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Assessment of trait association and path effects of rice (*Oryza sativa* L.) under saline condition

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Abstract
An experiment was conducted to evaluate the nature and magnitude of variability and character association among 36 rice genotypes. Increased temperature have high impact over salinity, hence the experimental materials were evaluated in randomized block design with three replications during 2017 under saline condition. The divergent studies showed the significant variation among the genotypes for all the characters studied. Correlation studies revealed that number of tillers/plant, 100 grain weight and grain length registered, positive correlation with grain yield per plant. Path analysis revealed that the traits grain breadth and grain L/B ratio had very high positive direct effect on grain yield. The traits days to first flowering, number of tillers per plant, Number of grains per panicle, grain breadth and grain L/B ratio had high positive direct effect on grain yield per plant.

Keywords: Salinity, genetic divergence, correlation, path analysis.

Introduction
Rice (*Oryza sativa* L.) with the chromosome number of 2n=2x=24 which is the cultivated species and that includes *O.sativa* and *O.glaberima.* Rice accounts for 43% of the total food grain production of our country. India is the second largest producer and consumer of rice next to China. Temperature is the most effective factor affecting crop distribution and moisture and soil- chemical properties. Apart from other effects of drought, salinity is the major cause of crop yield loss. The present investigation was carried out to study the importance of character association for genetic improvement of saline tolerant rice varieties of different morphological characters, association between the characters and direct and indirect effects of yield components on grain yield.

Methods and Materials
The investigation was carried out at the Plant Breeding Farm, Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, Chidambaram, Tamil Nadu, India during the year 2017-2018. The study was carried out with 36 rice genotypes collected from different locations. The seedlings of 25 days old were transplanted with the spacing of 20 x 15cm in a Randomized block design with three replications. Recommended agronomic practices and need based plant protection measures were carried out for the better crop stand. The survived genotypes were observed for 11 characters and subjected to correlation and path analysis to evaluate the character association and direct and indirect effects on grain yield.

Result and Discussion
The analysis of variance was calculated for all the 11 characters and showed significant difference among the 36 genotypes for all the 11 characters.
The efficiency of selection for yield mainly depends on the direction and magnitude of the association of the yield component Characters. Johnson *et al*. (1955) [2] pointed out that characters with no values in themselves and are not normally measured in the selection programme are not worthy of inclusion in the selection scheme. Estimates of correlation between yield and yield component characters in rice genotypes were presented in the table 1.
The table showed that, In the present study, correlation analysis indicated that grain yield per plant exhibited significant positive correlation with days to first flowering and number of productive tillers at genotypic level. However, correlation of yield and its components are not adequate in any selection programme. The inter relationship among the individual character may ultimately influence the yield.
The total number of productive tillers per plant had significant positive correlation with days to first flowering at genotypic level and number of tillers per plant at both genotypic and

phenotypic level.

The significant association of grain yield with number of productive tillers at genotypic level revealed that preference of plants with more productive tillers obviously yields higher. Also, significant association of grain yield with days to first flowering showed that under salinity plants complete its life cycle earlier and that escapes the plant from late season drought.

Table 1: Phenotypic and genotypic correlation among various characters in rice genotypes

Characters		Days to first flowering	Plant height	No. of tillers/ plant	No. of productive tillers/ Plant	Panicle Length	No. of grains/ panicle	100 Grain weight	Grain Length	Grain Breadth	L/B Ratio	Grain Yield/ plant
Days to first flowering	G	1.000	0.345**	0.355**	0.439*	0.432*	0.029	-0.039	-0.086	0.475*	-0.490*	0.279**
	P	1.000	0.263	0.211	0.222	0.214	0.067	-0.057	-0.139	0.164	-0.238	0.238
Plant height	G		1.000	0.277	0.239	0.876*	-0.023	-0.026	0.133	0.172	-0.029	-0.038
	P		1.000	0.215	0.182	0.273	0.003	-0.029	0.119	0.094	-0.022	-0.029
No. of tillers/ Plant	G			1.000	0.889*	0.565*	-0.194	-0.274	-0.162	0.127	-0.156	0.249
	P			1.000	0.790*	0.082	-0.192	-0.222	-0.062	0.026	-0.019	0.207
No. of productive tillers/plant	G				1.000	1.039*	-0.147	-0.140	-0.207	0.211	-0.224	0.346**
	P				1.000	0.126	-0.135	-0.088	-0.070	0.027	-0.011	0.252
Panicle length	G					1.000	0.012	0.474*	0.659*	0.126	0.304**	-0.097
	P					1.000	-0.019	0.144	0.201	0.035	0.053	-0.013
No. of grains/ Panicle	G						1.000	-0.266	-0.276	-0.174	-0.055	0.228
	P						1.000	-0.222	-0.196	-0.154	0.035	0.157
100 grain Weight	G							1.000	0.539*	0.211	0.122	-0.106
	P							1.000	0.439*	0.134	0.063	-0.103
Grain length	G								1.000	-0.087	0.576*	0.138
	P								1.000	-0.041	0.393*	0.047
Grain breadth	G									1.000	-0.859*	0.036
	P									1.000	-0.893*	-0.007
Grain L/B Ratio	G										1.000	-0.017
	P										1.000	0.003
Grain yield/ Plant	G											1.000
	P											1.000

G- Genotypic correlation effect P- Phenotypic correlation effect *,** significant at 5 and 1 percent level

The correlation co-efficient alone is insufficient to explain the relationship for effective manipulation of the characters, but path analysis furnishes a method for partitioning the correlation co-efficient into direct and indirect effect and measures the relative importance of the causal factor involved

The estimated residual effect was 0.518 (table 2). The traits grain breadth and grain L/B ratio had very high positive direct effect on grain yield. The traits days to first flowering, number of tillers per plant, Number of grains per panicle, grain breadth and grain L/B ratio had high positive direct effect on grain yield per plant. Panicle length had moderate positive direct effect on grain yield per plant. Plant height, number of productive tillers, 100 grain weight and grain length had high negative direct effect on grain yield per plant. Among the grain quality component characters, grain length recorded high negative direct effect and grain breadth, grain L/B ratio have very high positive direct effect respectively on grain yield. In addition to indirect effect via number of productive tillers per plant; low negative indirect effect via plant height on grain yield per plant.

Among the grain quality, grain length had high negative indirect effect on grain yield per plant via very high positive indirect effect via grain L/B ratio on grain yield per plant. Grain breadth had low positive indirect effect via days to first flowering, number of tillers per plant and panicle length; high positive and negative indirect effect via grain length and grain L/B ratio respectively on grain yield per plant. Hence, these traits should be given prime importance, while selection for high yielding genotypes.

Grain L/B character had very high positive indirect effect on grain yield per plant. It had high and very high negative indirect effect via grain length and grain breadth, respectively on grain yield per plant.

The character such as total number of tillers per plant, number of productive tillers per plant, grain length, grain L/B ratio recorded variable performance for direct and indirect effect and more similarly for correlation co-efficient. Hence, selection for such characters would be postponed to later generation until there is favourable and constant association of genes controlled the characters.

Table 2: Path co-efficient analysis depicting the direct and indirect effects of various characters in rice genotypes.

Characters	Days to first flowering	Plant height	Total number of tillers per plant	No. of productive tillers/plant	Panicle length	No. of grains/ panicle	100 Grain Weight	Grain length	Grain breadth	L/B ratio	Grain Yield/ Plant
Days to first Flowering	**0.503**	-0.214	0.193	-0.246	0.128	0.010	0.012	0.056	0.764	-0.927	0.279
Plant height	0.173	**-0.622**	0.151	-0.134	0.260	-0.008	0.008	-0.087	0.276	-0.055	-0.038
No. of tillers/ Plant	0.179	-0.172	**0.543**	-0.499	0.168	-0.066	0.082	0.106	0.204	-0.296	0.249
No. of Productive Tillers/plant	0.221	-0.149	0.482	**-0.561**	0.309	-0.050	0.042	0.136	0.339	-0.424	0.346
Panicle Length	0.218	-0.545	0.306	-0.583	**0.297**	0.004	-0.143	-0.431	0.203	0.576	-0.097
No. of grains/ panicle	0.015	0.014	-0.105	0.082	0.003	**0.340**	0.080	0.181	-0.280	-0.104	0.228
100 grain Weight	-0.020	0.016	-0.148	0.078	0.141	-0.090	**-0.301**	-0.352	0.340	0.231	-0.106
Grain Length	-0.043	-0.082	-0.088	0.116	0.196	-0.094	-0.162	**-0.654**	-0.140	1.090	0.138
Grain Breadth	0.239	-0.107	0.069	-0.118	0.037	-0.059	-0.064	0.057	**1.608**	-1.627	0.036
L/B ratio	-0.246	0.018	-0.085	0.125	0.090	0.019	-0.037	-0.377	-1.381	**1.894**	-0.017

Residual effect = 0.518

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