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CHARACTER ASSOCIATION AND PATH ANALYSIS IN RICE (*ORYZA SATIVA* L.) GENOTYPES

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Abstract

The genetic variability studies carried out on 10 rice genotypes indicated that the estimate of phenotypic coefficient of variation were greater than those of the genotypic coefficient of variation for all the traits studied. The close proximity between PCV & GCV values for most of the characters indicated less influence of environment on the expression of the characters under study. Considering heritability, most of the characters showed moderate values. High heritability coupled with moderate genetic advance as per cent of mean was recorded 1000 grain weight indicating the scope of improvement through direct selection. Correlation analysis revealed that panicle weight, number of effective tillers per plant, harvest index, number of tillers per plant, number of filled grains per plant and panicle length were positively and significantly associated with grain yield per plant. Path analysis revealed that panicle weight had the highest positive direct effect followed by number of grains per panicle, 1000 grain weight and plant height on the dependent character i.e., grain yield per plant. Hence, these characters could be considered as criteria for selection for higher yield as these were mutually and directly associated with grain yield.

Key words : Rice, correlation, path analysis, variability.

Introduction

Rice (*Oryza sativa* L., 2n = 2x = 24) is the principal staple cereal food and source of calories for more than half of the world's population. It offers a wealth of material for genetic studies because of its wide ecological distribution and enormous variation encountered for various qualitative and quantitative characters. Although, yield improvement is considered to be prime objective of any breeding programme, quality traits are yet another important consideration of rice breeding in India (Mishra, 2004). The most important criteria in any crop improvement programme is the selection of genotypes with all possible desirable yield contributing traits. To improve the yield, evaluation of germplasm is the most important aspect (Yadav, 2000) because yield as such is controlled by a large number of characters. Variability in genotypes for yield and yield component traits forms the basic factor to be considered while making selection. Heritability along with genetic advance may provide a clearer picture for selection of a particular trait.

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The knowledge regarding relative contribution of individual traits to yield may be accomplished by correlation studies (Allard, 1960 and Chaubey *et al*., 1994). However, simple correlation does not provide the adequate information about the contribution of each factor towards yield. Therefore, the technique of path coefficient analysis is utilized to have an idea of direct and indirect contribution of a trait towards the yield, the end product. The present investigation was undertaken to gather some useful information on genetic variability, character association and path coefficient analysis in a set of 10 rice genotypes.

Materials and Methods

The present investigation was carried out at Experimental Research Farm, school of agriculture, Lovely Professional University, Phagwara, Punjab during *kharif* season 2017-18. The experimental material consisted of 10 rice (PR-126, PUSA-44, HKR-127, PR-122, HKR-120, PR-114, HKR-47, PR-121, HEMAVATHI and ADT-44) genotypes. These genotypes

were sown in Randomized Block Design (RBD) with three replications. The sowing in nursery was done on 23-June-2017 and transplanted to the main field on 27-July-2017 given 2 lines for a variety with each line holding 10 plants in each line. The distance between two lines of a variety was 50 cm and between each variety was of 1 m. All the recommended package of practices was followed during the course of experimentation to grow a normal crop.

Quantitative data was collected from 5 plants of each genotype from every block for the characters of plant height (cm), panicle weight/plant (g), panicle length (cm), number of tillers/plant, number of effective tillers/plant, number of ineffective tillers/plant, number of grains/panicle, number of filled grains/panicle, number of unfilled grains/panicle, days to 50% flowering, 1000 grain weight and harvest index. The mean performance of each genotype was subjected for statistical analysis. The statistical analysis was done by the method given by Panse and Sukhatme (1954). Correlation coefficient and path coefficient was worked out as method suggested by Al-Jibouri *et al*. (1958) and Dewey and Lu (1959), respectively.

Table 1 : Analysis of variance for grain yield and its components in rice.

S. no.	Characters	Source of variation			CV
		Replication	Treatments	Error	
	Degree of freedom	2	9	18	
1	Panicle weight	3.0583	7.0706*	2.8650	4.0189
2	Plant height	114.7000	132.4498**	32.8533	7.7165
3	Panicle length	4.1440	4.0350*	1.4770	5.5443
4	No. of tillers/plant	0.3613	0.2643*	0.1021	2.4908
5	No. of effective tillers/plant	0.8040	0.8409*	0.3018	4.9401
6	No. of ineffective tillers/plant	0.1403	0.3885*	0.1529	24.4921
7	No. of grains/panicle	14.7970	10.8600*	4.2470	1.3981
8	No. of filled grains/panicle	16.1704	11.9415*	4.7107	1.5466
9	No. of unfilled grains/panicle	3.1523	2.3356*	0.8949	13.7969
10	Grain yield/plant	1.8523	6.0674*	2.1479	3.6876
11	Days to 50% flowering	7.6333	8.7556*	3.3000	1.7389
12	1000 grain weight	0.0583	10.0999**	0.0902	1.2057
13	Harvest index	2.5640	6.2721*	2.1300	3.6454

*, ** Significant at 5% and 1% level.

Table 2 : Genetic parameters of variation for grain yield and its components in rice.

S. no.	Character	Range		Mean	Co-variances		Heritability broad sense (%)	GA % of mean
		Min	Max		GCV	PCV		
1	Panicle weight	40.20	44.80	42.11	2.81	4.90	0.33	3.32
2	Plant height	66.46	84.56	74.28	7.76	10.94	0.50	11.33
3	Panicle length	19.20	23.66	21.92	4.21	6.96	0.37	5.25
4	No. of tillers/plant	12.53	13.53	12.82	1.81	3.08	0.35	2.20
5	No. of effective tillers/plant	10.46	12.06	11.12	3.81	6.24	0.37	4.80
6	No. of ineffective tillers/plant	1.13	2.06	1.59	17.55	30.13	0.34	21.06
7	No. of grains/panicle	145.2	151.90	147.4	1.01	1.72	0.34	1.21
8	No. of filled grains/panicle	137.8	144.86	140.3	1.11	1.90	0.34	1.33
9	No. of unfilled grains/panicle	5.466	8.40	6.85	10.11	17.10	0.35	12.30
10	Grain yield/plant	37.50	42.13	39.74	2.88	4.68	0.38	3.64
11	Days to 50% flowering	103.0	107.33	104.46	1.29	2.17	0.36	1.59
12	1000 grain weight	22.26	27.53	24.90	7.33	7.43	0.97	14.91
13	Harvest index	37.56	42.25	40.03	2.93	4.68	0.39	3.79

Results and Discussion

The analysis of variance (table 1) revealed that the treatments were highly significant for all the characters. This suggested that the genotypes selected were genetically variable and considerable amount of variability existed among them. Similar findings were reported by Dhurai *et al*. (2016). The genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were observed in the experimental material for all the characters studied (table 2). The PCV was higher than GCV for all the characters indicating that the visible variation in the expression of traits was not only due to varying influence of environment. High PCV and GCV was observed for number of ineffective tillers per plant (30.13, 17.55), number of unfilled grains per panicle (17.10, 10.11), plant height (10.94, 7.76), 1000 grain weight (7.43, 7.33), panicle length (6.96, 4.21), number of effective tillers per plant (6.24, 3.81), harvest index (4.68, 2.93), grain yield per plant (4.68, 2.88), panicle weight (4.90, 2.81), number of tillers per plant (3.08, 1.81), days to 50% flowering (2.17, 1.29), number of filled grains per panicle (1.90, 1.11), number of grains per panicle (1.72, 1.01). These results are in conformity with the finding of Sarwar *et al*. (2015). The proportion of genetic variability which is transmitted from parents to all springs is reflected by heritability. The estimates of heritability varied from 97% to 33%. Among all the characters, 1000 grain weight showed highest heritability of 97%. While in present study, moderate heritability was reported for plant height (50%). Low heritability was recorded for harvest index (39%), grain yield per plant (38%), panicle length (37%), number of effective tillers per plant (37%), days to 50% flowering (36%), number of unfilled grains per panicle and number of tillers per plant (35%), number of ineffective tillers per plant, number of grains per panicle, number of filled grains per panicle (34%) and panicle weight (33%) indicating preponderance of non-additive gene action. Similar findings were reported by Sarwar *et al*. (2015). Genetic advance as per cent of mean was recorded maximum for number of ineffective tillers per plant (21.06), 1000 grain weight (14.91), number of unfilled grains (12.30), plant height (11.33), panicle length (5.25), number of effective tillers per plant (4.80), harvest index (3.79), grain yield per plant (3.64), panicle weight (3.32), number of tillers per plant (2.20), days to 50% flowering (1.59) and number of filled grains per panicle (1.33). The estimates of high heritability (broad sense) and high genetic advance indicate that improvement in these traits could be possible by direct selection. High heritability coupled with moderate genetic advance was observed for 1000 grain weight indicating presence of G × E

Table 3 : Phenotypic correlation coefficient among characters in rice.

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13
X1	**1.0000**	-0.1438	0.3545	0.5391**	0.8773**	-0.5894**	0.2173	0.4569*	-0.4384*	0.0622	-0.3602*	0.6315**	**0.9358****
X2		**1.0000**	0.4033*	-0.2051	-0.1575	0.1695	-0.0270	-0.0097	0.0864	-0.6537**	0.2387	-0.3130	**-0.1092**
X3			**1.0000**	0.1995	0.2294	-0.2752	0.3071	0.3886*	-0.0351	-0.4144*	-0.3384	0.1416	**0.4095***
X4				**1.0000**	0.5711**	-0.0998	0.4747**	0.5545**	-0.2204	-0.0505	-0.0735	0.5663**	**0.5664****
X5					**1.0000**	-0.7285**	0.2555	0.5351**	-0.5061**	0.1477	-0.2934	0.5935**	**0.7897****
X6						**1.0000**	-0.1906	-0.4696**	0.4626**	-0.2556	0.4942**	-0.4047**	**-0.5078****
X7							**1.0000**	0.8640**	0.1822	-0.2157	-0.1630	0.1573	**0.2611**
X8								**1.0000**	-0.2149	-0.1329	-0.3081	0.3476	**0.4477***
X9									**1.0000**	-0.1921	-0.0197	-0.2223	**-0.3517**
X10										**1.0000**	-0.0726	0.1153	**0.0006**
X11											**1.0000**	-0.3699*	**-0.3812****
X12												**1.0000**	**0.6116****

*, ** indicate level of significance at 5% and 1%, respectively

X1 - Panicle weight, **X2** - Plant height, **X3** - Panicle length, **X4** – No. of tillers/plant, **X5** - No. of effective tillers/plant, **X6** - No. of ineffective tillers/plant , **X7** - No. of grains/panicle, **X8** - No. of filled grains/panicle, **X9** - No. of unfilled grains/panicle, **X10** - Days to 50% flowering, **X11** -1000 grain weight , **X12** – Harvest index, **X13**- Grain yield/plant.

Table 4 : Genotypic path coefficient showing direct and indirect effects of different contributing characters on grain yield/plant.

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12
X1	**4.5968**	-1.4611	5.5204	2.8507	4.3605	-5.9553	3.2145	4.0798	-0.7994	-0.3652	-3.0627	3.2478
X2	-0.1217	**0.3828**	0.0625	-0.1491	-0.0294	0.1110	-0.0388	-0.0378	0.1868	-0.3402	0.1350	0.0325
X3	-1.2308	-0.1674	**-1.0249**	-0.7570	-1.3180	1.2065	-0.7369	-1.0755	-0.3054	0.1113	0.6052	-1.1064
X4	-0.3767	0.2367	-0.4486	**-0.6074**	-0.4250	0.5386	-0.5902	-0.5058	-0.1816	0.1542	0.1304	-0.3716
X5	-2.0916	0.1694	-2.8356	-1.5425	**-2.2049**	2.6805	-1.6155	-2.2875	1.1111	1.0071	1.0345	-1.0754
X6	0.9254	-0.2072	0.8409	0.6334	0.8684	**-0.7143**	0.3390	0.6821	-0.5008	-0.2223	-0.5440	0.5381
X7	1.3566	-0.1967	1.3950	1.8852	1.4215	-0.9207	**1.9401**	1.8159	0.9992	-0.9552	-0.7888	0.0244
X8	-1.6379	0.1824	-1.9368	-1.5368	-1.9147	1.7624	-1.7275	**-1.8455**	-0.4174	1.1483	1.1432	-0.3440
X9	0.0334	-0.0938	-0.0572	-0.0574	0.0968	-0.1347	-0.0990	-0.0434	**-0.1921**	0.0480	0.0064	0.0074
X10	0.0613	0.6855	0.0837	0.1959	0.3523	-0.2400	0.3797	0.4799	0.1929	**-0.7713**	0.0335	0.3470
X11	-0.3411	0.1806	-0.3023	-0.1099	-0.2402	0.3898	-0.2081	-0.3171	-0.0172	-0.0222	**0.5119**	-0.3254
X12	-0.1825	-0.0220	-0.2788	-0.1580	-0.1260	0.1946	-0.0033	-0.0482	0.0100	0.1162	0.1642	**-0.2583**

RESIDUAL EFFECT = 1.4668

X1 - Panicle weight**, X2 -** Plant height, **X3 -** Panicle length**, X4 –** No. of tillers/plant**, X5 -** No. of effective tillers/plant**, X6 -** No. of ineffective tillers/plant **, X7 -** No. of grains/panicle**, X8 -** No. of filled grains/panicle**, X9 -** No. of unfilled grains/panicle, **X10 -** Days to 50% flowering**, X11 -**1000 grain weight , **X12** – Harvest index.

interaction. This indicated that simple selection may not be rewarding for these traits. The present findings corroborate the earlier report of Akhtar *et al*. (2011) and Sarwar *et al*. (2016). Correlation coefficient analysis (table 3) measure natural relation between 13 various plant characters and determine the component characters on which selection can be used for genetic improvement in yield. The correlation coefficient estimated positive and significant phenotypic correlation in panicle weight (0.9358), number of effective tillers per plant (0.7897), harvest index (0.6116), number of tillers per plant (0.5664), number of filled grains per plant (0.4477) and panicle length (0.4095) and negative significant association in number of ineffective tillers per plant (-0.5078) and 1000 grain weight (-0.3812) with grain yield per plant. Similar findings were reported by Akhtar *et al*. (2011), Nandan *et al.* (2010) and Reddy *et al.* (2013). Thus selection for higher yield on the basis of above characters would be reliable.

Path coefficient analysis is more useful for partitioning of direct and indirect causes of correlation and also enables to compare the component factors on the basis of their relative contributors. The path coefficient analysis in table 4 revealed that highest positive direct effects was noted for panicle weight (4.5968), number of grains per panicle (1.9401), 1000 grain weight (0.5119) and plant height (0.3828) on the dependent character *i.e.*, grain yield per plant. Hence, these characters could be considered as criteria for selection for higher yield as these were mutually and directly associated with grain yield. Whereas negative direct effects were noted for number of effective tillers per plant (-2.2049), number of filled grains per plant (-1.8455), panicle length (-1.0249), days to 50% flowering (-0.7713), number of ineffective tillers per plant (-0.6074), harvest index (-0.2583) and number of unfilled grains per panicle (-0.1921) on grain yield per plant. Similar findings were reported by Akhtar *et al.* (2011), Nandan *et al*. (2010) and Reddy *et al.* (2013).

Conclusion

Hence, it can be concluded that in rice, traits like showed positive correlation panicle weight, number of effective tillers per plant, harvest index, number of tillers per plant, number of filled grains per plant with yield as well as they have direct effect on yield. Hence, these traits can be used as selection indices in rice to bring about the improvement in yield.

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