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Short Communication

Association Analysis of Yield and Lodging Related Traits in Different Landraces of Rice (*Oryza sativa* L.)

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Rice suffers from a variety of biotic and abiotic stress around the world. Lodging is one among the serious problems especially in the coastal and windy areas. Numerous semi-dwarf rice cultivars have been developed during the green revolution to combat lodging issue but still, sufficient tolerance to lodging has been limited in the cultivated genotypes which hinders yield [1]. Germplasm lines and cultivars should be evaluated to study the degree of association present between yield and lodging related characters to enable them to employ in breeding programmes [2]. Keeping this as a main objective, the present study was determined to evaluate the degree and direction of association between various traits in 30 rice genotypes using correlation and path analysis.

Twenty-four landraces and six improved rice cultivars were raised during 2020 at Plant Breeding Farm, Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University. Twenty-eight days old seedlings were transplanted in the main field in randomized block design (RBD) with three replications each. Each entry was transplanted in plot of 2.55 m length and width of 1.20 m as spacing of 15 cm between rows, 10 cm between plants and 60 cm between plots. The standard agronomic practices were followed. They were evaluated for sixteen yield and lodging related characters viz., days to 50% flowering, plant height, panicle length, culm length, flag leaf length, flag leaf width, number of internodes, lodging index, number of productive tillers, grain length, grain breadth, grain L/B ratio, culm diameter, total spikelets per panicle, thousand grain weight, grain yield per plant. Five (three for lodging related characters) random plants from each plot were taken for recording data. The degree and direction of association between various traits in 30 rice genotypes were determined using correlation and path analysis.

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Correlation analysis

The correlation study revealed that grain yield per panicle showed significant and positive association with number of productive tillers per plant, grain breadth, culm diameter, total spikelets per panicle, thousand grain weight and non-significant positive association with days to 50% flowering, panicle length, flag leaf width, number of internodes and grain length. Hence the genotypes which has high means for the significantly associated characters- Kichedi samba, Thengai Poo samba, Karunguruvai and Kala namak could be utilized to improve these traits simultaneously to increase yield.

Significant negative association was exhibited between grain L/B ratio and yield and non-significant negative ratio was observed between plant height, culm length, flag leaf length, lodging index on grain yield per plant [3-4]. So, the genotype Salem sanna which has high grain L/B ratio could be neglected in the yield improvement programmes.

Hence, grain yield can be simultaneously increased by favoring indirect selection towards the traits like number of productive tillers, culm diameter, total spikelets per panicle and thousand grain weight. Negative association between culm diameter with lodging percentage and culm length indicates that increase in the culm diameter leads to reduction in lodging percentage and ultimately an increase in grain yield per plant. Also from these results, it can be interpreted that lesser the plant height lower will be the percentage of lodging.

Path analysis

Characters like panicle length, flag leaf length, flag leaf width, number of internodes per plant, lodging index, number of productive tillers, grain breadth, grain L/B and

thousand grain weight exhibited direct positive effect on grain yield per plant taken as a dependent trait [5].

Table 1 Genotypic and phenotypic correlation coefficients among the sixteen characters of rice

Characters		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	G	1.0000	-0.1291	0.0090	-0.1352	0.2826	0.0628	0.0609	0.0346	0.0337	0.0286	0.0724	-0.0142	0.2665	-0.1379	0.0646	0.0796
	P	1.0000	-0.1291	0.0099	-0.1332	0.2229	0.0524	0.0595	0.0345	0.0290	0.0195	0.0598	-0.0174	0.2312	-0.1199	0.0626	0.0750
2	G		1.0000	0.3450	0.9822**	0.2390	-0.1118	0.6226**	0.2037	-0.1332	0.2643	-0.2738	0.4155*	-0.2445	0.2537	-0.2408	-0.1004
	P		1.0000	0.3239	0.9768**	0.2087	-0.1041	0.5637**	0.2000	-0.1265	0.2209	-0.1787	0.2965	-0.2311	0.2356	-0.2305	-0.0918
3	G			1.0000	0.1620	-0.1617	0.0218	0.3277	0.2398	0.0581	0.1469	-0.1296	0.2269	0.0544	0.3491	-0.0274	0.1127
	P			1.0000	0.1211	-0.1091	0.0144	0.2943	0.2258	0.0497	0.0862	-0.0424	0.1071	0.0256	0.3273	-0.0255	0.1027
4	G				1.0000	0.2766	-0.1164	0.5982**	0.1583	-0.1428	0.2412	-0.2518	0.3789*	-0.2634	0.2008	-0.2399	-0.1164
	P				1.0000	0.2312	-0.1039	0.5313**	0.1536	-0.1341	0.2120	-0.1749	0.2841	-0.2414	0.1776	-0.2305	-0.1072
5	G					1.0000	0.1703	0.1584	0.3159	-0.3879*	0.2659	-0.2046	0.3225	-0.1014	-0.3836*	-0.2868	-0.3876
	P					1.0000	0.1359	0.1088	0.2836	-0.3098	0.1653	-0.1505	0.2183	-0.0655	-0.3028	-0.2698	-0.3117
6	G						1.0000	0.0893	0.1155	0.2336	-0.1749	0.3426	-0.4365*	0.1382	-0.2666	0.4256*	0.3149
	P						1.0000	0.0856	0.1152	0.1759	-0.2644	0.1303	-0.3311	0.1233	-0.1416	0.2967	0.1938
7	G							1.0000	-0.0137	0.1768	0.3335	0.1914	0.1188	0.0845	0.1464	0.0954	0.2664
	P							1.0000	-0.0120	0.1709	0.2175	0.0296	0.1359	0.0276	0.1308	0.0941	0.1987
8	G								1.0000	-0.6240**	-0.3880*	-0.5256**	0.0841	-0.3155	-0.3594	-0.5489	-0.5857
	P								1.0000	-0.6010**	-0.3261	-0.3677*	0.0427	-0.3002	-0.3280	-0.5349	-0.5574
9	G									1.0000	0.2865	0.6966**	-0.2934	0.5323	0.4123*	0.7549**	0.9919**
	P									1.0000	0.2264	0.4438*	-0.1709	0.4972	0.3738*	0.7156**	0.9059**
10	G										1.0000	0.2180	0.6344**	0.0552	0.5649**	0.2785	0.3361
	P										1.0000	0.1252	0.6410**	0.0645	0.3906*	0.2382	0.3040
11	G											1.0000	-0.6131**	0.4868	0.4544*	0.6117**	0.6623**
	P											1.0000	-0.6751**	0.2975	0.2885	0.4384*	0.5011**
12	G												1.0000	-0.3277	0.1391	-0.2508	-0.2259
	P												1.0000	-0.1885	0.0886	-0.1684	-0.1595
13	G													1.0000	0.1222	0.2646	0.4706**
	P													1.0000	0.0945	0.2316	0.4241*
14	G														1.0000	0.3052	0.4588**
	P														1.0000	0.2658	0.4094*
15	G															1.0000	0.8374**
	P															1.0000	0.7746**
16	G																1.0000
	P																1.0000

P-Phenotypic correlation coefficient; **Significance at 1% level
G-Genotypic correlation coefficient; *Significance at 5% level

1. Days to 50% flowering; 2. Plant height; 3. Panicle length; 4. Culm length; 5. Flag leaf length; 6. Flag leaf width; 7. Number of internodes; 8. Lodging incidence; 9. Number of productive tillers; 10. Grain length; 11. Grain breadth; 12. Grain L/B ratio; 13. Culm diameter; 14. Total spikelets per panicle; 15. 1000 grain weight; 16. Grain yield

Table 2 Path coefficient values depicting direct and indirect effects of sixteen characters on grain yield of rice

Characters	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	**-0.0450**	-0.0479	-0.0001	0.0452	0.0215	0.0049	0.0032	0.0009	0.0264	-0.0600	0.1516	-0.0364	-0.0068	0.0060	0.0162
2	0.0058	**-0.3713**	-0.0065	-0.3282	0.0181	-0.0087	0.0330	0.0054	-0.1044	-0.5556	-0.5729	1.1077	0.0063	-0.0111	-0.0605
3	-0.0004	0.1281	**0.01884**	-0.0541	-0.0122	0.0017	0.0174	0.0064	0.0456	-0.3089	-0.2711	0.6027	-0.0014	-0.0153	-0.0068
4	0.0061	0.3647	-0.0030	**-0.3342**	0.0210	-0.0091	0.0317	0.0042	-0.1120	-0.5070	-0.5269	1.0104	0.0068	-0.0088	-0.0603
5	-0.0127	0.0887	0.0030	-0.0924	**0.0760**	0.0133	0.0084	0.0084	-0.3041	-0.5591	-0.4279	0.8634	0.0026	0.0168	-0.0721
6	-0.0028	-0.0415	-0.0004	0.0389	0.0129	**0.0784**	0.0047	0.0031	0.1832	0.3677	0.7172	-1.1618	-0.0035	0.0116	0.1070
7	-0.0027	0.2312	-0.0061	0.0389	0.0120	0.0070	**0.0531**	-0.0003	0.1387	-0.7010	0.4006	0.3184	-0.0021	-0.0064	0.0240
8	-0.0015	0.0756	-0.0045	-0.0529	0.0240	0.0090	-0.0007	**0.0268**	-0.4894	0.8155	-1.0999	0.2263	0.0081	0.0157	-0.1380
9	-0.0015	-0.0494	-0.0011	0.0477	-0.0295	0.0183	0.0093	-0.0167	**0.7843**	-0.6022	1.4580	-0.7832	-0.0137	-0.0180	0.1898
10	-0.0012	0.0981	-0.0027	-0.0806	0.0202	-0.0137	0.0177	-0.0104	0.2247	**-1.1022**	0.4563	1.6861	-0.0014	-0.0247	0.0700
11	-0.0032	-0.1016	0.0024	0.0841	-0.0155	0.02687	0.0101	-0.0140	0.5463	-0.4583	**1.0930**	-1.6291	-0.0125	-0.0199	0.1538
12	0.0006	0.01547	-0.0042	-0.1270	0.0247	-0.0342	0.003	0.0022	-0.2311	-1.3335	-1.2828	**2.5818**	0.0084	-0.0060	-0.0634
13	-0.0120	-0.0908	-0.0010	0.0880	-0.0077	0.0108	0.0044	-0.0084	0.4174	-0.1160	1.0189	-0.8685	**-0.0258**	-0.0053	0.0665
14	0.0062	0.0942	-0.0065	-0.0671	-0.0291	-0.0209	0.0077	-0.0096	0.3234	-1.1875	0.6510	0.3673	-0.0031	**-0.0438**	0.0767
15	-0.0029	-0.0894	0.0005	0.0801	-0.0218	0.0333	0.0050	-0.0147	0.5921	-0.5855	1.2802	-0.6708	-0.0068	-0.0133	**0.2514**

Diagonal values indicate direct effects of respective characters on grain yield
Residual effect = 0.1468

1. Days to 50% flowering; 2. Plant height; 3. Panicle length; 4. Culm length; 5. Flag leaf length; 6. Flag leaf width; 7. Number of internodes; 8. Lodging incidence; 9. Number of productive tillers; 10. Grain length; 11. Grain breadth; 12. Grain L/B ratio; 13. Culm diameter; 14. Total spikelets per panicle; 15. 1000 grain weight

Whereas, traits like days to 50% flowering, plant height, culm length, grain length, culm diameter and total spikelets per panicle contributed direct negative effects on grain yield per plant. But among these traits days to 50% flowering, grain length, culm diameter and total spikelets per panicle showed positive correlation which may be due to the indirect effects of the character through another component trait. Hence, indirect selection for such traits may not be effective. Similar findings for direct negative effects of days to 50% flowering and plant height on grain yield per plant [6].

The findings from the studies on correlation and path analysis indicated that the characters viz., number of productive tillers, grain breadth and thousand grain weight had strong positive correlations as well as high magnitude of positive direct effects with grain yield per panicle. Hence, it is suggested that preference should be given to these three component characters in the selection program to isolate genetically superior lines for higher grain yield per plant. According to this study the genotypes Bhavani, Thengai Poo samba and Kala namak could be utilized in yield improvement programmes. Besides, the residual effect (0.1468) on grain yield per plant was negligible, thereby suggesting that most of the yield components have been included in this study [7].

SUMMARY

Correlation and path analysis was carried out for different yield and lodging related traits for 24 landraces and 6 improved varieties of rice. Grain yield per plant showed significant positive correlation with number of productive tillers, thousand grain weight and total spikelets per panicle had negative correlation with lodging index. Path analysis revealed that high positive and direct effect was recorded by grain L/B ratio followed by grain breadth, number of productive tillers and thousand grain weight. Whereas, direct negative effects were shown by grain length, plant height and culm length.

LITERATURE CITED

1. Chettri D, Anandan A, Nagireddy R, Sabarinathan S, Sathyanarayana N. 2021. Genetic diversity in rice (*Oryza sativa* L.) landraces of Sikkim-Himalaya and early insight into their use in genome-wide association analysis. *Plant Genetic Resources: Characterization and Utilization* 19(4): 347-356.
2. Abdurakhmonov IY, Abdukarimov A. 2008. Application of association mapping to understand the genetic diversity of plant germplasm resources. *International Journal of Plant Genomics* 2008: 574927.
3. Rangare NR, Krupakar A, Ravichandra K, Shukla AK, Mishra AK. 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.
4. Nagaraju C, Reddi Sekhar 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. *International Journal of Applied Biology and Pharmaceutical Technology* 4(3): 137-142.
5. Ravindrababu V, Shreya K, Kuldeep Singh D, Usharani, Shankar AS. 2012. Correlation and path analysis studies in popular rice hybrids of India. *International Journal of Scientific and Research Publications* 2(3): 1-5.
6. Akhi AH, Miah MAK, Ivy NAT, Islam A, Islam MZ. 2016. Association of yield and yield related traits in aromatic rice (*Oryza sativa* L.). *Bangladesh Journal of Agricultural Research* 41(3): 387-396.
7. Nomura T, Seki Y, Matsuoka M. 2021. Potential of rice landraces with strong culms as genetic resources for improving lodging resistance against super typhoons. *Science Reporter* 11: 15780.