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A Study under Sodic Soil Condition for Estimation of Correlation and Path Coefficient Analysis of Rice (*Oryza sativa* L.) Yield and Its Component Traits

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Effective selection necessitates knowledge of the nature and extent of population variation, character correlation with yield among individuals, and effect of environment on the assertion of these traits. Under timely seeded and irrigated conditions in sodic soil, this study used Augmented Block Design (ABD) to investigate correlations and path coefficients between yield and yield components in 85 germplasms, including four checks (Pusa sungandha-4, NDR-2065, sarjoo-52, Narendra usar-3). The correlation coefficient expresses the relationship between two variables, but it contains no information regarding cause and effect, such as which variable is dependent and which is independent. As a result, path-coefficient analysis must be utilized to examine the direct and indirect impact of numerous independent characters on a dependent character. The GYPP exhibited highly significant and positive correlations with BYPP and HI. When the genotypic correlation was assigned, it was discovered that characters like BYPP and HI had a positive direct impact on GYPP whereas characters DFF and DM were exhibited negative direct impact on GYPP**.** The most important indirect yield component was BYPP. As a result, these traits should be emphasized and further evaluated as a selection criterion for future rice improvement programmes in sodic soil.

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Keywords: Correlation; path coefficient; grain yield; direct impact; indirect impact; breeding programme.

1. INTRODUCTION

Rice is a globally important staple food crop. This crop's productivity can be increased significantly by varietal improvement and hybrid development. By 2030, the global population is predicted to exceed 8 billion people, necessitating a 50 percent increase in rice production to fulfill the rising demand [1]. As a result, rice breeders are working to create cultivars with higher yields and other desirable agronomic characteristics. According to Kumar et al. [2]. SAS (salt affected area) estimates in India range from 0.68 to 26.1 million hectares, depending on the methods and definitions used by various organizations across the country. For the selection of optimal genotypes for every environmental condition, several statistical factors such as correlation and path analysis would be effective.

Yield component breeding to increase grain yield would be most effective, if the components involved (genetically) positively correlated with grain yield [3]. The correlation analysis deals with association between two or more variables. However, it is very difficult to observe about the cause and effect, such as which variable is dependent and which is independent. In such cases path-coefficient analysis must be used. Moreover, it assesses the impact of several independent characters on a dependent character, both directly and indirectly. Indirect selection can benefit from path analysis since it indicates the relative value of yield-contributing characters.

Saha et al. [4] find out that days to 50% flowering, flag leaf area, number of effective tillers per hill, pollen fertility, panicle length, number of grains per panicle, and 100 seed weight all had a direct positive effect on yield per plant at both the phenotypic and genotypic levels whereas Rashmi et al*.* [5] obtained that panicle weight, filled grains per panicle, total grains per panicle, and panicle length all demonstrated a strong positive and significant relationship with grain yield. The panicle weight had the greatest direct contribution to GYPP, followed by the TPP, according to path coefficient analysis. Similar finding were also obtained by Bhati et al. [6] that GYPP was favorably correlated with HI, BYPP, TW, and PH at both the genotypic and phenotypic levels, according to correlation studies. The HI, BYPP, SPP, TPP, and PH all exhibited a strong positive direct effect on GYPP at both the genotypic and phenotypic levels, according to path coefficients.

With this knowledge in mind, a study was designed to evaluate the characters correlations between various rice genotypes for traits that contribute to yield under sodic soil conditions.

2. MATERIALS AND METHODS

For this investigation, 85 rice germplasm/genotypes and four check (Pusa sungandha-4, NDR-2065, sarjoo-52 and Narendra Usar Dhan 3) varieties were used as the experimental material at Genetics and Plant Breeding Research Farm of Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.) under natural sodic condition with an EC = 2.24 and pH of 9.3 (dSm^{-1}). Genotypes were grown in augmented block design (ABD) in such a way that the field was divided into 5 blocks, each with 21 plots. Twenty-eight (28)-day-old seedlings were transplanted under sodic soil with 20 cm x 10 cm spacing onto the experimental area. For each genotype, observations were made on five randomly selected plants with no border effect. The average values were evaluated and subjected to statistical analysis. Observation was recorded on plant basis for all characters, except days to maturity, which was recorded on plot basis. Details of the 13 characters studied are as viz., DFF (days to 50% flowering), DM (days to maturity), PL (panicle length), PH (plant height), FLA (flag leaf area), TPP (number of productive tillers / plant), SPP (number of fertile spikelets / panicle), SF (spikelet fertility), BYPP (biological yield / plant), HI (harvest index), TW (test weight), L:B ratio and GYPP (grain yield / plant). Correlation coefficients and path-coefficient analysis were calculated in accordance with [7] and [8] respectively. GYPP was classified as a dependent variable (effect) that was influenced by the other twelve characters, which were classified as independent variables (causes).

3. RESULTS AND DISCUSSION

3.1 Correlation Coefficients Analysis

The degree of correlation between the characters is an important consideration, especially for economic and sophisticated characters like yield.

Table 1. Displays the estimations of simple correlation coefficients between thirteen characters

Traits	DM	PH (cm)	FLA (cm^2)	TPP	PL (cm)	SPP	SF (%)	BYPP (g)	HI (%)	TW (g)	L:B ratio	GYPP (g)
DFF	0.112	0.044	0.065	0.021	-0.091	0.132	0.067	-0.033	-0.045	0.239*	-0.123	-0.056
DM		-0.048	0.028	-0.028	0.034	0.090	0.188	-0.187	0.058	0.070	-0.148	-0.134
PH (cm)			0.386**	0.048	0.029	-0.052	0.193	0.296**	0.005	-0.067	-0.165	0.271*
FLA(cm^2)				0.032	0.015	0.156	0.144	0.240*	0.031	0.049	-0.108	0.231*
TPP					0.016	-0.045	0.004	0.261*	0.053	0.100	0.110	0.263*
PL (cm)						0.309**	-0.063	0.088	-0.035	0.076	-0.008	0.047
SPP							0.373**	0.031	0.040	0.106	0.021	0.038
SF (%)								0.169	0.205	-0.011	-0.207	0.258*
BYPP (g)									-0.001	-0.087	0.050	0.866**
HI (%)										0.170	0.031	0.491**
TW (g)											0.057	0.004
L:B ratio												0.063

**, ** significant at 5% and 1% level, respectively*

Table 2. Effects of twelve independent variables on one dependent variable (GYPP) directly or indirectly under sodic soil conditions

Traits	DFF	DM	PH (cm)	FLA (cm^2)	TPP	PL (cm)	SPP	SF (%)	BYPP (g)	HI (%)	TW (g)	L:B ratio	GYPP (g)
DFF	-0.0063	-0.0001	0.0004	0.0005	0.0003	0.0007	-0.0013	0.0010	-0.0279	-0.0219	-0.0004	-0.0011	-0.056
DM	-0.0007	-0.0011	-0.0005	0.0002	-0.0003	-0.0003	-0.0009	0.0029	-0.1601	0.0281	-0.0001	-0.0013	-0.134
PH (cm)	-0.0003	0.0001	0.0095	0.0031	0.0006	-0.0002	0.0005	0.0029	0.2533	0.0025	0.0001	-0.0015	0.271*
FLA (cm^2)	-0.0004	0.0000	0.0037	0.0080	0.0004	-0.0001	-0.0016	0.0022	0.2052	0.0152	-0.0001	-0.0010	0.231*
TPP	-0.0001	0.0000	0.0005	0.0003	0.0119	-0.0001	0.0005	0.0001	0.2232	0.0261	-0.0002	0.0010	0.263*
PL (cm)	0.0006	0.0000	0.0003	0.0001	0.0002	-0.0081	-0.0031	-0.0010	0.0757	-0.0172	-0.0001	-0.0001	0.047
SPP	-0.0008	-0.0001	-0.0005	0.0013	-0.0005	-0.0025	-0.0100	0.0057	0.0262	0.0193	-0.0002	0.0002	0.038
SF (%)	-0.0004	-0.0002	0.0018	0.0012	0.0001	0.0005	-0.0037	0.0152	0.1451	0.0999	0.0000	-0.0019	0.258*
BYPP (g)	0.0002	0.0002	0.0028	0.0019	0.0031	-0.0007	-0.0003	0.0026	0.8565	-0.0004	0.0002	0.0005	0.866**
HI (%)	0.0003	-0.0001	0.0001	0.0003	0.0006	0.0003	-0.0004	0.0031	-0.0008	0.4880	-0.0003	0.0003	0.491**
TW (g)	-0.0015	-0.0001	-0.0006	0.0004	0.0012	-0.0006	-0.0011	-0.0002	-0.0746	0.0829	-0.0018	0.0005	0.004
L:B ratio	0.0008	0.0002	-0.0016	-0.0009	0.0013	0.0001	-0.0002	-0.0032	0.0425	0.0151	-0.0001	0.0091	0.063

Residual = 0.0061, ** significant at 5% and 1% level, respectively, Bold digit = Direct impact*

Understanding associations between yield and its components is vital for developing an effective breeding plan, and correlation coefficient plays an important role in this regard. Table 1 shows the correlation coefficient estimates for various characters viz., DFF, DM, PH, FLA, TPP, PL, SPP, SF, BYPP, HI, TW, L:B ratio and GYPP were computed separately for rice genotypes. The GYPP exhibited highly significant and positive correlations with BYPP (0.866) and HI (0.491) whereas; PH (0.271), FLA (0.231), SF (0.258) and TPP (0.263) were showed significant and positive correlation. It has been also showed that GYPP was non-significant and positively correlated with PL (0.047), SPP (0.038), TW (0.004) and L: B ratio (0.063) but non- significant and negative correlation showed by DFF (-0.056), DM (-0.134).

Similar kind of association was revealed by Ratna et al. [9] for plant height, Idris and Mohamed [10] for number of tillers per plant and Rahman et al. [11] for panicle length.

3.2 Path Coefficient Analysis

The path coefficient analysis was performed to examine the direct and indirect impacts of twelve independent characters on the dependent character grain yield per plant were covered in current study by using simple correlation coefficients under sodic soil conditions. Direct impact refers to an independent character's direct effect on a dependent character, whereas indirect effect refers to an independent character's effect on a dependent character with the help of other independent characters. The term residual effect refers to the impacts that were not examined in the study. Table 2 shows the effects of twelve independent variables on one dependent variable (GYPP) directly or indirectly under sodic soil conditions. The path analysis identified the major direct effect on grain yield per plant showed via trait biological yield per plant per plant (BYPP) followed by harvest index (HI), plant height (PH), L: B ratio while BYPP and HI came out as most important traits that showed indirect impact on GYPP. It was found that when assigning to the genotypic correlation, traits like DFF (-0.0063), DM (-0.0011), SPP (-0.0100), TW (-0.0018) exhibited negative direct effect while positive and direct effect were showed by the traits PH (0.0095), FLA (0.0080), TPP (0.0119), SF (0.0152), HI (0.4880), L:B ratio (0.0091) on GYPP. As a result, the findings show that these traits can be utilized to determine grain yield component for selection in future validation programme.

The similar results were reported by Bhujel et al. [12] that 1000-grain weight had the greatest positive direct impact on grain yield, followed by panicle length and fertility per cent, according to path coefficient analysis. According to Devi et al. [13] test weight (3.48), effective tillers (1.57), and filled grains per panicle (1.41) all had a positive direct impact on grain production per plant, according to path analysis. Kernel length, milling percent, and kernel elongation ratio were the quality traits that had a direct effect on head rice recovery. However Rao et al. [14] path coefficient analysis, the quantity of grains per panicle, test weight, and productive tillers per square meter were all important variables to consider for improving yield. According to Pandey et al. [15] harvest-index, days to maturity, effective tillers per plant, 1000-grain weight, flag leaf area, and panicle length were found as major direct contributors using path analysis. Singh et al. [16] reported in their study that BYPP (0.814) and HI (0.200) were showed positive direct impact on GYPP.

4. CONCLUSION

In the current study, a lesser amount of direct and indirect effects had high order values. This may be because the germplasm lines have extremely high genetic variability, which causes many character associations that ultimately cancel out one each other. When the correlation values were partitioned, it was discovered that some of the traits were unable to establish a significant correlation with individual plant yield; this might be as a result of extremely large detrimental and negative direct effects. The findings of character association and path analysis revealed that BYPP and HI had both positive associations and strong positive direct impacts, according to a careful review of the data. As a result, after further validation, selecting for these traits may enhance yield and yield components for future rice breeding programmes.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Khush GS, Brar DS. Biotechnology for rice breeding: progress and impact. In: Sustainable rice production for food security. Proceedings of the 20th Session

of the *International Rice Commission Bangkok*, Thailand; 2002.

2. Kumar N, Singh SK, Reddy GO, Mishra VN, Bajpai RK. Remote sensing applications in mapping salt affected soils. *Agric Rev.* 2021;*10*:18805.
3. Sharma DK, Chaudhari SK. Agronomic research in salt-affected soils of India: An Overview. Indian J. Agron. 2012;5 (7):175-185.
4. Saha SR, Hassan L, Haque MA, Islam MM, Rasel M. Genetic variability, heritability, correlation and path analyses of yield components in traditional rice (*Oryza sativa* L.) landraces: Variability and traits association in rice. Journal of the Bangladesh Agricultural University. 2019;17(1):26-32.
5. Rashmi D, Saha S, Loitongbam B, Singh S, Singh PK. Genetic variability study for yield and yield components in rice (*Oryza sativa* L.). International Journal of Agriculture, Environment and Biotechnology. 2017;10(2):171.
6. Bhati M, Rajput GSBAS. Genetic variability, correlation and path coefficient for grain yield and quantitative traits of elite rice (*Oryza sativa* L.) genotypes at Uttar Pradesh. Electronic Journal of Plant Breeding. 2015;6(2):586-591.
7. Searle SR. Phenotypic, genetic and environmental correlations. Biometrics. 1961;17(3):474-480.
8. Wright S. The method of path coefficients. The annals of Mathematical Statistics. 1934;5(3):161-215.
9. Ratna M, Begum S, Husna A, Dey SR, Hossain MS. Correlation and path coefficient analysis in Basmati rice. Bangladesh Journal of Agriculture Research. 2015;40(1):153-161.
10. Idris AE, Mohamed KA. Estimation of genetic variability and correlation for grain yield components of rice (*Oryza sativa* L.). Global Journal of Plant Ecophysiology. 2013;3(1):1-6.
11. Rahman MA, Hossain MS, Chowdhury IF, Matin MA, Mehraj H. Variability study of advanced fine rice with correlation, path co-efficient analysis of yield and yield contributing characters. International Journal of Applied Science and Biotechnology. 2014;2(3):364-370.
12. Bhujel J, Sharma S, Shrestha J, Bhattarai A. Correlation and path coefficient analysis in normal irrigated rice (*Oryza sativa* L.). Farming and Management. 2018;3(1): 19-22.
13. Devi KR, Chandra BS, Lingaiah N, Hari Y, Venkanna V. Analysis of variability, correlation and path coefficient studies for yield and quality traits in rice (*Oryza sativa* L.). Agricultural Science Digest-A Research Journal. 2017;37(1):1-9.
14. Rao VT, Mohan YC, Bhadru D, Bharathi D, Venkanna V. Genetic Variability and Association Analysis in Rice; 2014.
15. Pandey VR, Singh PK, Verma OP, Pandey P. Inter-relationship and path coefficient estimation in rice under salt stress environment. International Journal of Agricultural Research, 2012;7(4):169-184.
16. Singh P, Singh PK, Singh V, Verma OP, Debnath A. A Study on Correlation and Path Analysis for Yield and Yield Components in Rice (*Oryza sativa* L.) under Sodic Soil. Int. J. Curr. Microbiol. App. Sci. 2020;9(11):1121-1126.

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