I J PS INTERNATIONAL JOURNAL OF PLANT SCIENCES
e ISSN-0976-593X Volume **10** | Issue 1 | January, 2015 | 33-37

DOI: 10.15740/HAS/IJPS/10.1/33-37
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RESEARCH ARTICLE

Genetic studies in upland rice (*Oryza sativa* L.)

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SUMMARY

Studies on genetic variability, character association and path co-efficient analysis were conducted on 40 rice genotypes. Analysis of variance revealed considerable variability among the genotypes for all the characters. A high genotypic and phenotypic co-efficient of variation was observed for grain yield per plant, straw yield per plant, productive tillers per plant, spikelets per panicle, harvest index, 1000 grain weight, number of panicles per running meter, spikelet fertility, plant height, days to 50 per cent flowering and panicle length. Spikelets per panicle showed the highest broad sense heritability (95.81%). Grain yield per plant showed high value of heritability coupled with low genetic advance. The genotypic correlations among the yield traits and their path co-efficient were estimated. The grain yield per plant showed significant positive correlation with harvest index, 1000 grain weight, straw yield per plant, plant height and productive tillers per plant. The traits days to maturity, plant height, straw yield per plant and harvest index had moderate to high positive direct effect on grain yield per plant. The study revealed that genetic improvement of grain yield in rice is admissible by selecting characters having high positive correlation and positive direct effect.

Key Words : *Oryza sativa*, Heritability, Genetic advance, Correlation, Path co-efficient

How to cite this article : Shinde, S.R., Kumar, Kamlesh and Pawar, R.M. (2015). Genetic studies in upland rice (*Oryza sativa* L.). *Internat. J. Plant Sci.*, **10** (1): 33-37.

Article chronicle : Received : 19.06.2014; **Revised :** 14.11.2014; **Accepted :** 28.11.2014

Rice is the world's most important food crop and a primary food source for more than one third of world's population (Singh and Singh, 2008). Thus, the emphasis in all rice economies is on self-sufficiency. In many Asian countries, rice self-sufficiency and political stability are interdependent issues.

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The variability observed is the sum total of hereditary effects of concerned genes as well as the environmental influence. Hence, the variability is partitioned into heritable and non-heritable components with suitable genetic parameters such as genotypic co-efficient of variation (GCV), phenotypic co-efficient of variation (PCV), heritability (h^2) and genetic advance (GA). The estimation of this genetic variability parameter helps breeder in achieving the required crop improvement by selection. The basic objective of most of the crop improvement programs is to realize a marked improvement in crop yield.

Grain yield, an extremely complex trait, is an example of integration of component factors. Therefore, an analysis of the association between yield and other morphological components through correlation co-efficient studies would be vital to understand the intricacy of the trait. Therefore, for designing effective breeding programme, adequate knowledge about the degree and direction of association between yield and its components traits, is of great significance to the breeders when they have to exercise selection for simultaneous improvement of more than one character. However, path co-efficient analysis helps in partitioning the correlation co-efficient into direct and indirect effects, thereby providing relative importance of each of casual factors (Mahajan *et al.*, 1993 and Bhadru *et al.*, 2012). In this study, an attempt was made to study the direct and indirect influences of some important yield components on grain yield among the genotypes by adopting genotypic correlation and path co-efficient analysis.

MATERIAL AND METHODS

The experimental material comprising 40 genotypes were raised in Randomized Block Design in three replications during *Kharif* 2012, at Post Graduate Research Farm, College of Agriculture, Kolhapur. Each entry was represented by a double row of 3 m length with a spacing of 20 cm between rows and 15 cm between plants within a row. Four grains were dibbled per hill to ensure better crop stand and a single seedling was kept per hill after thinning. Observations on 12 quantitative characters were recorded on five randomly selected plants from each plot in each replication. These plants were tagged before flowering. The data were recorded on days to 50 per cent flowering, days to maturity, plant height (cm), productive tillers per plant, panicles per running meter, panicle length (cm), spikelets per panicle, spikelet fertility (%), 1000 grain weight (g), grain yield per plant (g), straw yield per plant (g) and harvest index (%). The analysis of variance was done as suggested by Panse and Sukhatme (1967). Genotypic co-efficient of variation (GCV), phenotypic co-efficient of variation (PCV) and heritability were estimated by formula suggested by Burton (1952). Genetic advance (GA) was calculated by the method suggested by Johnson *et al.* (1955). The genotypic and phenotypic correlation co-efficients were worked out by adopting method described by Singh and Chaudhary (1977). Path co-efficient analysis was done according to the procedure suggested by Dewey and Lu (1959).

RESULTS AND DISCUSSION

The analysis of variance revealed highly significant differences for all the 12 characters studied (Table 1). Prajapati *et al.* (2011) and Parikh *et al.* (2012) also noticed significant differences among genotypes for different traits.

The genotypes exhibited the higher magnitude of genotypic and phenotypic variances for grain yield per plant followed by straw yield per plant, productive tillers per plant, spikelets per panicle, harvest index, 1000 grain weight, number of panicles per running meter, spikelet fertility, plant height, days to 50 per cent flowering and days to maturity (Table 2).

The characters grain yield per plant, straw yield per plant, productive tillers per plant, spikelets per panicle and harvest index showed higher estimates of GCV and PCV, indicating the presence of large variation among the genotypes for these characters. Therefore, simple selection can be practiced for further improvement of these characters. This was in confirmity with the findings of Jayasudha and Sharma (2010), Karthikeyan *et al.* (2010) and Lal and Chauhan (2011).

The magnitude of differences between phenotypic co-efficients of variability (PCV) and genotypic co-efficients of variability (GCV) was observed to be relatively low for all the traits indicating less environmental influence.

In the present study, in general, high heritability values were recorded for all the characters. High heritability estimates indicating the least influence of environment on these characters. Here high heritability was exhibited due to

Table 1 : Analysis of variance (ANOVA) for 12 characters in rice

Sr. No.	Characters	Mean sum of squares		
		Replication (d. f. = 2)	Treatments (d. f. = 39)	Error (d. f. = 78)
1.	Days to 50% flowering	40.75	294.87**	4.83
2.	Days to maturity	36.43	263.55**	4.98
3.	Plant height (cm)	386.80	588.11**	12.49
4.	Productive tillers / plant	3.49	6.69**	0.64
5.	Panicles / running meter	7.61	17.50 **	2.26
6.	Panicle length (cm)	19.80	9.91 **	1.62
7.	Spikelets / panicle	189.9	2646.25**	38.05
8.	Spikelet fertility (%)	62.78	388.99**	14.85
9.	1000 grain weight (g)	4.41	37.56**	1.01
10.	Grain yield / plant (g)	21.02	44.52**	2.06
11.	Straw yield / plant (g)	65.83	158.55**	8.97
12.	Harvest index (%)	12.72	145.87**	14.24

* and ** indicate significance of values at P=0.05 and 0.01, respectively

favourable influence of environment rather than genotype, hence, selection for these traits may not be rewarding but heterosis breeding may be useful.

Heritability estimates are generally influenced by the type of genetic material, sample size, method of sampling, conduct of experiment, method of calculation and effect of linkage etc., therefore, their scope was restricted (Lal and Chauhan, 2011). Thus, heritability values coupled with genetic advance would be more reliable and useful in predicting the gain under selection than heritability estimates alone.

The characters plant height, spikelets per panicle and spikelet fertility exhibited high heritability coupled with high genetic advance, indicating that most likely heritability was due to additive gene effects and selection may be effective for these characters. Similar results were observed by Jayasudha and Sharma (2010) and Chanbeni *et al.* (2012).

Yield is a complex trait controlled by many genes. Selection of parents based on yield alone often misleading. Hence, the knowledge about relationship between yield and its contributing characters is needed for an efficient selection strategy. In the present study, grain yield per plant showed significant positive correlation with harvest index, 1000 grain weight, straw yield per plant, plant height and productive tillers per plant at genotypic level. Similar results were reported by Abdul *et al.* (2011) and Basavaraja *et al.* (2011). Days to 50 per cent flowering and days to maturity showed significant negative correlation with grain yield. These results are in consonance with the reports of Talwar and Goud (1974) and Garg *et al.* (2010). The negative correlations of days to 50 per cent flowering and days to maturity suggest its use in breeding programme for earliness in rice. The information on the inter association among the yield components showed the nature and extent of relationship with each other. This will help in the simultaneous improvement of different characters along with yield in breeding programme. Days to 50 per cent flowering had displayed significant positive association with days to maturity, days to maturity was significantly correlated with plant height, plant height had exhibited significantly positive correlation with panicle length, 1000 grain weight and straw yield per plant, productive tillers per plant had significantly positive correlation with number of panicles per running meter and harvest index, number of panicles per running meter had positive correlation with straw yield per plant and harvest index, panicle length had significant positive association with spikelets per panicle, spikelets per panicle had positive correlation with straw yield per plant, spikelet fertility recorded significant positive association with 1000 grain weight and harvest index, 1000 grain weight had significant positive correlation with straw yield per plant and harvest index, straw yield per plant exhibited non- significant negative correlation with harvest index (Table 3).

Path co-efficient analysis permits a thorough understanding of contribution of various characters by partitioning the correlation co-efficient into components of direct and indirect effects which helps breeder in determining the yield components. Days to maturity, plant height, straw yield per plant and harvest index exerted positive direct effect on grain yield per plant. These results are in consonance with the reports of Jayasudha and Sharma (2010) and Garg *et al.* (2010). Seven traits, *viz.*, days to 50 per cent flowering, productive tillers per plant, number of panicles per running meter, panicle length, spikelets per panicle, spikelet fertility and 1000 grain weight exhibited negative direct effects on grain yield. However, these traits influenced the yield through the positive indirect effects mainly *via* days to maturity, plant height, straw yield per plant and harvest index. The residual effects in present studies was high, it indicates that besides the characters studied, there were some other attributes which

Table 2 : Variability parameters for different traits in 40 genotypes of rice

Sr. No.	Characters	Range		Mean	S.E. (±)	GCV (%)	PCV (%)	Heritability (broad sense) (%)	Genetic advance (K= 2.06)
		Min	Max						
1.	Days to 50% flowering	89.66	128.66	114.04	1.26	8.62	8.83	95.24	19.76
2.	Days to maturity	124.6	159.66	145.36	1.28	6.38	6.56	94.54	18.59
3.	Plant height (cm)	62.86	145.33	100.23	2.04	13.81	14.26	93.89	27.64
4.	Productive tillers / plant	3.90	10.20	6.22	0.46	22.79	26.17	75.87	2.54
5.	Panicles / running meter	7.99	17.83	11.62	0.86	19.38	23.31	69.13	3.86
6.	Panicle length (cm)	17.73	26.19	20.68	0.73	8.03	10.13	62.91	2.71
7.	Spikelets / panicle	60.66	208.26	129.77	3.56	22.71	23.21	95.81	59.45
8.	Spikelet fertility (%)	47.66	90.76	74.01	2.22	15.08	15.96	89.36	21.74
9.	1000 grain weight (g)	9.6	23.60	17.56	0.58	19.87	20.68	92.33	6.90
10.	Grain yield / plant (g)	3.34	24.58	9.75	0.83	38.58	41.30	87.25	7.23
11.	Straw yield / plant (g)	9.98	54.84	22.21	1.72	31.77	34.52	84.75	13.38
12.	Harvest index (%)	8.35	38.66	29.81	2.17	22.21	25.56	75.49	11.85

GCV = Genotypic co-efficient of variation and PCV = Phenotypic co-efficient of variation

Table 3 : Genotypic (above diagonal) and phenotypic (below diagonal) correlation co-efficients amongst 12 characters in 40 genotypes of rice

Characters	Days to 50% flowering	Days to maturity	Plant height (cm)	Productive tillers / plant	Panicles / running meter	Panicle length (cm)	Spikelets / panicle	Spikelet fertility (%)	1000 grain weight (g)	Straw yield / plant (g)	Harvest index (%)	Grain yield / plant (g)
Days to 50% flowering	1.0000	0.9808**	0.0694	-0.0639	-0.0125	-0.2195	0.0032	-0.2996	-0.1822	0.1632	-0.5406**	-0.3738*
Days to maturity	0.9794 **	1.0000	0.0674	-0.1094	-0.0473	-0.2111	-0.0502	-0.2931	-0.1419	0.1255	-0.5422**	-0.3889*
Plant height (cm)	0.0657	0.0609	1.0000	-0.2760	-0.1962	0.5647**	0.2173	0.0198	0.3724*	0.6486**	-0.1816	0.4602**
Productive tillers / plant	-0.0452	-0.0804	-0.2319	1.0000	0.8213**	-0.4532**	-0.3019	0.1142	0.1067	0.1895	0.3870*	0.3655*
Panicles / running meter	0.0037	-0.0208	-0.1695	0.7538 **	1.0000	-0.5826**	-0.3374*	-0.0758	-0.0009	0.2606	0.1979	0.2880
Panicle length (cm)	-0.1853	-0.1784	0.4591**	-0.2526	-0.2847	1.0000	0.3992*	-0.0353	0.2215	0.2279	0.0475	0.3043
Spikelets / panicle	0.0048	-0.0467	0.2146	-0.2545	-0.2494	0.3600 *	1.0000	-0.2978	-0.3710*	0.1213	-0.0237	0.0985
Spikelet fertility (%)	-0.2789	-0.2727	0.0291	0.1019	-0.0612	0.0222	-0.2671	1.0000	0.3191*	-0.2434	0.5172**	0.2204
1000 grain weight (g)	-0.1793	-0.1374	0.3568 *	0.1281	0.0372	0.2421	-0.3474 *	0.3063	1.0000	0.3863*	0.3513*	0.6208**
Straw yield / plant (g)	0.1501	0.1202	0.5822**	0.2130	0.2805	0.2511	0.1243	-0.1963	0.3652 *	1.0000	-0.2591	0.5689**
Harvest index (%)	-0.4524 **	-0.4522 **	-0.1393	0.2954	0.1603	0.1030	-0.0156	0.4624 **	0.3173 *	-0.2373	1.0000	0.6293**
Grain yield / plant (g)	-0.3298*	-0.3415*	0.4273*	0.3480*	0.3019	0.3352*	0.1095	0.2138	0.5755**	0.5743**	0.5572**	1.000

* and ** indicate significance of values at P=0.05 and 0.01, respectively.

Table 4 : Direct (diagonal) and indirect effects using genotypic correlation of different characters towards grain yield

Characters	Days to 50% flowering	Days to maturity	Plant height (cm)	Productive tillers / plant	Panicles / running meter	Panicle length (cm)	Spikelets / panicle	Spikelet fertility (%)	1000 grain weight (g)	Straw yield / plant (g)	Harvest index (%)	Grain yield / plant (g)
Days to 50% flowering	-0.3078	0.2434	0.0141	0.0030	0.0014	0.0185	-0.0003	0.0362	0.0174	0.1283	-0.5280	-0.3738*
Days to maturity	-0.3019	0.2482	0.0137	0.0051	0.0054	0.0177	0.0048	0.0355	0.0136	0.0987	-0.5296	-0.3889*
Plant height (cm)	-0.0214	0.0167	0.2030	0.0130	0.0224	-0.0475	-0.0207	-0.0024	-0.0356	0.5100	-0.1774	0.4602**
Productive tillers / plant	0.0197	-0.0271	-0.0560	-0.0469	-0.0939	0.0381	0.0287	-0.0138	-0.0102	0.1490	0.3780	0.3655*
Panicles / running meter	0.0038	-0.0117	-0.0398	-0.0386	-0.1143	0.0490	0.0321	0.0092	0.0001	0.2049	0.1933	0.2880
Panicle length (cm)	0.0676	-0.0524	0.1146	0.0213	0.0666	-0.0841	-0.0380	0.0043	-0.0212	0.1792	0.0464	0.3043
Spikelets / panicle	-0.0010	-0.0125	0.0441	0.0142	0.0386	-0.0336	-0.0952	0.0360	0.0355	0.0953	-0.0231	0.0985
Spikelet fertility (%)	0.0922	-0.0727	0.0040	-0.0054	0.0087	0.0030	0.0283	-0.1210	-0.0305	-0.1914	0.5052	0.2204
1000 grain weight (g)	0.0561	-0.0352	0.0756	-0.0050	0.0001	-0.0186	0.0353	-0.0386	-0.0957	0.3037	0.3431	0.6208**
Straw yield /plant (g)	-0.0502	0.0312	0.1317	-0.0089	-0.0298	-0.0192	-0.0115	0.0294	-0.0370	0.7863	-0.2531	0.5689**
Harvest index (%)	0.1664	-0.1346	-0.0369	-0.0182	-0.0226	-0.0040	0.0023	-0.0626	-0.0336	-0.2037	0.9768	0.6293**

*and ** indicate significance of values at P=0.05 and 0.01, respectively contribute for grain yield (Table 4).

The present investigation concludes that harvest index was the foremost factor responsible for grain yield followed by straw yield per plant. Days to 50 per cent flowering, plant height, straw yield per plant and harvest index can choose direct selection for yield improvement and remaining all the traits choose for indirect selection.

REFERENCES

Abdul, F.R., Ramya, K.T., Chikkalingaiah, Ajay, B.C., Gireesh, C. and Kulkarni, R.S. (2011). Genetic variability, correlation and path co-efficient analysis studies in rice (*Oryza sativa* L.) under alkaline soil condition. *Electron. J. Plant Breed.*, **2**(4): 531-537.

Basavaraja, T., Gangaprasad, S., Dhusyantha Kumar, B.M. and Hittlamani, S. (2011). Correlation and path analysis of yield and yield attributes in local rice cultivars (*Oryza sativa* L.). *Electron. J. Plant Breed.*, **2**(4): 523-526.

Bhadru, D., Reddy, L.D. and Ramesha, M.S. (2012). Correlation and path co-efficient analysis of yield and yield components in hybrid rice. *Agric. Sci. Digest.*, **32**(3):199-203.

Burton, G.W. (1952). Quantitative inheritance in grasses. *Proc. Sixth Internat. Grassland Congress*, **1**: 277-283.

Chanbeni, Y.O., Lal, G.M. and Rai, P.K. (2012). Studies on genetic diversity in rice (*Oryza sativa* L.). *J. Agril. Tech.*, **8**(3): 1059-1065.

Dewey, D.R. and Lu, K.H. (1959). A correlation and path analysis of components of crested wheat grass seed production. *Agron. J.*, **51**: 515-518.

Garg, P., Pandey, D.P. and Singh, D. (2010). Correlation and path analysis for yield and its components in rice. *Crop Improv.*, **37**(1): 46-51.

Jayasudha, S. and Sharma, D. (2010). Genetic parameters of variability, correlation and path co-efficient for grain yield and physiological traits in rice under shallow lowland situation. *Electron. J. Plant Breed.*, **1**(5): 1332-1338.

Johnson, H.W., Robinson, H.E. and Comstock R.E. (1955). Estimation of genetic and environmental variability in soybean. *Agron. J.*, **47**(7): 314-318.

Karthikeyan, P., Anubuselvam, Y., Elangaimannan, R. and Venkatesan, M. (2010). Variability and heritability studies in rice (*Oryza sativa* L.) under coastal salinity. *Electron J. Plant Breed.*, **1**(2): 196-198.

Lal, M. and Chauhan, D.K. (2011). Studies of genetic variability, heritability and genetic advance in relation to yield traits in rice. *Agric. Sci. Digest.*, **31**(3): 220-222.

Mahajan, C.R., Patil, P.A., Mehetre, S.S. and Hajare, D.N. (1993). Relationship of yield contributing characters to the grain yield in upland rice. *Ann. Plant Physiol.*, **7**(2): 266-269.

Panse, V.G. and Sukhatme, P.V. (1967). *Statistical methods for agricultural workers*. Indian Council of Agric. Res., NEW DELHI, INDIA.

Parikh, M., Motiramani, N.K., Rastogi, N.K. and Sharma, B. (2012). Agro-morphological characterization and assessment of variability in aromatic rice germplasm. *Bangladesh J. Agric. Res.*, **37**(1): 1-8.

Prajapati, M.K., Singh, C.M., Suresh Babu, G., Roopa Lavanya, G. and Jadhav, P. (2011). Genetic parameters for grain yield and its component characters in rice. *Electron J. Plant Breed.*, **2**(2): 235-238.

Singh, R.K. and Chaudhary, B.D. (1977). Variance and covariance analysis. *Biometrical methods in quantitative genetics analysis*. Kalyani Publishers, NEW DELHI, INDIA.

Singh, Y. and Singh, U.S. (2008). Genetic diversity analysis in aromatic rice germplasm using agro- morphological traits. *J. Pl. Genet. Resour.*, **21**(1): 32-37.

Talwar, S.N and Goud, J.V. (1974). Pattern of association between yield and yield attributes in rice. *Indian J. agric. Sci.*, **44**: 712-717.

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