of environment. Similar findings were reported earlier by Mamta Singh *et al.,* (2007) [19]. Further, the high (>20%) estimates of genotypic and phenotypic co-efficient of variation recorded for number of filled grains per panicle, grain yield per plant and ear bearing tillers which were in conformity with the findings of Srinivas *et al.,* (2004) for filled grains per panicle; Hasib *et al.,* (2004) for grain yield per plant Bekele *et al.,* (2013) for productive tillers per plant. Padmaja *et al.,* (2008) also recorded similar observation for single plant yield. Hence, selection on the basis of phenotype in these genotypes can also be effective for improvement of grain yield. However, moderate (10-20%) genotypic and phenotypic coefficients of variation were recorded in the present study for panicle length, panicle height and 1000 grain weight. These results are in conformity with the findings of Bornane *et al.,* (2014) for 1000 grain weight. In contrast, low (<10%) estimates of genotypic and phenotypic coefficients of variation were noticed for plant height, days to 50 per cent flowering, panicle length. These results are in conformity with Padmaja *et al.,* (2008) for days to 50 per cent flowering and panicle length. Similar findings were reported earlier by Satish *et al.,* (2003) [26] for plant height, Indicating low variability for these characters in the present experimental material and therefore little scope for improvement of these traits.

The broad sense heritability was highest for plant height (99.6%), grain yield (98.8 %), days to 50 per cent flowering (98.2 %), 1000-seed weight (95.3%) and ear bearing tillers (91.8%). These results are in conformity with the reports of Aditya *et al.,* (2013) for plant height; Idris *et al.,* (2013) [13] for 1000-seed weight and plant height; Bisne *et al.,* (2009) for ear bearing tillers per hill; Dhanwani *et al.,* (2013) [9] for days to 50 per cent flowering; and Kundu *et al.,* (2008) [17] for grain yield per plant. The estimate of heritability alone is not very much useful because it includes the effect of both additive and non-additive genes. The genetic advance is a useful indicator of the progress that can be expected as a result of exercising selection on the pertinent population. The estimate of genetic advance was found to be highest for number of filled grains per panicle and grain yield per plant (Sharma and Sharma, 2007). The number of filled grains per panicle and grain yield per plant had high heritability as well as high genetic advance. It is suggested that these characters were predominantly controlled by additive gene action. Hence genetic improvement through selection for these traits may be effective. Heritability estimates along with genetic advance are more helpful in predicting gain under selection than heritability estimate alone (Johnson *et al.,* 1955; Sinha *et al.,* 2004) [14].

The results of correlation analysis are presented in Table 2, Days to flowering exhibited significant positive correlation with number of filled grains per panicle and negative significant correlation with 1000 grain weight. Plant height exhibited significant positive correlation with panicle length and negative significant correlation with ear bearing tillers and 1000 grain weight. Ear bearing tillers exhibited positive significant correlation with grain yield per plant and negative significant correlation with number of filled grains per panicle. Panicle length exhibited positive significant correlation with 1000 grain weight. Number of filled grains per panicle exhibited positive significant correlation with grain yield per plant negative correlation with 1000 grain weight. 1000-grain weight exhibited positive significant correlation with grain yield per plant.

Further, grain yield per plant exhibited a significant positive correlation with ear bearing tillers and 1000 grain weight. The findings are in agreement with the reports of Manikyaminnie *et al.,* (2013) [20] for ear bearing tillers per plant; 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. On contrary, non-significant association was noticed for grain yield with days to 50 per cent flowering, plant height, panicle length and number of filled grains per panicle. The findings are in consonance with the reports of Yadav *et al.,* (2010) [32] for days to 50 per cent flowering, plant height and panicle length.

As simple correlation does not provide the true contribution of the characters towards the yield, these genotypic correlations were partitioned into direct and indirect effects through path coefficient analysis. The estimates of path coefficient analysis are furnished for yield and yield component characters in Table 3. Path co-efficient analysis provides an effective means of finding out the direct and indirect causes of association and presents a critical examination of the specific forces acting to produce a given correlation and also measures the relative importance of each causal factor. Hence, the study of direct and indirect effects of yield components on grain yield per plant was undertaken in the present investigation and the results obtained are presented in Table 3. A perusal of these results on path co-efficients for yield and yield components revealed that genotypic and phenotypic path co-efficients were in similar direction and magnitude. Further, the genotypic path coefficients were observed to be of higher magnitude, compared to phenotypic path coefficients indicating the masking effect of environment. The results also revealed high residual effect for both phenotypic (0.8343) and genotypic (0.8134) path coefficients, where other attributes besides the characters studied are contributing for grain yield per plant. The results also revealed high (>0.30) direct effects of ear bearing tillers, 1000-grain weight, number of filled grains per panicle, days to 50 per cent flowering and plant height on grain yield per plant. High positive direct effect of ear bearing tillers (Manikyaminnie *et al.*, 2013) [20] and 1000-seed weight (Adilakshmi and Girijarani, 2012) [2] on grain yield were also reported earlier. These traits had also recorded highly significant and strong positive association with grain yield per plant. High direct effects of these traits therefore appear to be the main factor for their strong association with grain yield per plant. Hence, these traits should be considered as important selection criteria in all rice improvement programmes and direct selection for these traits is recommended for yield improvement (Kishore *et al.*, 2015). The results are in conformity with the findings of Meena Kumari *et al.*, (2011). Further, number of filled grains per panicle, days to 50 percent flowering, plant height had also recorded high positive direct effects on grain yield per plant. The results are in consonance with the findings of Parvathi *et al.*, (2011) [24] for number of filled grains per panicle; Seyoum *et al.*, (2012) [27] for days to 50 percent flowering; and Adilakshmi and Girijarani *et al* 2012 [2] for plant height. However, their association with grain yield per plant was noticed be non-significant in the present investigation indicating the need for adoption of restricted simultaneous selection model to nullify the undesirable indirect effects and make use of the high direct effects (Singh and Kakar, 1977) [29].

Table 1: Analysis of variance (Mean squares) and their components for yield and its contributing traits in rice:

	DF	Days to flowering	Plant height (cm)	Ear bearing tillers	Panicle length (cm)	No. of filled grains/panicle	1000-gram weight (g)	Grain yield/plant (g)
Replicates	1	0.02	3.82	1.84	0.02	16.08	0.06	0.32
Treatments	100	95.40**	547.32**	14.55**	15.12**	5664.20**	26.80**	129.59**
Error (A)	100	0.87	1.07	0.61	1.53	177.19	0.64	0.75
Total	201	47.90	272.85	7.56	8.28	2906.24	13.65	64.85
General Mean		94.38	101.57	12.98	22.60	163.55	18.78	31.72
PCV		7.35	16.30	21.21	12.76	33.04	19.72	25.44
GCV		7.28	16.27	20.32	11.53	32.02	19.25	25.29
h^2 (broad sense)		98.2	99.6	91.8	81.6	93.9	95.3	98.8
Gen.Adv as % of Mean 1%		19.05	42.87	51.42	27.50	81.94	49.61	66.39
C.V.		0.98	1.02	6.06	5.47	8.13	4.28	2.74

** Significant at 5% and 1% levels, respectively

Table 2: Correlation coefficients for yield and its contributing characters in rice:

	Days to flowering	Plant height	Ear bearing tillers	Panicle Length	No. of filled grains/panicle	1000 grain weight	Grain yield/plant
Days to flowering	1	0.1717	0.1144	0.0703	0.2833**	-0.2776**	0.1548
Plant height		1	-0.1134	0.7172**	0.1286	-0.0204	0.1069
Ear bearing tillers			1	0.0077	-0.0176	0.0608	0.4235**
Panicle Length				1	0.0388	0.2021*	0.1847
No.of filled grains/Panicle					1	-0.5410**	-0.0531
1000 grian weight						1	0.2650**
Grain yield/plant							1

Significance Levels0.050.01 If correlation r =>0.19550.2552

Table 3: Estimates of direct and indirect effects of yield contributing traits on grain yield in 101 genotypes of rice

		Days to flowering	Plant height	Ear bearing tillers	Panicle Length	No. of filled grains/panicle	1000 grain weight (g)	Grain Yield
Days to flowering	P	0.1386	0.0237	0.0152	0.0090	0.0386	-0.0377	0.1529
	G	0.0140	0.0242	0.0166	0.0107	0.0404	-0.0396	0.1567
Plant height	P	0.0154	0.0904	-0.0101	0.0618	0.0113	-0.0018	0.1071
	G	0.0205	0.1189	-0.0141	0.0900	0.0157	-0.0025	0.0127
Ear bearing tillers	P	0.0423	-0.0432	0.3858	0.0010	-0.0064	0.0232	0.4104
	G	0.0486	-0.0486	0.4108	0.0055	-0.0070	0.0247	0.4346
Panicle length	P	0.0016	0.0172	0.0001	0.0251	0.0011	0.0048	0.1796
	G	-0.0010	-0.0099	-0.0002	-0.0131	-0.0005	-0.0028	0.1918
No. of filled grains/panicle	P	0.0590	0.026	-0.0035	0.0090	0.2116	-0.1119	0.0541
	G	0.0688	0.0315	-0.0040	0.0086	0.2385	-0.1320	0.0523
1000 grain weight (g)	P	-0.1040	-0.0076	0.0230	0.0737	-0.2021	0.3820	0.2586
	G	-0.1201	-0.0089	0.0255	0.0901	-0.2348	0.4240	0.2718

Residual effect (Phenotypic) = 0.8343; Residual effect (Genotypic) = 0.0.8134; Diagonal values = Direct effects; Off-Diagonal values = Indirect effects

Conclusion

Results of the present investigation on variability, heritability and genetic advance indicated a scope for improvement of grain yield through selection Further, studies on character association and path co-efficients revealed the importance of ear bearing tillers and 1000 grain weight as selection criteria for effective yield improvement. Among these characters, ear bering tillers possessed both positive association and high direct effects. Hence, selection for this character could bring improvement in grain yield and yield components. The study also indicated the need for balanced selection in light of negative association of 1000-grain weight with number of filled grains per panicle in crop yield improvement programme.

References

1. Abdullah AB, Shoichi I, Adhana K. Estimate of Rice Consumption in Asian Countries and the World Towards 2050. Tottori University, 2006.
2. Adilakshmi D, Girijarani M. Variability character association and path analysis in rice under submergence. Crop Research. 2012; 44(1, 2):146-151.
3. Babu VR, Shreya K, Kuldeep Singh Dangi, Usharani G, Nagesh P. Genetic variability studies for qualitative and quantitative traits in popular rice (*Oryza sativa* L.) hybrids of India. International Journal of Scientific and Research Publications. 2012; 2(6):1-5.
4. Bisne R, Sarawgi AK, Verulkar SB. Study of heritability, genetic advance and variability for yield contributing characters in rice. Bangladesh Journal of Agricultural Research. 2009; 4(2):175-179.
5. Bornare SS, Mittra SK, Mehta AK. Genetic variability, correlation and path analysis of floral, yield and its component traits in CMS and restorer lines of rice (*Oryza sativa* L.). Bangladesh Journal of Botany. 2014; 43(1):45-52.
6. Burton GW. Quantitative inheritance in grasses. Proceedings, 6th grassland Congress Journal. 1952; 1:277-81.
7. Burton GW, Devane EH. Estimating heritability in tall fescue (*Festuca arundinaceae*) from replicated clonal material. Agronomy Journal. 1953; 45:478-481.
8. Dewey DR, Lu KH. A Correlation and Path Coefficient Analysis of Components of Crested Wheat Grass Seed Production. Agronomy Journal. 1959; 51:515-518.
9. Dhanwani RK, Sarwgi AK, Akashsolanki, Jitendrakumartiwari. Genetic variability analysis for various yield attributing and quality traits in rice (*Oryza sativa* L.). The Bioscan. 2013; 8(4):1403-1407.
10. Falconer DS. Introduction to quantitative genetics. Oliver and Boyd, London. 1981, 340.
11. Fisher RA, Yates F. Statistical tables for biological, agricultural and medical research. Six Edition Oliver Boyes Ltd. Edinburgh, 1967.
12. Hasib KM, Ganguli PK, Kole PC. Evaluation of the performance of advanced generation lines of mutant x Basmati crosses of scented rice. Journal of International Academicia. 2004; 8(1):7-10.
13. Idris AE, Mohamed KA. Estimation of genetic variability and correlation for grain yield components in rice (*Oryza sativa* L.). Global Journal of Plant Ecophysiology. 2013; 3(1):1-6.
14. Johnson HW, Robinson HF, Comstock RE. Estimation of genetic and environmental variability in soybean. Agronomy Journal, 47, 314-318.
15. Khush GS. 2005. What it will take to feed 5.0 billion rice consumers in 2030. Plant Molecular Biology. 1955; 59:1-6.
16. Kishore NS, Srinivas, Nagabhushanam U, Pallavi M, Sameera Sk. Genetic variability, correlation and path analysis for yield and yield components in promising rice (*Oryza sativa* L.) genotypes SAARC Journal of Agriculture. 2015; 13(1):99-108.
17. Kundu A, Senapati BK, Bakshi A, Mandal GS. Genetic variability of panicle characters in tall indica aman rice. *Oryza*. 2008; 45(4):320-323.
18. Madhavilatha L, Reddi Sekhar M, Suneetha Y, Srinivas T. Genetic variability, correlation and path analysis for yield and quality traits in rice (*Oryza sativa* L.). Research on Crops. 2005; 6(3):527-534.
19. Mamta Singh, Kumar K, Singh RP. Study of co-efficient of variation, heritability and genetic advance in hybrid rice. *Oryza*. 2007; 44(1):160-162.
20. Manikyaminnie C, Dayakar reddy T, Surendra Raju Ch. Correlation and path analysis for yield and its components in rice (*Oryza sativa* L.). The Journal of Research Angrau. 2013; 41(1):132-134.
21. Meena Kumari K, Seetha Ramaiah KV, Satyanarayana V, Sreekanth B. Correlation and path co-efficient analysis in rice. The Andhra Agricultural Journal. 2011; 58(4):434-438.
22. Mishra LK, Verma RK. Genetic variability for quality and yield traits in non-segregating populations of rice (*Oryza sativa* L.). Plant Archives. 2002; 2(2):251-256.
23. Mohana Krishna D, Reddy DM, Reddy KHP, Sudhakar P. Character association and interrelationship of yield and quality attributes in rice (*Oryza sativa* L.). The Andhra Agricultural Journal. 2009; 56(3):298-301.
24. Parvathi PS, Satyanarayana Rao V, Lal Ahmed M, Anil Kumar P. Correlation and path analysis of yield and quality attributes in rice. The Andhra Agricultural Journal. 2011; 58(3):310-314.
25. Prasad BA, Patwary K, Biswas PS. Genetic variability and selection criteria in fine rice. (*Oryza sativa* L.). Pakistan J. Biol. Sci. 2001; 4:1188-1190.
26. Satish Y, Seetha Ramaiah KV, Sree Rama Reddy N, Naidu TCM. Genetic variability, heritability and Genetic advance in scented rice (*Oryza sativa* L.). The Andhra Agricultural Journal. 2003; 50 (1, 2):24-26.
27. Seyoum M, Sentayehualamerewandkassahun Bantte. Genetic variability, heritability correlation coefficient and path analysis for yield and yield related traits in upland rice (*Oryza sativa* L.). Journal of Plant Sciences. 2012; 7(1):13-22.
28. Singh PK, Dhakad BK, Singh HB, Singh AK. Genetic variability and association analysis in rice (*Oryza sativa* L.) treated with trichoderma harzianum. Crop Research. 2012; 44(1&2):141-145.
29. Singh RK, Kakar SN. Control on individual trait means during index selection. Proceedings of third Congress. SABRAO (Canberra). 1977; 3:22-25.
30. Sudharani M, Raghava Reddy P, Hariprasad Reddy G, Surendra Raju Ch. Correlation and path coefficient analysis for yield and physiological attributes in rice (*oryza sativa* L.) hybrids under saline soil conditions. The Journal of Research ANGRAU. 2013; 41(1):105-108.
31. Wright S. Correlation and causation. Journal of Agricultural Research. 1921; 20:257-287.
32. Yadav SK, Suresh BG, Praveen Pandey, Binod Kumar. Assessment of genetic variability, correlation and path

association in rice (*Oryza sativa* L.). Journal of BioScience. 2010; 18:1-8.

33. 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 Science. 2006; 5:643-645.