Environment and Ecology 37 (4A) : 1317—1322, October—December 2019
Website: environmentandecology.com ISSN 0970-0420

Genetic Variability, Correlation, Path for Yield, its Contributing Characters in Rice (*Oryza sativa* L.)

K. Supriya, S. Vanisri, N. Suresh, Md. Shafiqur Rhaman

Received 28 June 2019; Accepted 13 August 2019; Published on 16 September 2019

ABSTRACT

Forty eight rice (*Oryza sativa* L.) genotypes were evaluated during *kharif* 2015 to estimate the genetic variability, heritability, correlation coefficients and path coefficient for 11 yield traits. The experiment was conducted in an alpha lattice design with 2 replications. Among the traits, high GCV and PCV values swere observed for plant height, number of productive tillers per plant, grain yield per plant. High heritability coupled with high genetic advance as percent of mean was observed for days to 50% flowering, plant height, number of filled grains per panicle, kernel breadth, L/B ratio. The correlation studies revealed that the genotypic correlation were higher than the corresponding phenotypic correlations. Yield exhibited positive association with plant height, panicle length, days to maturity and kernel length and nagative associate on with L/B ratio.Path analysis indicated that plant height, number of productive tillers per plant, number of filled grains per panicle, 1000 seed weight and kernel length exhibited direct positive effect on yield indicating the importance of these traits during selections for improvement of yield in rice and panicle length, kernel breadth and L/B ratio showed direct negative effect on yield.

Keywords Genetic variability, Correlation, Path, Yield, Rice.

K. Supriya*
Department of Genetics and Plant Breeding, College of Agriculture, PJTSAU, India

S. Vanisri
Institute of Biotechnology, College of Agriculture, Rajendranagar, Hyderabad 500030, India

N. Suresh
Department of Genetics and Plant Breeding, College of Agriculture, PJTSAU, India

Md. Shafiqur Rhaman
Department of Genetics and Plant Breeding, CCSHAU, Hisar 125001, India
e-mail : supriya.kamera@gmail.com
*Corresponding author

INTRODUCTION

Rice is a main staple food for most people in the world and it is a crop with the longest history of cultivation. More than 90% of the world's rice is produced in Asia and for more than three billion people it is the staple food that accounts for 35—75% of the calorie intake (Khush 2005). Rice occupies an important position in the agricultural development, history and civilization of Asian nations.

A wide range of genetic variability has been reported for yield traits in the past, but still there exists untapped genetic variability in germplasm which is of paramount importance in selecting the potential parents so as to get maximum heterosis and superior recombinants with respect to yield components. Genetic parameters such as genotypic coefficient of variation and phenotypic coefficient of variation are useful in detecting the amount of variability present in the germplasm. Heritability coupled with high genetic advance helps in determining the influence environment on the expression the genotypic and reliability of characters. Genotypic correlation among grain yield and its components provide the information about their performance and association with one another. Path coefficient analysis partitions into direct and indirect matrix presenting correlation in a more meaningful way. The present research study was conducted to find out the genetic variability among different plant traits, direct and indirect contribution of these parameters towards paddy yield and to identify better combinations as selection criteria for developing grain yield traits among a set of 48 rice genotypes.

MATERIALS AND METHODS

The experimental material for the study comprised of 48 genotypes laid in alpha lattice design (ALD) with two replications at the Rice Research Center, Agricultural Research Institute (ARI), Rajendranagar, Hyderabad, Telangana during *kharif* 2015. The seedlings were transplanted to main field 15 cm apart between rows and 10 cm within the row. Standard agronomic practices and plant protection measures were taken as per schedule. Observations were recorded on five randomly selected plants per replication for plant height (cm), number of tillers per plant, panicle length (cm), number of filled grains per panicle, 1000 grain weight (g), grain yield per plant (g), grain length (mm), grain breadth (mm), L/B ratio and days to 50% flowering, days to maturity were recorded plot basis. The analyis of variance was carried out for all the characters, the genotypic and phenotypic coefficients of variation were calculated according to the formula given by Falconer (1981), heritability in the broad sense refers to the proportion of genotypic variance to the total observed variance in the total population. Heritability (h^2) in the broad sense was calculated according to the formula given by Allard (1960), Johnson et al. (1955) and genetic advance refers to the expected gain or improvement in the next geneation by selecting the superior individuals under certain amount of selection pressure. From the heritability estimates the genetic advance was estimated by Burton (1952). Correlation coefficients were calculated at genotypic and phenotypic level using the formulae suggested by Falconer (1964). The direct and indirect effects both at genotypic and phenotypic level were estimated by taking seed yield as dependent variable, using path coefficient analysis suggested by Wright (1921), Dewey and Lu (1959).

RESULTS AND DISCUSSION

Analysis of variance revealed highly significant differences for all the traits studied indicating the presence of sufficient amount of genetic variability among the germplasm studied. The estimates of genotypic variation (σ2g), phenotypic variation (σ2p), genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability (h^2) and genetic advance (GA) for different characters have been presented in Table 1. High estimates of variability were recorded for grain yield per plant followed by number of productive tillers per plant, plant height. In contrast, low variability was noticed for days to maturity, panicle length, kernel length, days to 50% flowering, kernel breadth, 1000 seed weight, L/B ratio, number of filled grains per panicle.

Table 1. Estimates of range, variability, heritability, genetic advance for grains yield and its components in rice germplasm lines.

Characters	Mean	Range		Coefficient of variation		Heritability in broad sense $h^{2\,bs}$ (%)	Gen adv as percent of mean (at 5% level)
		Min	Max	Phenotypic	Genotypic		
Days to 50% flowering	94.19	70.0	127	14.28	14.24	99.60	29.28
Plant height (cm)	113.13	66.8	172.3	25.83	24.07	86.80	46.20
No.of productive tillers/plant	5.80	2.9	11.2	29.71	21.91	54.40	33.28
Panicle length (cm)	21.69	14.9	25.2	8.95	6.84	58.40	10.76
No.of filled grains per panicle	102.35	58.6	153.4	20.19	19.47	93.00	38.67

Table 1. Continued.

Characters	Mean	Range Min	Max	Coefficient of variation Phenotypic	genotypic	Heritability in broad sense $h^{2\ bs}$ (%)	Gen adv as percent of mean (at 5% level)
Days to maturity	128.01	100	156	8.86	8.77	98.10	17.90
1000 seed weight (g)	22.24	12.50	33.30	16.48	16.44	99.50	33.79
Grain yield for plant (g)	13.29	5.91	29.03	42.83	37.87	78.20	68.98
Kernel length (mm)	6.07	4.30	7.15	11.19	9.32	69.40	15.99
Kernel breadth (mm)	2.15	1.13	2.89	14.90	13.11	77.40	23.77
L/B ratio	2.88	1.81	3.88	17.28	16.84	95.00	33.82

High heritability coupled with high genetic advance as percent of mean was observed for days to 50% flowering, plant height, number of filled grains per panicle, 1000 seed weight, grain yield per plant , kernel breadth and L/B ratio indicating the influence of additive gene action and simple selection would be effective for improvement of these traits. Although heritability estimates are high, days to maturity and kernel length has shown low variability and moderate genetic advance as percent of mean and number of productive tillers per plant recorded moderate variability and high genetic advance as percent of mean indicating the presence of non-additive gene action. Hence, selection is not effective for these characters and further improvement is possible by intermating of superior genotypes of segregating population from recombination breeding . This finding is comparable with the results previously published by Kumar et al. (2015), Rajkumar et al. (2015), Sameera et al. (2015), Sahu et al. (2015).

Genotypic correlation coefficients, in general were higher than phenotypic correlation coefficients (Table 2) indicating a strong inherent association between the traits. Plant height, panicle length, days to maturity and kernel length (Ganapati et al. 2014, Nagaraju et al. 2013, Mareker and Siddiqui 1996)

Table 2. Phenotypic (P) and genotypic (G) correlation coefficient analysis of yield and yield contributing characters in rice. *Significant at 5% level,** Significant at1% level.

Characters		Days to 50% flowering	Plant height (cm)	No.of productive tillers/plant	Panicle length (g)	No. of filled grains/ panicle	Days to maturity
Days to 50% flowering	G	**1.0000**	0.2158	-0.2491	0.1353	0.1569	0.4240
	P	**1.0000**	0.2081*	-0.1892	0.0977	0.1538	0.4209***
Plant height (cm)	G		**1.0000**	0.1857	0.6646	0.1863	0.1805
	P		**1.0000**	0.1227	0.5310***	0.1622	0.1805
No. of productive tillers/plant	G			**1.0000**	0.2532	-0.0859	-0.1422
	P			**1.0000**	0.2069*	-0.0833	-0.0872
Panicle length	G				**1.0000**	0.0512	0.0592
	P				**1.0000**	0.0085	0.0376
No. of filled grains/panicle	G					**1.0000**	0.2337
	P					**1.0000**	0.2255*
Days to maturity	G						**1.0000**
	P						**1.0000**
1000 grain weight	G						
	P						
Kernel length (mm)	G						
	P						
Kernel breadth (mm)	G						
	P						
L/B ratio	G						
	P						

Table 2. Continued.

Characters		1000 grain weight (g)	Kernel length (mm)	Kernel breadth (mm)	L/B ratio	Grain yield /plant
Days to 50% flowering	G	0.0347	-0.0405	0.0777	-0.0914	-0.0868
	P	0.0368	-0.0339	0.0684	-0.0880	-0.0792
Plant height (cm)	G	0.1308	-0.0112	0.1350	-0.0979	0.2811
	P	0.1230	0.0008	0.1128	-0.0820	0.2209
No.of productive tillers/plant	G	0.2298	0.2114	0.1870	0.0199	0.6893
	P	0.1726	0.0764	0.0776	0.0133	0.7533
Panicle length	G	0.1342	0.0225	-0.0959	0.1378	0.2324
	P	0.1037	0.0349	-0.0535	0.0922	0.1745
No. of filled grains/panicle	G	0.0884	-0.0599	-0.1667	0.0378	0.4800
	P	0.0827	-0.0303	-0.1108	0.0247	0.4096
Days to maturity	G	-0.1456	-0.0428	-0.0918	0.0014	-0.0921
	P	-0.1451	-0.0435	-0.0918	0.0062	-0.0661
1000 grain weight	G	**1.0000**	0.3957	0.0611	0.2119	0.6649
	P	**1.0000**	0.3270**	0.0530	0.2049*	0.5898
Kernel length (mm)	G		**1.0000**	-0.1467	0.6150	0.2898
	P		**1.0000**	0.0661	0.5239***	0.1842
Kernel breadth (mm)	G			**1.0000**	-0.8544	0.0777
	P			**1.0000**	-0.7787***	0.0396
L/B ratio	G				**1.0000**	0.1146
	P				**1.0000**	0.0972

showed a positive correlation with yield. L/B ratio (Sakthivel 2001, Krishna et al. 2008) had a negative association with yield.

Direct and indirect effects (phenotypic) between yield and yield contributing traits in rice presented in Table 3. Path coefficient analysis revealed that

Table 3. Phenotypic (P) and genotypic (G) path coefficient analysis of yield and yield contributing characters in rice. Phenotypic residual effect = 0.1613, Genotypic residual effect = 0.1023. Bold values are direct effects.

Characters		Days to 50% flowering	Plant height (cm)	No.of productive tillers/plant	Panicle length (g)	No.of filled grains/ panicle	Days to maturity
Days to 50% flowering	G	**-0.0003**	0.0095	-0.1590	-0.0026	0.0725	– 0.0301
	P	**-0.0141**	0.0088	-0.1353	-0.0037	0.0668	– 0.0185
Plant height (cm)	G	-0.0001	**0.0442**	0.1186	-0.0126	0.0861	– 0.0128
	P	-0.0029	**0.0422**	0.0877	-0.0203	0.0705	– 0.0080
No. of productive tillers/plant	G	0.0001	0.0082	**0.6386**	-0.0048	-0.0397	0.0101
	P	0.0027	0.0052	**0.7148**	-0.0079	-0.0362	0.0038
Panicle length	G	0.0000	0.0294	0.1617	**-0.0190**	0.0236	– 0.0042
	P	-0.0014	0.0224	0.1479	**-0.0382**	0.0037	– 0.0017
No.of filled grains/panicle	G	0.0000	0.0082	-0.0549	-0.0010	**0.4622**	– 0.0166
	P	-0.0022	0.0068	-0.0595	-0.0003	**0.4346**	-0.0099
Days to maturity	G	-0.0001	0.0080	-0.0908	-0.0011	0.1080	– **0.0709**
	P	-0.0059	0.0076	-0.0623	-0.0014	0.0980	– **0.0441**
1000 grain weight	G	0.0000	0.0058	0.1467	-0.0025	0.0409	0.0103
	P	-0.0005	0.0052	0.1234	-0.0040	0.0360	0.0064

Table 3. Continued.

Characters		Days to 50% flowering	Plant height (cm)	No. of productive tillers/plant	Panicle length (g)	No. of filled grains/ panicle	Days to maturity
Kernel length (mm)	G	0.0000	-0.0005	0.1350	-0.0004	-0.0277	0.0030
	P	0.0005	0.0000	0.0546	-0.0013	-0.0132	0.0019
Kernel breadth (mm)	G	0.0000	0.0060	0.1194	0.0018	-0.0771	0.0065
	P	-0.0010	0.0048	0.0555	0.0020	-0.0482	0.0040
L/B ratio	G	0.0000	-0.0043	0.0127	-0.0026	0.0175	–0.0001
	P	0.0012	-0.0035	0.0095	-00035	0.0107	–0.0003

Table 3. Continued.

Characters		1000 grain weight (g)	Kernel length (mm)	Kernel breadth (mm)	L/B ratio	Grain yield plant
Days to 50% flowering	G	0.0176	–0.0101	–0.0338	0.0493	–0.0868
	P	0.0158	–0.0020	–0.0055	0.0086	–0.0792
Plant height (cm)	G	0.0662	-0.0028	-0.0587	0.0529	0.2811
	P	0.0527	0.0000	–0.0090	0.0080	0.2209
No.of productive tillers/plant	G	0.1164	0.0525	–0.0813	–0.0107	0.6893
	P	0.0740	0.0044	-0.0062	-0.0013	0.7533
Panicle length	G	0.0680	0.0056	0.0417	–0.0744	0.2324
	P	0.0445	0.0020	0.0043	–0.0090	0.1745
No. of filled grains/panicle	G	0.0448	–0.0149	0.0725	–0.0204	0.4800
	P	0.0355	–0.0018	0.0089	–0.0024	0.4096
Days to maturity	G	–0.0737	–0.0106	0.0399	–0.0007	–0.0921
	P	–0.0622	–0.0025	0.0074	–0.0006	–0.0661
1000 grain weight	G	**0.5064**	0.0983	–0.0266	–0.1144	0.6649
	P	**0.4286**	0.0190	–0.0043	–0.0200	0.5898
Kernel length (mm)	G	0.2004	**0.2483**	0.0638	–0.3322	0.2898
	P	0.1402	**0.0580**	–0.0053	–0.0512	0.1842
Kernel breadth (mm)	G	0.0309	–0.0364	**–0.4349**	0.4615	0.0777
	P	0.0227	0.0038	**–0.0802**	0.0760	0.0396
L/B ratio	G	0.1073	0.1527	0.3716	**–0.5401**	0.1146
	P	0.0878	0.0304	0.0625	**–0.0977**	0.0972

plant heigth, number of productive tillers per plant, number of filled grains per panicle, 1000 seed weight (Sanghera et al. 2013, Nagaraju et al. 2013, Yadav et al. 2011) and kernel length (Rajamadhan et al. 2011) exhibited direct positive effect on yield. Panicle length, kernel breadth (Naseem et al. 2014, Nandan et al. 2010) and L/B ratio (Garg et al. 2010) showed the direct negative effect on yield. Hence, selection should be practiced for these traits in order to isolate superior plant types for improvement of grain yield.

REFERENCES

Allard RW (1960) Principles of Plant Breeding. Publishers by John Wiley and Sons Inc, New York, USA, pp 485.

Burton GW (1952) Quantitative inheritance in grasses. Proc on 6th Int Grassland Congress J 1 : 277—283.

Dewey JR, Lu KH (1959) Correlation and path coefficient analysis of components of crested wheat grass seed production. Agron J 51 : 515—518.

Falconer DS (1964) Introduction to quantitative genetics. Longmann, pp 294—300.

Falconer DS (1981) Introduction to quantitative genetics. Oliver Boyd, London, pp 340.

Ganapati RK, Rasul MG, Mian MAK, Sarker U (2014) Genetic variability and character association of T-Aman Rice (*Oryza sativa* L.) Int J Pl Biol Res 2 (2) : 1013.

Garg Pankaj, Pandey DP, Singh Dhirendra (2010) Correlation and path analysis for yield and its components in rice (*Oryza sativa* L.) Crop Improvement 37 (1) : 46–51.

Johnson HW, Robinson HF, Comstock RE (1955) Estimates of genetic and environmental variability in soybean. Agron J 47 (7) : 314—318.

Khush GS (2005) What it will take to feed 5.0 billion rice consumers in 2030.

Krishna L, Raju CHD, Raju CHS (2008) Genetic variability and correlation in yield and grain quality characters of rice germplasm. Andhra Agric J 55 (3) : 276—279.

Kumar K, Shinde SR, Jagtap SM (2015) Genetic divergence in upland rice (*Oryza sativa* L.). Int J Pl Sci 10 : 60—63.

Mareker RV, Siddiqui (1996) Genetic variability and correlation studies in rice. J Maharashtra Agric Univ 21 (2) : 249—251.

Nagaraju C, Reddi Shekhar M, Hariprasad Reddy K, Sudhakar P (2013) Correlation between traits and path analysis coefficient for grain yield and other components in rice (*Oryza sativa* L.) genotypes. Int J Appl Biol Pharmaceut Technol 4 (3) : 137—142.

Nandan R, Sweta, Singh SK (2010) Character association and path analysis in rice (*Oryza sativa* L.) genotypes. World J Agric Sci 6 (2) : 201—206.

Naseem Imad, Khan abdus Salam, Akhter Muhammad (2014) Correlation and path coeffieient studies of some yield related traits in rice (*Oryza sativa* L.). Int J Scient Res Publ 4 : 4.

Rajamadhan R, Eswaran R, Anandan A (2011) Investigation of correlation between traits and path analysis of rice (*Oryza sativa* L.) grain yield under coastal salinity. Elect J Pl Breed 2 (4) : 538—542.

Rajkumar A, Badri J, Bhadana VP, Priyanka C, Ansari NA, Dey S, Chary DS (2015) Genetic divergence studies for yield and its components in rice. J Rice Res 8 : 1.

Sahu PK, Sharma D, Sahu P, Singh S, Chaudhary PR, Sao FC (2015) Assessment of genetic parameters for various quantitative and qualitative traits in hybrid rice (*Oryza sativa* L.). Int J Trop Agric 33 (1) : 97—102.

Sakthivel P (2001) Genetic divergence and genetic analysis of yield attributes and certain quality traits in rice (*Oryza sativa* L.). MSc (Ag) thesis. Acharya NG Ranga Agricultural University, Hyderabad.

Sameera SK, Rajesh AP, Jayalakshmi V, Nirmala PJ, Srinivas T (2015) Genetic variability studies for yield and yield components in rice (*Oryza sativa* L.). Elect J Pl Breed 6 (1) : 269—273.

Sanghera GS, Kashyap SAND, Parry GA (2013) Genetic variation for grain yield and related traits in temperate rice. Ecotypes : Natulae Scientica Biologicae 5 (3) : 400—406.

Wright S (1921) Con-elation and causation. J Agric Res 20 : 557—585.

Yadav VK, Singh Yuvraj , Soni Sandeep Kumar, Yadav AK (2011) Genetic divergence analysis in salt tolerance rice (*Oryza sativa* L.) genotypes. Pl Arch 11 (2) : 593—595.