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ASSOCIATION ANALYSIS IN RICE (*ORYZA SATIVA* L.) GENE BANK IN NEP ZONE

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Abstract

The present investigation was under taken with the objectives to find out associations among different characters and to analyze direct and indirect effects of different characters on grain yield. The experiment was conducted during *Kharif* 2015 at Narendra Deva University of Agriculture and Technology, Narendra Nagar, Kumarganj, Faizabad. The experimental materials of rice for this investigation comprised of 30 genotypes along with (two checks *viz*., Narendra Usar 3 and IR 28) of rice were evaluated in randomized block design with three replications during *kharif* 2015for thirteen characters *viz*., days to 50% flowering, plant height (cm), flag leaf area, (cm^2), panicle bearing tillers per plant, panicle length (cm), spikelets per panicle, grains per panicle, spikelet fertility (%), biological yield per plant (g), harvest index (%), L:B ratio, 1000-grains wt. (g) and grain yield per plant (g) under salt affected soil. The genotypic correlation coefficients between most of the characters were higher in magnitude than phenotypic correlation coefficients indicating strong association between various characters studied and that the genotypic expression of the association was comparatively less influenced by the environmental deviation. The correlation study revealed that grain yield per plant showed positive and significant association with flag leaf area, panicle bearing tillers per plant, panicle length, spikelets per panicle, grains per panicle, spikelet fertility, biological yield per plant, harvest index and 1000-grains wt. these traitsemerge as most important associates of grain yield in rice. Hence, by exercising selection for these characters, it may possible to isolate superior high yielding genotypes. Path analysis identified biological yield and harvest-index as most important direct yield contributing traits. Flag leaf area,panicle bearing tillers per plant, panicle length, spikelets per panicle, grains per panicle, spikelet fertilityexhibited high and positive indirect effect on grain yield via biological yield per plant.Hence, selection based on these characters would be more effective to meet higher grain yield. The residual effect under path analysis was very low and negligible.

Key words : Correlation, path coefficient analysis, salt affected soil, rice (*Oryza sativa* L.).

Introduction

Rice, *Oryza sativa* L. (2n = 24) is a cereal foodstuff which forms an important part of the diet of more than three billion people around the world. It is the principal staple food for more than half of the world's population. It is grown under diverse agro-climatic conditions and over wide geographical range. Drought and salinity are major constraints on crop production and food security and adversely impact the socioeconomic fabric of many developing countries. Water scarcity, declining water quality for irrigation and soil salinity are problems which are becoming more acute. It is estimated that 20% of all cultivated land and nearly half of irrigated land is affected by salt, greatly reducing the yield of crops to well below their genetic potential. There is limited evidence at present that new strategies to enhance crop yield stability on salt affected soil, based on soils remediation are feasible. Salinity-stress effects on crop grown are manifested by impairment of photosynthetic capacity. High amounts of sodium in the soil solution impair cell metabolism and photosynthesis by imposing an osmotic stress on cell water relations and by increasing the toxicity of sodium in the cytosol.

Materials and Methods

The experiment was conducted during *kharif*, 2015 at the at the Research Farm of Genetics & Plant

Table 1 : Analysis of variance for randomized block design for 13 characters in rice under salt affected soil.

Characters	Sources of variation		
	Replications	Treatments	Error
d.f.	2	31	62
Days to 50% flowering	0.32	76.16**	1.02
Plant height (cm)	12.45	145.55**	7.11
Flag leaf area (cm^2)	0.57	18.72**	1.12
Panicle bearing tillers per plant	1.71	3.30**	0.69
Panicle length (cm)	0.39	6.50**	0.99
Spikelets per panicle	30.19	1336.95**	19.37
Grains per panicle	32.28	874.71**	19.46
Spikelet fertility (%)	2.08	62.31**	2.86
Biological yield per plant (g)	1.03	155.50**	1.41
Harvest-index (%)	3.47	6.58**	2.43
L:B ratio	0.04	1.27**	0.03
1000- grains weight (g)	1.23	5.82**	0.50
Grains yield per plant (g)	0.97	20.68**	0.87

*,** Significant at 5% and 1% probability levels, respectively.

Breeding, N. D. University of Agriculture and Technology, Kumarganj, Faizabad (U.P.), India. The experimental materials of rice for this investigation comprised of 30 genotypes along with (two checks *viz*., Narendra Usar 3 and IR 28) of rice were evaluated in randomized block design with three replications with the spacing of 20 cm row to row and 15 cm plant to plant during *kharif* 2015under salt affected soil. Observations were recorded on randomly selected five plants from each entry in each replication. The data were recorded on days to 50% flowering, plant height (cm), flag leaf area, (cm^2), panicle bearing tillers per plant, panicle length (cm), spikelets per panicle, grains per panicle, spikelet fertility (%), biological yield per plant (g), harvest index (%), L:B ratio, 1000-grains wt. (g) and grain yield per plant (g). Recommended cultural practices were adopted to raise good crop.

Results and Discussion

Mean sum of square due to treatments were significant for all the characters showed presence of variability in the study materials (table 1).

In the present investigation, phenotypic and genotypic correlation coefficients were computed among thirteen characters (tables 2 and 3). Grain yield per plant showed positive and significant association with flag leaf area, panicle bearing tillers per plant, panicle length, spikelets per panicle, grains per panicle, spikelet fertility, biological yield per plant, harvest index and 1000-grains wt.at phenotypic and genotypic levels. Therefore, these characters emerged as most important associates of grain yield in rice. The strong positive association of grain yield with the characters mentioned above has also being reported in rice by earlier workers (Ramkrishnan *et al*., 2006; Nandan *et al*., 2010; Akhtar *et al*., 2011). In the present study, majority of significant estimates of correlations between yield and yield components were positive in nature. Thus, selection practiced for improving these traits individually or simultaneously would bring improvement in other due to correlated response. This suggested that selection would be quite efficient in improving yield and yield components.

In the present investigation, phenotypic and genotypic direct and indirect effect of 13 characters on grain yield per plant in rice (*Oryza sativa* L.) under salt affected soil were presented in tables 4 and 5. Path coefficient analysis is a tool to partition the observed correlation coefficient into direct and indirect effects of yield components on grain yield. Path analysis provides clearer picture of character associations for formulating efficient selection strategy. Path coefficient analysis differs from simple correlation in that it points out the causes and their relative importance, whereas, the later measures simply the mutual association ignoring the causation. The concept of path coefficient was developed by Wright (1921) and technique was first used for plant selection by Dewey and Lu (1959). Path analysis has emerged as a powerful and widely used technique for understanding the direct and indirect contributions of different characters to economic yield in crop plants so that the relative importance of various yield contributing characters can be assessed.

In the present study, the path coefficient analysis was carried out using correlation coefficients between thirteen characters. The high positive direct effects on grain yield per plant were exerted by biological yield per plant and harvest-index (tables 4 and 5). Thus, harvest-index and biological yield per plant emerged as most important direct yield components on which emphasis should be given during simultaneous selection aimed at improving grain yield in rice. These characters have also been identified as major direct contributors towards grain yield by Akhtar *et al*. (2011), Kumar *et al.* (2011), Bhadru *et al.* (2011), Rangare *et al.* (2012), Krishnamurthy and Kumar (2012) and Kumar and Verma (2015). The direct effects of remaining characters were too low to be considered important.

Flag leaf area,panicle bearing tillers per plant, panicle length, spikelets per panicle, grains per panicle, spikelet

Table 2 : Estimate of genotypic correlation coefficients between 13 characters in rice under salt affected soil.

Character	Days to 50% flowering	Plant height (cm)	Flag leaf area (cm^2)	Panicle bearing tillers/plant	Panicle length (cm)	Spikelets per panicle	Grains per panicle	Spikelet fertility (%)	Biological yield/ plant	Harvest Index (%)	L/B ratio	1000 grain weight (g)	Grain yield/ plant (g)
Days to 50% flowering	**1.000**	-0.118	-0.333	-0.420	-0.342	-0.438	-0.320	0.247	-0.421	0.356	0.104	-0.162	-0.421
Plant height (cm)		**1.000**	0.268	-0.292	0.408	-0.115	-0.161	-0.182	-0.159	0.067	-0.215	0.122	-0.168
Flag leaf area (cm^2)			**1.000**	0.121	0.176	0.280	0.334	0.177	0.228	-0.068	-0.068	-0.077	0.247
Panicle bearing tillers/plant				**1.000**	0.475	0.601	0.627	0.190	0.783	-0.785	-0.044	0.071	0.753
Panicle length (cm)					**1.000**	0.305	0.291	0.053	0.359	-0.033	0.264	0.063	0.397
Spikelets per panicle						**1.000**	0.938	-0.040	0.824	-0.421	0.017	0.128	0.848
Grains per panicle							**1.000**	0.303	0.798	-0.486	0.019	0.173	0.815
Spikelet fertility (%)								**1.000**	0.071	-0.259	0.033	0.173	0.057
Biological yield/plant									**1.000**	-0.736	-0.059	0.249	0.995
Harvest index (%)										**1.000**	0.211	-0.723	-0.663
L/B ratio											**1.000**	-0.340	-0.035
1000 grain weight (g)												**1.000**	0.182
Grain yield per plant (g)													**1.000**

*,** Significant at 5% and 1% probability levels, respectively.

Table 3 : Estimate of phenotypic correlation coefficients between 13 characters in rice under salt affected soil.

Character	Days to 50% flowering	Plant height (cm)	Flag leaf area (cm^2)	Panicle bearing tillers/plant	Panicle length (cm)	Spikelets per panicle	Grains per panicle	Spikelet fertility (%)	Biological yield/ plant	Harvest Index (%)	L/B ratio	1000 grain weight (g)	Grain yield/ plant (g)
Days to 50% flowering	**1.000**	-0.116	-0.312	-0.332	-0.267	-0.417*	-0.301	0.227	-0.413*	0.189	0.088	-0.125	-0.399*
Plant height (cm)		**1.000**	0.244	-0.176	0.304	-0.112	-0.147	-0.150	-0.142	0.058	-0.200	0.112	-0.137
Flag leaf area (cm^2)			**1.000**	0.091	0.124	0.246	0.293	0.155	0.206	-0.047	-0.051	-0.072	0.210
Panicle bearing tillers/plant				**1.000**	0.225	0.496**	0.523**	0.179	0.670**	0.062	-0.021	0.046	0.721**
Panicle length (cm)					**1.000**	0.261	0.256	0.052	0.284	-0.024	0.183	-0.027	0.302
Spikelets per panicle						**1.000**	0.933**	-0.025	0.813**	-0.159	0.023	0.111	0.820**
Grains per panicle							**1.000**	0.329	0.784**	-0.171	0.027	0.142	0.791**
Spikelet fertility (%)								**1.000**	0.081	-0.064	0.039	0.137	0.084
Biological yield/plant									**1.000**	-0.319	-0.054	0.218	0.977**
Harvest index (%)										**1.000**	0.133	-0.322	-0.113
L/B ratio											**1.000**	-0.264	-0.029
1000 grain weight (g)												**1.000**	0.160
Grain yield per plant (g)													**1.000**

*,** Significant at 5% and 1% probability levels, respectively.

Table 4 : Estimate of genotypic direct and indirect effect of 13 characters on grains yield per plant in rice undersalt affected soil.

Character	Days to 50% flowering	Plant height (cm)	Flag leaf area (cm²)	Panicle bearing tillers/plant	Panicle length (cm)	Spikelets per panicle	Grains per panicle	Spikelet fertility (%)	Biological yield/ plant	Harvest Index (%)	L/B ratio	1000 grain weight (g)	Grain yield/ plant (g)
Days to 50% flowering	**-0.014**	0.003	-0.001	0.008	-0.009	-0.016	0.008	0.007	-0.454	0.049	-0.001	-0.001	-0.421
Plant height (cm)	0.002	**-0.022**	0.001	0.006	0.010	-0.004	0.004	-0.005	-0.171	0.009	0.002	0.001	-0.168
Flag leaf area (cm²)	0.005	-0.006	**0.002**	-0.002	0.004	0.010	-0.008	0.005	0.246	-0.009	0.001	0.000	0.247
Panicle bearing tillers/plant	0.006	0.006	0.000	**-0.020**	0.012	0.022	-0.016	0.005	0.844	-0.108	0.000	0.000	0.753
Panicle length (cm)	0.005	-0.009	0.000	-0.009	**0.025**	0.011	-0.007	0.001	0.387	-0.005	-0.003	0.000	0.397
Spikelets per panicle	0.006	0.002	0.001	-0.012	0.008	**0.037**	-0.024	-0.001	0.889	-0.058	0.000	0.001	0.848
Grains per panicle	0.005	0.003	0.001	-0.012	0.007	0.035	**-0.025**	0.008	0.860	-0.067	0.000	0.001	0.815
Spikelet fertility (%)	-0.003	0.004	0.000	-0.004	0.001	-0.001	-0.008	**0.026**	0.077	-0.036	0.000	0.001	0.057
Biological yield per plant	0.006	0.003	0.001	-0.015	0.009	0.030	-0.020	0.002	**1.079**	-0.101	0.001	0.001	0.995
Harvest index (%)	-0.005	-0.001	0.000	0.015	-0.001	-0.016	0.012	-0.007	-0.794	**0.138**	-0.002	-0.003	-0.663
L/B ratio	-0.001	0.005	0.000	0.001	0.007	0.001	0.000	0.001	-0.064	0.029	**-0.011**	-0.001	-0.035
1000 grain weight (g)	0.002	-0.003	0.000	-0.001	0.002	0.005	-0.004	0.005	0.269	-0.100	0.004	**0.004**	0.182

Table 5 : Estimate of phenotype direct and indirect effect of 13 characters on grains yield per plant in rice under salt affected soil.

Character	Days to 50% flowering	Plant height (cm)	Flag leaf area (cm²)	Panicle bearing tillers/plant	Panicle length (cm)	Spikelets per panicle	Grains per panicle	Spikelet fertility (%)	Biological yield/ plant	Harvest Index (%)	L/B ratio	1000 grain weight (g)	Grain yield/ plant (g)
Days to 50% flowering	**-0.012**	0.001	0.000	-0.002	-0.003	-0.006	0.001	0.004	-0.422	0.042	0.000	0.000	-0.399
Plant height (cm)	0.001	**-0.006**	0.000	-0.001	0.003	-0.002	0.000	-0.002	-0.145	0.013	0.001	0.000	-0.137
Flag leaf area (cm²)	0.004	-0.001	**0.000**	0.001	0.001	0.004	-0.001	0.003	0.211	-0.010	0.000	0.000	0.210
Panicle bearing tillers/plant	0.004	0.001	0.000	**0.006**	0.002	0.008	-0.001	0.003	0.684	0.014	0.000	0.000	0.721
Panicle length (cm)	0.003	-0.002	0.000	0.001	**0.010**	0.004	-0.001	0.001	0.291	-0.005	-0.001	0.000	0.302
Spikelets per panicle	0.005	0.001	0.000	0.003	0.003	**0.015**	-0.002	0.000	0.830	-0.035	0.000	0.000	0.820
Grains per panicle	0.004	0.001	0.000	0.003	0.003	0.014	**-0.002**	0.005	0.800	-0.038	0.000	0.000	0.791
Spikelet fertility (%)	-0.003	0.001	0.000	0.001	0.001	0.000	-0.001	**0.017**	0.083	-0.014	0.000	0.000	0.084
Biological yield per plant	0.005	0.001	0.000	0.004	0.003	0.012	-0.002	0.001	**1.021**	-0.070	0.000	0.000	0.977
Harvest index (%)	-0.002	0.000	0.000	0.000	0.000	-0.002	0.000	-0.001	-0.326	**0.220**	-0.001	-0.001	-0.113
L/B ratio	-0.001	0.001	0.000	0.000	0.002	0.000	0.000	0.001	-0.055	0.029	**-0.005**	0.000	-0.029
1000 grain weight (g)	0.002	-0.001	0.000	0.000	0.000	0.002	0.000	0.002	0.223	-0.071	0.001	**0.002**	0.160

Residual effect = 0.038

fertilityexhibited high and positive indirect effect on grain yield *via* biological yield per plant. Zahid *et al*. (2006) and Kishore *et al*. (2007) have also identified biological as important direct and indirect yield contributing characters. The indirect effects of remaining characters were too low to be considered important.

In the present study, path analysis identified grain yield per plant followed by biological yield per plant and harvest-index as most important direct as well as indirect yield contributing traits or components which merit due consideration at time of devising selection strategy aimed at developing high yielding varieties/hybrids in rice.

References

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

Bhadur, D., D. L. Reddy and M. S. Ramesha (2011). Correlation and path coefficient analysis of yield and yield contributing traits in rice hybrids and their parental lines. *Electronic Journal of Plant Breeding*, **2 (1)** : 112-116.

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

Kishore, N. S., N. A. Ansari, V. R. Babu, N. S. Rani, L. V. Rao and R. Subba (2007). Correlation and path analysis in aromatic and non-aromatic rice genotypes. *Agricultural Science Digest*, **27**(Issue 2).

Krishnamurthy, H. T. and H. D. M. Kumar (2012). Correlation and path coefficient studies of some physiological traits among indigenous aromatic rice (*Oryza sativa* L) cultivars. *Agricultural & Biological Research*, **28(2)** : 120-127.

Kumar, Y., B. N. Singh, O. P. Verma, S. Tripathi and D. K. Dwivedi (2011). Correlation and path coefficient analysis in scented rice (*Oryza sativa* L.) under sodicity. *Environment and Ecology*, **29(3B)** : 1550-1556.

Kumar, A. and O. P. Verma (2015). Correlation and path coefficient analysis in certain quantitative traits in rice (*Oryza sativa* L.) under saline-alkaline condition. *Res. Envi. Life Sci*., **8(3)** : 443-446.

Nandan, R., Sweta and S. K. Singh (2010). Character Association and Path Analysis in Rice (*Oryza sativa* L.) Genotypes. *World Journal of Agricultural Sciences*, **6(2)** : 201-206.

Ramakrishnan, S. H., A. C. R. Kumar, S. Sarvanan and N. Malini (2006). Association analysis of some yield traits in Rice (*Oryza sativa* L.). *Journal of Applied Sciences Research*, **2 (7)** : 402-404.

Rangare, N. R., A. Krupakar, K. Ravichandra, A. K. Shukla and A. K. Mishra (2012). Estimation of characters association and direct and indirect effects of yield contributing traits on grain yield in exotic and Indian rice (*Oryza sativa* L.) germplasm. *International Journal of Agri Science*, **2(1)** : 54-61.

Wright, S. (1921). Correlation and causation. *J. Agric. Res*., **203** : 557-585.

Zahid, M. A., M. Akhter, M. Sabar, M. Zaheen and A. Tahir (2006). Correlation and path analysis studies of yield and economic traits in Basmati rice (*Oryza sativa* L.). *Asian Journal of Plant Sciences*, **5(4)** : 643-645.