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Research Note

Investigation of correlation between traits and path analysis of rice (*Oryza sativa* L.) grain yield under coastal salinity

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Abstract:
Correlation and path analysis was carried out to study the association between quantitative traits on yield of rice. Grain yield per plant exhibited positive and significant association with number of productive tillers, panicle length, number of grains per panicle, grain breadth and hundred grain weight suggesting that selection pressure applied for these traits will eventually increase the grain yield per plant under salinity. The secondary trait panicle length showed significant positive association with number of grains per panicle, hundred grain weight and grain yield, suggesting that selection based on this trait will be fruitful for enhancing grain yield.

Key words: *Oryza sativa*, saline, correlation coefficient, path analysis

Among the cereals, rice share equal importance as leading food sources for mankind for about 2.51 million rural households. In India it is the staple food and contributes more to our food requirements annually. It accounts for about 43% of food grain production in the country. At the current rate of population growth, which is 1.8%, rice requirement by 2020 would be around 125 million tonnes (Mishra, 2005) More than 2,000 modern varieties have been commercially released in twelve countries of South and Southeast Asia over the past 40 years (Cantrell and Hettel, 2004). Being an exportable commodity, it has an immense economic value which greatly strengthens our national economy. Rice industry is an important source of employment and income for rural masses. The need and importance of rice is increasing day by day due to the increase in human population pressure on the earth. Therefore, improving the productivity of rice would contribute to hunger eradication, poverty alleviation, national food security and economic development. Higher population growth rate and the conversion of some highly productive rice cultivation lands for industrial and residential purposes, has pushed rice cultivation to less productive area such as saline, drought and flood prone areas (Anandan *et al.*, 2009a). In India, salinity accounts for 8.5 million hectares of land and the yield reduction is estimated at 30-50% (Anandan *et al.*, 2011a).

Most of the cultivated rice varieties are susceptible to salinity but rice germplasm do have sources for salt tolerance trait (Flowers *et al*., 2000). Successful rice crop production with good grain quality on salt-affected soils demands the suitable variety selection particularly with better salt tolerance (Arshadullah *et.al*., 2011). The objective of any plant breeder includes selection from a generated or natural population for one or several characters (Simmonds, 1983). Success in plant breeding programme primarily depends on the magnitude of variation present for yield and yield components and the nature of association among them. To improve the yield, evaluation of germplasm is the most important aspect because yield as such is controlled by a large number of characters. Most of the characters of interest to breeders are complex and are result of the interaction of a number of components (Sarawgi *et al.*,1997). Being a complex trait, grain yield is influenced by various genetic factors and environmental fluctuations. An idea on the extent of association between traits will be much helpful to decide upon the traits, which should be given importance in selection. A positive association between traits warrants the simultaneous improvement of both the traits while restricting selection to any one of the associated traits. On the other hand, a negative relationship between two traits necessitates equal weightage to be given on both the traits during selection process. Relative importance of the attributes may be decided based on highly correlated trait with grain yield. Path analysis has been used to organize the relationship between predictor variables and response variables. The advantage of path analysis is that it permits the partitioning of the correlation coefficient into its components-one component being the path coefficient (or standardized partial regression coefficient) that measures the direct effect of a predictor variable upon its response variables, the second component being the indirect effect(s) of a predictor variable on the response variable through other predictor variables (Dewey and Lu, 1959). Path coefficient analysis assists plant breeders in identifying traits on which selection pressure should be given for improving yield. With these points in view, the present investigation was framed to study the direct and indirect influences of some important yield components on grain yield of rice by correlation and path coefficient analysis.

The experiment was conducted at the experimental farm (11^o 24' N latitude and 79^o 44' E longitude, + 5.79 m MSL) of Department of Genetics and Plant Breeding, Annamalai University, Annamalai Nagar, Tamil Nadu, India during 2010-11. Thirty three genetically diverse genotypes of rice were planted in a randomized block design with three replications at the rate of one seedling per hill adopting spacing of 15 cm within the row and 20 cm between the rows in saline soil with electrical conductivity (EC) of 2.81 ds m^{-1}. Each genotype was planted in five rows with each row consisting of 20 hills. Data were collected for days to first flowering, days to 50% flowering, plant height (cm), number of productive tillers per plant, panicle length (cm), number of grains per panicle, grain length (mm), grain breadth (mm), hundred seed weight (g) and grain yield per plant (g). Estimates of correlation and path coefficient were determined by following the method suggested by Dewey and Lu (1959), to partition the correlation coefficients into direct effects (unidirectional pathways, P) and indirect effects through alternate pathways.

Salt stress confines rice production in vast areas worldwide, and the problem is ever increasing because of absurd human acts, causing secondary salinization, as well as because of global warming, with the consequent rise in sea level and increase in storm incidences, particularly in coastal areas. Salt stress affects the growth of the rice genotypes during seedling and reproductive stage. Therefore, studying genotypes and their traits at this stage will be appropriate for further progress in developing saline tolerant rice genotypes (Anandan *et al.*, 2011a). Even though grain yield is the primary trait for selection in breeding programmes for the breeders, yield improvement could be achieved by identifying and selecting a secondary trait that contribute to increase in yield under salinity. However, for a secondary trait to be useful in a breeding programme, it should be genetically correlated with yield.

In the present investigation, grain yield per plant exhibited positive and significant association with number of productive tillers, panicle length, number of grains per panicle, grain breadth and hundred grain weight. (Table 1). This was in conformity with the findings of Raju *et al.*, (2003), Ganapathy *et al.*, (2006) and Seyed Mustafa Sadeghi (2011). Thus suggesting that selection pressure applied for these traits will eventually increase the grain yield per plant. However, association of yield and its components alone are not adequate in any selection programme. Knowledge on interrelationship between yield and yield related traits under salinity may facilitate breeder to decide upon the intensity and direction of selection pressure to be given on related traits for the simultaneous improvement of yield contributing traits for salty soil. It is believed that the quality varies depending upon the location, soil type and soil fertility (Anandan *et al.,* 2009b). At present, superior grain quality is gaining momentum. Therefore, improving grain yield under salinity with superior grain quality is of high commercial value.

In the present study, days to first flowering had positive and significant association with days to 50 per cent flowering and plant height. Similar findings were reported by Latha *et al.*, (2003) and Raju *et al.*, (2003). Similarly, positive and significant relationship was observed between number of productive tillers with panicle length and panicle length with number of grains per panicle and hundred grain weight.These results are in conformity with the findings of Malarvizhi *et al.* (2006), Chakraborty *et al.* (2001) and Anandan *et al.* (2011b).

In the light of above discussion, it may be suggested that days to first flowering, days to 50 per cent flowering, plant height, number of productive tillers, panicle length, number of grains per panicle and hundred grain weight should be given prime importance during selection process, as they exhibit positive and significant correlation with grain yield. The trait panicle length showed significant positive association with number of grains per panicle, hundred grain weight and grain yield, suggesting that selection based on these (secondary) traits will be fruitful in developing high yielding genotypes for salinity condition.

Rate of improvement is expected to be rapid if differential emphasis is laid on the component characters during selection. The basis of differential emphasis could be the degree of influence of component characters on the character of interest. Path analysis gives an idea about how a trait influences grain yield directly and indirectly *via* other traits and measures the relative importance of the casual factor involved. This is very important in giving due weightage to major yield contributing traits while selecting.

In the present investigation under salinity, the yield component characters hundred grain weight, number of productive tillers per plant, panicle length and grain breadth had very high positive direct effect on grain yield per plant (Table 2). This was in conformity with the findings of Sathish *et al.* (2003) and Kavitha and Sree Rama Reddy (2001). In addition to its direct effect the trait plant height had indirect effect on yield via grain length, number of productive tillers per plant via days to 50 per cent flowering, hundred grain weight with grain breadth, number of grains per panicle via hundred grain weight and panicle length showed low to high indirect effects on grain yield per plant. Therefore, the above mentioned traits should be given more importance for enhancing grain yield in rice for salt affected soil.

References

Anandan, A., Eswaran, R. and Prakash, M. 2011a. Diversity in rice genotypes under salt affected soil based on multivariate analysis. *Pertanika J. Trop. Agric. Sci.,* **34 (1)**: 33 – 40

Anandan, A., Rajiv, G., Eswaran, R. and Prakash, M. 2011b. Genotypic variation and relationships between quality traits and trace elements in traditional and improved rice (*Oryza sativa* L.) genotypes. *J. Food Sci.,* **76(4):** 122-130.

Anandan, A., Eswaran, R., Sabesan, T. and Prakash, M. 2009a. Additive main effects and multiplicative interactions analysis of yield performances in rice genotypes under coastal saline environments. *Adv. Bio. Res.,* **3(1-2):** 43-47.

Anandan, A., Sabesan, T., Eswaran, R., Rajiv, G., Muthalagan, N. and Suresh, R. 2009b. Appraisal of Environmental Interaction on Quality Traits of Rice by Additive Main Effects and Multiplicative Interaction Analysis. *Cereal Res. Comm.,* **37(1):** 139-148

Arshadullah, M., Rasheed, M. and Zaidi S.A.R. 2011. Salt tolerance of different rice cultivars for their salt tolerance under salt-affected soils. *Int. Res. J. Agric. Sci. Soil Sci.,* **1(5):** 183-184

Cantrell, R.P. and Hettel, G.P. 2004. New challenges and technological opportunities for rice-based production systems for food security and poverty alleviation in Asia and the Pacific. Presented at the FAO Rice Conference, FAO, Rome, Italy, February 12-13.

Chakraborty, S., Das, P.K., Guha, B., Barman, B. and Sarmah, K.K. 2001. Coheritability, correlation and path analysis of yield component in boro rice. *Oryza,* **38**(3& 4): 99-100.

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

Flowers, T.J., Koyama, M.L., Flowers, S.A., Sudhakar, C., Singh, K.P. and Yeo, A.R. 2000. QTL: their place in engineering tolerance of rice to salinity. *J. Exp. Bot.,* **51:** 99-106.

Ganapathy, S., Ganesh, S.K., Vivekanandan, P., Chandra, R., Babu and Shanmugasundaram, P. 2006. Genetic variability and association analysis for drought tolerance, yield and its contributing traits in rice (*Oryza sativa* L.). In *Plant breeding in post genomics era. Second National Plant Breeding Congress,* TNAU, Coimbatore 1-3 March, p. 111.

Kavitha, S. and Sree R**a**ma Reddy, N. 2001.Correlation and path analysis of yield components in rice (*Oryza sativa* L.). *Andhra Agric J.,* **48**(3&4): 311-314.

Latha, J., Venuprasad, R., Shashidar, H.E. and Shailaja Hittalmani. 2003. Correlation and path coefficient analysis in rice cultivars adapted to rainfed lowland of southern Karnataka. *Mysore J.Agric.Sci.,* **37**(2): 115-121.

Malarvizhi, P., Thiyagarajan, K. and Vijayalakshmi, C. 2006. Association analysis in rice hybrids under water limited conditions for yield and Morpho-Physiological traits. In *Plant breeding in post genomics era. Second national plant breeding congress*, TNAU, Coimbatore 1-3 March, p. 170-171.

Mishra, B. 2005. More crop per drop. Survey of Indian Agriculture, The Hindu, Kasthuri Publishers, Chennai, pp. 41-46.

Raju,C.H.S., Rao, M.V.B. and Sudarshanan, A. 2003. Association of physiological growth parameters in rice hybrids. *Madras Agric.J.,* **90(12):** 621-624.

Sarawgi, A.K, Rastogi, N.K and Soni, D.K. 1997. Correlation and path analysis in rice accessions from Madhya Pradesh. *Field Crops Res.,* **52:** 161-167

Sathish,Y., Seetha, K.V., Ramaiah, R., Srinivasalu and Sree Rama Reddi, N. 2003. Correlation and path analysis of certain quantitative and physiological characters in rice (*Oryza sativa* L.). *Andhra Agric.J.,* **50**(2&4): 231-234.

Seyed Mustafa Sadeghi 2011. Heritability, phenotypic correlation and path coefficient studies for some agronomic characters in land race rice varieties. *World Appl .Sci. J.,* **13**(5): 1229-1233.

Simmonds, N.W. 1983. Plant breeding: The state of the art. In *Genetic Engineering of Plants. An Agricultural Perspective,* K. Koruge, C.P. Keredeth and A. Hollaender (Eds.), Plenum Press, New York, London, p. 5-26.

Table.1 Genotypic correlation coefficients among various morphological characters in rice under salinity

Characters	Days to 50 Per cent flowering	Plant Height (cm)	No. of productive tillers	Panicle Length (cm)	Grains per panicle	Grain length (mm)	Grain breadth (mm)	100 grain weight (g)	Seed yield per plant (g)
Days to first flowering	0.923**	0.526*	0.295	0.230	0.048	-0.200	0.260	0.119	0.263
Days to 50 Per cent flowering		0.547**	0.296	0.177	0.057	-0.246	0.150	0.105	0.230
Plant height (cm)			0.296	0.363*	0.207	-0.388*	0.054	0.122	0.228
No. of productive tillers				0.390*	0.350*	0.080	0.070	0.470*	0.570**
Panicle length (cm)					0.357*	0.097	0.130	0.450**	0.500**
Grains per panicle						0.190	0.175	0.877**	0.450**
Grain length (mm)							0.119	-0.025	-0.065
Grain breadth (mm)								0.362*	0.42*
100 grain weight (g)									0.470**

* significant at 5 per cent level
** significant at 1 per cent level.

Table.2 Path coefficient analysis depicting the direct and indirect effects of various morphological characters on grain yield in rice genotypes under salinity

Characters	Days to first flowering	Days to 50 Per cent flowering	Plant Height (cm)	No. of productive tillers	Panicle Length (cm)	Grains per panicle	Grain length (mm)	Grain breadth (mm)	100 grain weight (g)	Coorelation with Seed yield per plant (g)
Days to first flowering	**-0.220**	0.113	0.122	0.311	0.044	-0.095	-0.065	0.035	0.023	0.268
Days to 50 Per cent flowering	0.193	**-0.310**	0.032	0.234	0.081	-0.083	-0.111	0.071	-0.112	0.235
Plant height (cm)	0.423	1.062	**0.160**	0.185	0.121	0.112	-1.019	0.011	0.021	0.235
No. of productive tillers	-1.162	1.132	0.411	**0.551**	0.232	0.017	-0.341	-0.111	-0.151	0.577
Panicle length (cm)	-1.044	0.321	0.051	0.062	**0.431**	1.012	-0.414	0.012	0.073	0.531
Grains per panicle	0.311	-0.382	0.111	0.412	0.411	**-0.972**	-0.212	0.316	0.461	0.456
Grain length (mm)	-0.142	0.130	-0.020	-0.050	-0.010	0.010	**0.050**	**-0.010**	-0.021	-0.061
Grain breadth (mm)	0.054	-0.181	0.012	-0.122	-0.011	-0.011	-0.311	**0.360**	**0.635**	0.425
100 grain weight (g)	0.121	-0.232	0.141	-0.322	0.414	-0.412	0.323	0.455	**0.630**	0.470

Diagonal (Bold) values indicates direct effect