The Bioscan 10(4): 2151-2154, 2015 (Supplement on Genetics and Plant Breeding) www.thebioscan.in
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES

CHARACTER ASSOCIATION AND PATH COEFFICIENT ANALYSIS FOR YIELD AND ITS COMPONENT TRAITS IN RICE LANDRACES OF BIHAR

SMRITI[1]*, S. P. SINGH[1], MANKESH KUMAR[1], R. K. VERMA[2], RISHAV KUMAR[1] AND KUMARI NEHA[1]
[1]Department of Plant Breeding and Genetics, BAU, Sabour, Bhagalpur -813 210, INDIA
[2]Department of Horticulture, BAU, Sabour, Bhagalpur - 813 210, INDIA.
e-mail: smriti04singh@gmail.com

KEYWORDS
Rice landraces
Correlation
Path analysis
Yield
contributing traits

Received on :
09.10.2015

Accepted on :
22.12.2015

***Corresponding author**

ABSTRACT
An investigation was carried out in 16 rice genotypes including 13 local landraces of Bihar to understand association among 13 contributing traits for yield and their direct and indirect influence on grain yield. The correlation analysis indicated that genotypic correlation coefficient was higher than their respective phenotypic correlation coefficient. Grain yield/ha was found significantly and positively correlated with number of grains/panicle (0.546, 0.454) and significantly but negatively correlated with plant height (-0.840, -0.727) at both genotypic and phenotypic level respectively. Path coefficient analysis revealed that kernel breadth (1.810) had high positive direct effect on grain yield followed by kernel L/B ratio (1.357), number of grains/panicle (1.309), panicle length (0.362), 1000 grain weight (0.313), number of tillers/hill (0.186) and panicles/m^2(0.087). Hence, selection based on traits like number of grains/panicle could bring improvement in paddy yield in these rice genotypes.

INTRODUCTION

Rice plays a major role in Indian economy as it is the staple food for two third of mass. It occupies a predominant position in Bihar accounting for more than half of total cereal production. Landraces maintained through traditional farming practices possess high genetic diversity and specific traits such as disease resistance, environmental constraint tolerance and nutritional quality which are often used in crop improvement (Camacho-villa *et al*., 2005). Yield is a complex character which is controlled by association of number of components most of which are under polygenic control. Grain yield in any crop depends on many component characters which influence yield either singly or jointly and either directly or indirectly through other related characters. Selection for yield on the basis of per se performance alone may not be effective as that based on component characters associated with it, (Laxuman *et al*., 2011) which is biometrically determined by correlation coefficient and path analysis. This kind of analysis is helpful for the breeder to design breeding strategies for yield improvement. Correlation coefficient may also help to determine characters with little or no importance in selection program (Mishra *et al*., 2015). Unlike correlation coefficient values which measures the extent of relationship, path coefficient (Dewey and Lu, 1959) measure the magnitude of direct and indirect effects of characters on complex dependent characters like yield and helps in making selection more effective (Sandhya *et al*., 2014). Keeping in view the present research was under taken to study association interrelationships of different yield contributing traits and also their contributions to yield directly or indirectly through related traits in rice landraces of Bihar.

MATERIALS AND METHODS

A field experiment was conducted with 16 rice genotypes in which 13 were landraces collected locally from different districts of Bihar and the remaining 3 were released varieties, at Rice Section of Bihar Agricultural University, Sabour, Bhagalpur during *kharif* 2014. Seeds of the 16 genotypes were sown in raised nursery bed and 28 days old seedlings of each genotypes were transplanted by adopting a spacing of 20cm between rows and 15cm between plants within row in a randomized block design with three replications. The recommended agronomical practices and plant protection measures were followed to ensure normal crop. Five plants were selected randomly from the center row of each genotype in each replication and observations were recorded for plant height, panicle length, number of tillers/hill, flag leaf length, flag leaf width, panicles/m^2, number of grains/panicle, grain yield, 1000 grain weight, kernel length, kernel breadth and kernel L/B ratio except for days to 50% flowering which was recorded on plot basis. Number of grains/panicle and grain characters were recorded on five panicles of selected plants. Reading from five randomly selected plants were averaged replication wise and the mean data were subjected to statistical analysis using INDOSTAT software. Correlation coefficients were computed at genotypic and phenotypic levels between pair of characters adopting formula given by Johnson *et al.* (1955) and the direct and indirect effects were estimated as suggested by Dewey and Lu (1959). To test the significance of correlation coefficient, the estimated values were compared with table values of correlation coefficient as prescribed by Fisher and Yates (1967).

RESULTS AND DISCUSSION

The association of grain yield with its component traits was estimated by genotypic and phenotypic correlation. In the present investigation, correlation coefficient analysis measure the mutual relationship between 13 different morphological and reproductive characters to determine the component character on which selection can be emphasized for yield improvement. The phenotypic and genotypic correlation coefficient of the characters studied are presented in table 1 and table 2 respectively. In general the magnitudes of genotypic correlation coefficient are higher than the respective phenotypic correlation coefficient for most of the characters under study which indicated strong inherent association between the characters which might be due to masking or modifying effects of environment (Reddy *et al.*, 2013). Effect of environment at phenotypic level resulted in low phenotypic correlation coefficient (Chaubey and Singh, 1994; Ojo *et al.*, 2006). Grain yield/ha showed positive significant correlation only with number of grains/panicle. This indicated that number of grains/panicle can be used as selection criteria for yield improvement in succeeding generations. Similar results were earlier reported by Chandra *et al.* (2009) and Akhtar *et al.* (2011). It indicated that grain yield could be improved whenever a character showed positive and significant association with grain yield. Plant height was found to be negatively and significantly correlated with number of grains/ panicle and grain yield. Negative correlation of plant height with paddy yield indicates that tallness in rice reduces the paddy yield due to high accumulation of photosynthates in vegetative parts as compared to reproductive parts (seed formation and grain filling) and lodging susceptibility (Tahir *et al.*, 1988 and Zahid *et al.*, 2006). The genetic reason for this

Table 1: Estimation of phenotypic correlation coefficient for different quantitative characters in rice

Character	Days to 50% flowering	Plant height	Panicle length	Tillers /hill	Flag leaf length	Flag leaf width	Panicles / m²	Grains/ panicle	1000 grain weight	Kernel length	Kernel breadth	Kernel L/B ratio	Grain yield
Days to 50% flowering	1.000	0.402*	0.052	0.635**	-0.580**	-0.438*	0.257	-0.216	-0.205	-0.203	-0.259	0.144	-0.317
Plant height		1.000	0.644*	0.183	-0.150	-0.011	-0.238	-0.432*	0.006	0.308	-0.048	0.327	-0.727*
Panicle length			1.000	-0.055	0.391*	0.013	-0.165	0.087	-0.104	0.023	-0.143	0.152	-0.341
Tillers/hill				1.000	-0.337	-0.536**	0.521**	-0.010	-0.328	-0.040	-0.338	0.323	-0.120
Flag leaf length					1.000	0.146	-0.175	0.356	-0.046	0.095	-0.046	0.087	0.223
Flag leaf width						1.000	-0.665**	0.015	0.797**	0.352	0.662**	-0.355	0.185
Panicles/ m²							1.000	0.121	-0.585**	-0.299	0.545**	0.238	-0.027
Grains/panicle								1.000	-0.275	-0.532**	-0.323	-0.184	0.454*
1000 grain weight									1.000	0.453*	0.786**	-0.321	0.167
Kernel length										1.000	0.359	0.507**	-0.088
Kernel breadth											1.000	-0.597**	0.172
Kernel L/B ratio												1.000	-0.202
Grain yield													1.000

and ** Significant at 5% and 1% level of significance respectively

Table 2: Estimation of genotypic correlation coefficient for different quantitative characters in rice

Character	Days to 50% flowering	Plant height	Panicle length	Tillers /hill	Flag leaf length	Flag leaf width	Panicles / m²	Grains /panicle	1000 grain weight	Kernel length	Kernel breadth	Kernel L/B ratio	Grain yield
Days to 50% flowering	1.000	0.456*	0.058	0.931**	-0.736**	-0.447*	0.292	-0.258	-0.205	-0.204	-0.268	0.153	-0.365
Plant height		1.000	0.686**	0.169	-0.202	-0.037	-0.325	-0.535*	0.006	0.329	-0.050	0.351	-0.840**
Panicle length			1.000	-0.222	0.411	-0.027	-0.216	0.092	-0.117	-0.002	-0.181	0.179	-0.400
Tillers/hill				1.000	-0.711**	-0.830**	0.725**	-0.275	-0.478*	-0.134	-0.550*	0.487*	-0.196
Flag leaf length					1.000	0.143	-0.053	0.479*	-0.055	0.107	-0.063	0.121	0.347
Flag leaf width						1.000	-0.816**	0.034	0.816**	0.355	0.675**	-0.365	0.219
Panicles/m²							1.000	0.165	-0.695**-	0.382	-0.695**	0.341	0.056
Grains/panicle								1.000	-0.321	-0.621**	-0.385	-0.215	0.546*
1000 grain weight									1.000	0.459*	0.710**	-0.335	0.192
Kernel length										1.000	0.365	0.531*	-0.079
Kernel breadth											1.000	-0.596**	0.195
Kernel L/B ratio												1.000	-0.257
Grain yield													1.000

* and ** Significant at 5% and 1% level of significance respectively

Table-3: Direct (diagonal) and indirect effects of component traits attributing to grain yield per hectare in rice at phenotypic level.

Character	Days to 50% flowering	Plant height	Panicle length	Tillers per hill	Flag leaf length	Flag leaf width	Panicles /m²	Grains /panicle	1000 grain weight	Kernel length	Kernel breadth	Kernel L/B ratio
Days to 50% flowering	0.068	0.027	0.004	0.043	-0.039	-0.030	0.017	-0.015	-0.014	-0.014	-0.018	0.010
Plant height	-0.437	-1.088	-0.700	-0.200	0.163	0.012	0.259	0.469	-0.007	-0.335	0.052	-0.356
Panicle length	0.018	0.218	0.339	-0.019	0.133	0.004	0.056	0.030	-0.035	0.008	-0.049	0.051
Tillers/hill	0.111	0.032	-0.010	0.174	-0.059	-0.093	0.091	-0.017	-0.057	-0.007	-0.059	0.056
Flag leaf length	0.068	0.018	-0.046	0.039	-0.117	-0.017	0.021	-0.041	0.005	-0.011	0.005	-0.010
Flag leaf width	-0.068	-0.002	0.002	-0.083	0.023	0.156	-0.104	0.002	0.124	0.055	0.103	-0.055
Panicles/m²	-0.055	0.051	0.035	-0.111	0.037	0.142	-0.213	-0.026	0.125	0.064	0.116	-0.051
Grains /panicle	-0.054	-0.107	0.022	-0.025	0.088	0.004	0.030	0.248	-0.068	-0.132	-0.080	-0.046
1000 grain weight	0.024	-0.001	0.012	0.038	0.005	-0.092	0.068	0.032	-0.116	-0.052	-0.091	0.037
Kernel length	0.131	-0.199	-0.015	0.026	-0.061	-0.228	0.193	0.344	-0.293	-0.647	-0.232	-0.328
Kernel breadth	-0.288	-0.053	-0.159	-0.376	-0.051	0.737	-0.606	-0.359	0.874	0.399	1.112	-0.664
Kernel L/B ratio	0.166	0.377	0.175	0.373	0.101	-0.410	0.274	-0.213	-0.371	0.585	-0.689	1.153
Grain yield	-0.317	-0.727	-0.341	-0.120	0.223	0.185	-0.027	0.454	0.167	-0.088	0.172	-0.202

R SQUARE = 0.7498 RESIDUAL EFFECT = 0.5002

Table 4: Direct (diagonal) and indirect effects of component traits attributing to grain yield per hectare in rice at genotypic level

Character	Days to 50% flowering	Plant height	Panicle length	Tillers /hill	Flag leaf length	Flag leaf width	Panicles /m²	Grains /panicle	1000 grain weight	Kernel length	Kernel breadth	Kernel L/B ratio
Days to 50% flowering	-0.414	-0.188	-0.024	-0.385	0.305	0.185	-0.121	0.107	0.085	0.085	0.111	-0.063
Plant height	-0.286	-0.627	-0.431	-0.106	0.127	0.023	0.204	0.335	-0.004	-0.206	0.032	-0.220
Panicle length	0.021	0.248	0.362	-0.080	0.149	-0.010	-0.078	0.033	-0.042	-0.001	-0.065	0.065
Tillers /hill	0.173	0.031	-0.041	0.186	-0.132	-0.154	0.134	-0.051	-0.089	-0.025	-0.102	0.090
Flag leaf length	0.471	0.129	-0.263	0.455	-0.639	-0.091	0.034	-0.306	0.035	-0.068	0.040	-0.077
Flag leaf width	0.254	0.021	0.015	0.471	-0.081	-0.567	0.463	-0.019	-0.463	-0.202	-0.383	0.207
Panicles/m²	0.026	-0.028	-0.019	0.063	-0.005	-0.071	0.087	0.014	-0.061	-0.033	-0.061	0.030
Grains/panicle	-0.338	-0.700	0.120	-0.360	0.627	0.044	0.215	1.309	-0.419	-0.813	-0.503	-0.281
1000 grain weight	-0.064	0.002	-0.037	-0.150	-0.017	0.255	0.217	-0.100	0.313	0.144	0.250	-0.105
Kernel length	0.070	-0.112	0.001	0.045	-0.036	-0.121	0.130	0.211	-0.156	-0.340	-0.124	-0.181
Kernel breadth	-0.485	-0.092	-0.327	-0.990	-0.113	1.222	-1.258	-0.696	1.447	0.660	1.810	-1.079
Kernel L/B ratio	0.208	0.476	0.243	0.660	0.164	-0.496	0.462	-0.292	-0.455	0.721	-0.809	1.357
Grain yield	-0.365	-0.840	-0.399	-0.196	0.347	0.219	0.056	0.546	0.192	-0.079	0.195	-0.257

R SQUARE = 0.9594 RESIDUAL EFFECT = 0.2014

type of negative association may be attributed to linkage or pleiotropy. Similar kind of negative association between plant height and grain yield was reported earlier by Akhtar *et al*.(2011). It was also observed that flag leaf length, flag leaf width, panicles/m^2, 1000 grain weight and kernel breadth had non-significant positive association with grain yield and negative non-significant association of days to 50% flowering, panicle length, number of tillers/hill, kernel length and kernel L/B ratio with grain yield.

Days to 50% flowering had significant positive association with plant height and number of tillers/hill and significant negative association with flag leaf length and flag leaf width. Plant height had positive significant association with panicle length but significant negative association with number of grains/panicle. Number of tillers/hill was positively and significantly associated with panicles/m^2 and kernel L/B ratio but negatively associated with flag leaf length, flag leaf width, 1000 grain weight and kernel breadth. Flag leaf length was significantly and positively correlated with number of grains/panicle while flag leaf width was significantly and positively correlated with 1000 grain weight and kernel breadth but negatively correlated with panicles/m^2. Panicles/m^2 had significant negative association with 1000 grain weight and kernel breadth while number of grains/panicle had significant negative association with kernel length. 1000 grain weight had significant positive association with kernel length and kernel breadth. Kernel length was significantly and positively correlated with kernel L/B ratio while kernel breadth was negatively correlated with kernel L/B ratio. Similar results were obtained by Sarkar *et al*. (2007) for kernel breadth. In both the experiments generally most of the genotypic and phenotypic correlation coefficients were non-significant, this might be attributed to the difference in genetic constitution of the breeding material used.

The path coefficient analysis furnishing the cause and effect of different yield variables would provide better index for selection rather than correlation coefficient alone. It measures the direct and indirect contribution of various independent characters on a dependent character. The direct and indirect effects of the studied characters on grain yield at phenotypic and genotypic level are presented in Table 3 and Table 4 respectively. Path coefficient analysis revealed that kernel breadth exerted the highest direct effect on grain yield followed by kernel L/B ratio, number of grains/panicle, panicle length, 1000 grain weight, number of tillers/hill and panicles/m^2, indicating that selection for these characters are likely to bring about an overall improvement in grain yield directly in these rice genotypes. Similar results were also reported by Reddy (2004) for kernel breadth, Dhote (2002) for kernel L/B ratio, Vinothini and Ananda (2005) for panicle length, Zahid *et al*. (2006) for 1000 grain weight and number of grains/panicle. Whereas traits like flag leaf length, plant height, flag leaf width, days to 50% flowering and kernel length showed negative direct effects on grain yield. Results were in agreement with Swain and Reddy (2006) for days to 50% flowering. Plant height expressed indirect positive effect on grain yield through flag leaf length, flag leaf width, panicles/m^2, number of grains/ panicle and kernel breadth. The indirect effect of panicle length on grain yield through plant height, flag leaf length, number of grains/panicle and kernel L/B ratio had a positive effect. Number of tillers/hill expressed indirect positive effect on grain yield through plant height, panicles/m^2, and kernel L/B ratio. Flag leaf length expressed positive indirect effect on grain yield through plant height, number of tillers/hill, panicles/m^2, 1000 grain weight and kernel breadth. Flag leaf width expressed positive indirect effect on grain yield via plant height, panicle length, number of tillers/hill, panicles/m^2 and kernel L/B ratio. The indirect effect of panicles/m^2 on grain yield through number of tillers/hill, number of grains/panicle and kernel L/B ratio was positive. Number of grains/panicle expressed indirect negative effect on grain yield through all characters except panicle length, flag leaf length, flag leaf width and panicles/m^2 which were positive. 1000 grain weight expressed indirect positive effect on grain yield through plant height, flag leaf width, panicles/m^2, kernel length and kernel breadth. Kernel length expressed positive indirect effect through panicle length, number of tillers/hill, panicles/m^2 and number of grains/panicle on grain yield. Kernel breadth expressed indirect negative effect on grain yield through all the characters except flag leaf width, 1000 grain weight and kernel length. Kernel L/B ratio expressed indirect positive effect on grain yield through plant height, panicle length, number of tillers/hill, flag leaf length, panicles/ m^2 and kernel length.On the basis of correlation and path coefficient studies, it may be concluded that number of grains/ panicle, kernel breadth, 1000 grain weight and panicles/m^2 exhibited maximum positive direct effect on grain yield and are the most important characters which could be used as selection criteria for improvement of grain yield in these rice genotypes. Therefore due weightage should be given to these characters for future rice improvement programs.

ACKNOWLEDGEMENT

Authors are highly thankful to Bihar Agricultural University, Sabour, Bhagalpur, Bihar for providing plot at rice section and facilities for research work and M. M. Khaitan for data analysis.

REFERENCES

Akhtar, N., Nazir, M. F., Rabnawaz, A., Mahmood, T., Safdar, M. E., Asif, M. and Rehman, A. 2011. Estimation of heritability, correlation and path coefficient analysis in fine grain rice (*Oryza sativa* L.). *J. Animal and Plant Sci.* **21(4):** 660-664.

Camacho-Villa, T. C., Maxted, N., Scholten, M. and Ford-Lloyd, B. 2005. Defining and identifying crop landraces. *Pl. Genet. Resour. Charact. Util.* **3:** 373-384.

Chandra, B. S., Reddy, T. D. and Kumar, S. S. 2009. Variability parameters for yield, its components and quality traits in rice (*Oryza sativa* L.). *Crop Res.* (Hisar). **38(1/3):** 144-146.

Chaubey, P. K. and Singh, R. P. 1994. Genetic variability, correlation and path analysis of filled components in rice. *Madras Agri. J.* **81:** 438-470.

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

Dhote, S. 2002. Quality considerations for the development of intra and inter sub-specific hybrids in rice (*Oryza sativa* L.) Ph.D. Thesis, *Acharya N.G. Ranga Agricultural University.* Hyderabad.

Fisher, R. A. and Yates, F. 1967. Statistical tables for Biological, Agricultural and Medical Research, *Longmen Group Ltd.* London.

Reddy, S. J. 2004. Combining ability analysis for yield and yield components in gall midge resistant rice (*Oryza sativa* L.) genotypes. M.Sc. (Ag.) Thesis, *Acharya N.G. Ranga Agricultural University.* Hyderabad.

Johnson, H. W., Robinson, H. F. and Comstock, R. E. 1955. Estimates of genetic and environmental variability in soyabeans. *Agron. J.* **47:** 314-318.

Laxuman, Salimath, P. M., Shashidhar, H. E., Mohankumar, H. D., Patil, S. S., Vamadevaiah, H. M. and Janagoudar, B. S. 2011. Character association and path coefficient analysis among the backcross inbred lines derived from Indica x NERICA cross for productivity traits in rice (*Oryza sativa* L.). *Karnataka J. Agric. Sci.* **24(5):** 626-628.

Mishra, A. K., Kumar, A., Rangare, N. R., Kumar, R. and Singh, R. 2015. Genetic association for grain yield and its component trait in indigenous and exotic rice accessions. *The Ecoscan.* **9(1&2):** 463-467.

Ojo, D. K., Omikunle, O. A., Ajala, M. O. and Ogunbayo, S. A. 2006. Heritability, character correlation and path coefficient analysis among six-linked of maize. *World J. Agri. Sci.* **2:** 352-358.

Reddy, G. E., Suresh, B. G., Sravan, T. and Reddy, P. A. 2013. Interrelationship and cause-effect analysis of rice genotypes in north east plain zone, *The Bioscan.* **8(4):** 1141-1144.

Sandhya., Suresh, B. G. and Kumar, R. 2014. Genetic variability, interrelationship and path analysis for yield improvement of rice genotypes. *The Bioscan.* **9(3):** 1161-1164.

Sarkar, K. K., Bhutia, K. S., Senapati, B. K. and Roy, S. K. 2007. Genetic variability and character association of quality traits in rice (*Oryza sativa* L.). *Oryza.* **44(1):** 64-67.

Swain, B. and Reddy, J. N. 2006. Correlation and path analysis of yield and its components in rainfed lowland rice genotypes under normal and delayed planting conditions. *Oryza.* **43(1):** 58-61.

Tahir, H., Jillani, G. and Iqbal, M. Z. 1988. Integrated use of organic and inorganic N fertilizers in rice-wheat cropping system. *Pakistan J. Soil Sci.* **3:** 19-23.

Vinothini, S. and Ananda, C. R. 2005. Correlation and path co-efficient analysis in drought tolerant rice cultures for yield. *Andhra Agri. J.* **52(3&4):** 373-377.

Zahid, M. A., Akhtar, M. M., Sabir, Z. M. and Awan, T. H. 2006. Correlation and path analysis studies of yield and economic traits in Basmati rice (*Oryza sativa* L.). *Asian J. Plant Sci.* **5:** 643-645.