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Correlation and Path Coefficient Analysis for Yield and Yield Component Traits in Boro Rice (*Oryza sativa* L.)

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ABSTRACT: *Selection for yield is often difficult in crop breeding because yield is a complex inherited character controlled polygenically, contributed by several component traits. In the present investigation correlation and path coefficient analysis with direct and indirect effect for ten quantitative traits were studied using fifty genotypes. Character association studies revealed that the characters grain yield per plant showed significant positive association with number of productive tillers per plant, number of tillers per plant, plant height, number of filled grains per panicle, 1000 grain weight, panicle length, This indicated that simultaneous selection of all these characters was important for yield improvement. A critical analysis of the results by path analysis revealed that the traits viz., number of filled grains per panicle, 1000 grain weight, number of productive tillers per plant, number of filled grains per panicle, days to maturity and number of productive tillers per plant and number of tillers per plant, plant height were directly influencing the grain yield per plant. A critical analysis of correlation and direct and indirect effects indicated that emphasis should be directed towards selection of parents having higher number of productive tillers per plant coupled with higher number of filled grains per panicle,1000 grain weight, plant height, longer panicle length. As the yield component, filled grains per panicle is intern dependent on panicle length and plant height attention should be paid towards increasing the panicle length, maintaining optimum plant height. Thus, a plant with medium height, sturdy culm with increased panicle length, higher number of filled grains per panicle and productive tillers per plant would be more desirable for selection to realize higher yield.*

Key words: *Rice, Correlation, Path coefficient, Yield*

INTRODUCTION

Boro rice is cultivated during October/November to May/June and ahu rice during February to June. Ahu rice is shorter in growing duration, requires 'life-saving' irrigation and minimum inputs of fertilizer and pesticides. Areas under boro rice can be broadly delineated into three categories on the basis of land and water source: (i) rainfed swampy, flood prone ecology; (ii) irrigated flood prone ecology and (iii) irrigated flood-free ecology. Boro rice produces more yields than the kharif rice in the same ecology. In fact, the yields recorded from experiments, both at research station and at farmers fields show that yields from boro rice are manifolds compared to kharif rice. 'Gautam' one of the recently released varieties, from Rajendra Agricultural University, Pusa (Samastipur) have recorded yields between 8-10 t/ha. Even on farmer's fields [11]. Despite the higher cost of cultivating boro rice the returns per ha. are significantly higher than kharif rice [10]. Boro rice cultivation despite being a new phenomenon in Bihar plains has been able to make a significant impact in the economy of North Bihar areas, which could be achieved through their own innovative approach, in the form of some new varieties of boro rice. Agronomic practices followed by the farmers varied

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from farm to farm but it was observed that in general the farmers followed most of the recommended practices. The high water requirement of the crop was met with a local innovation called "bamboo boring" which served as the chief source of irrigation during the months of April-May when there was a scarcity of surface water in the region and farmers had to use ground water sources , this led to the higher cost to be spend on fuel etc. by the farmers. The study strengthened the belief that farmers are better innovators and a little support to them in terms of research and infrastructure could lead to even better results. Shallow water level and water logged low land can be utilized by using boro rice cultivation, which remains fallow in winter due to excessive moisture and late maturing rice. Immense potential for improving boro rice yield over winter crops in low land areas. Boro rice matures before on-set of monsoon and get sufficient time for harvesting as compared to chaite rice (spring). Good market price of boro rice due to offseason production. Reduces risk of natural calamities like flood for main season under flood prone areas using boro rice cultivation. The economic product of rice, exhibits complex genetics and is influenced by various yield contributing characters. These yield contributing characters are further interrelated. The study of relationship among quantitative traits is important for assessing the feasibility of joint selection for two or more traits instead of selection of secondary traits on genetic gain for the primary trait under consideration [3]. Path coefficient analysis is a tool which permits the partitioning of the correlation coefficient into its components, one component being the path coefficient that measures the direct effect of a predictor variable upon its response variable; the second component being the indirect effect of a predictor variable on the response variable through other predictor variables [2]. In agriculture, path analysis has been used by plant breeders to assist in identifying traits that are useful as selection criteria to improve crop yield [4]. Thus, present study was undertaken to describe the character association and contribution of various yield influencing traits to establish appropriate plant attributes for selection to improve the yield of rice breeding lines.

MATERIALS AND METHODS

The experimental material consisted of 50 genotypes of boro rice which were planted during Rabi 2014 at Directorate of Rice Research Farm, ICRISAT Campus, Patancheru, Hyderabad during *Rabi,* 2013-14.These test genotypes were tested in the field in a randomized block design with three replications adopting a spacing of 20 cm within the row and 30 cm between the rows. The recommended agronomic practices were followed to raise a healthy crop. Five plants were selected randomly and tagged from each genotype per replication and observations were recorded on Days to 50% Flowering, Plant Height (cm), Number of tillers/ plant, Number of productive tillers/plant, Panicle length(cm), Number of filled grains/panicle, Number of unfilled grains/panicle, Days to maturity, Grain yield/plant(g) and 1000 grain weight(g). The mean of three replications was used for statistical analysis to compute correlation coefficients, and path coefficient analysis with direct and indirect effect on yield.

RESULTS AND DISCUSSION

The data revealed highly significant differences among the genotypes for all the characters indicating significant diversity among the genotypes to proceed further for statistical tests.

The phenotypic and genotypic correlations among all pairs of characters are shown in Table 1.0. The genotypic correlations in general, were higher than corresponding phenotypic correlations. This is due to the modified effect of environment on character association at the genetic level [9]. Phenotypic correlations revealed that grain yield per plant had significant positive association with Plant height (0.3867), number of tillers per plant (0.4341), number of productive tillers per plant (0.5072), panicle length (0.2481), number of filled grains per panicle (0.3251), 1000 grain weight (0.2892). The trait recorded a

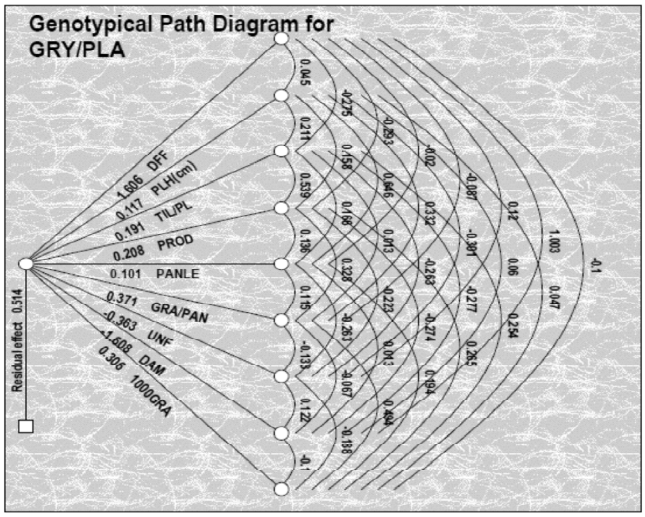

Figure 1: Phenotypical path diagram for grain yield per plant (g)

Table 1
Phenotypic (P) and Genotypic (G) correlation coefficient analysis of yield and yield contributing characters in boro rice

Character		*Days to 50% Flowering*	*Plant Height (cm)*	*No. of tillers/ plant*	*No of prod. Tillers / Plant*	*Panicle Length (cm)*	*No.of filled grains/ Panicle*	*No.of unfilled grains/Panicle*	*Days to maturity*	*1000 Grain Weight (g)*	*Grain Yield/ Plant (g)*
Days to 50% flowering	**P**	**1.0000**	0.0381	-0.2214**	-0.2352**	-0.0181	-0.0860	0.1119	0.9788	-0.0899	**-0.1963***
	G	**1.0000**	0.0454	-0.2750**	-0.2928**	-0.0200	-0.0873	0.1203	1.0034	-0.1004	**-0.2242****
Plant Height (cm)	**P**		**1.0000**	0.1882*	0.0770	0.4776**	0.2908**	-0.2614**	0.0420	0.0385	**0.3867****
	G		**1.0000**	0.2106**	0.1582	0.6465**	0.3317**	-0.3005**	0.0601	0.0474	**0.4785****
Number of tillers / plant	**P**			**1.0000**	0.3851**	0.0984	-0.0014	-0.2670**	-0.2250**	0.1973*	**0.4341****
	G			**1.0000**	0.5395**	0.1663*	0.0132	-0.2634**	-0.2769**	0.2540**	**0.5261****
Number of prod.	**P**				**1.0000**	0.1097	0.2635**	-0.1618*	-0.2099**	0.2084**	**0.5072****
tillers / plant	**G**				**1.0000**	0.1363	0.3284**	-0.2230**	-0.2737**	0.2651**	**0.5968****
Panicle Length (cm)	**P**					**1.0000**	0.0737	-0.1620*	-0.0082	0.1680*	**0.2481****
	G					**1.0000**	0.1149	-0.2634**	0.0131	0.1944*	**0.3812****
Number of filled	**P**						**1.0000**	-0.1237	-0.0682	-0.4530**	**0.3251****
grains/panicle	**G**						**1.0000**	-0.1330	-0.0675	-0.4938**	**0.3580****
Number of un filled	**P**							**1.0000**	0.1211	-0.1698*	**-0.5752****
grains/panicle	**G**							**1.0000**	0.1220	-0.1877*	**-0.6311****
Days to maturity	**P**								**1.0000**	-0.0903	**-0.1786***
	G								**1.0000**	-0.1000	**-0.1976***
1000 Grain Weight (g)	P									1.0000	0.2892**
	G									1.0000	0.3191**

** Significant at 1 percent level of significance

* Significant at 5 percent level of significance

Table 2
Phenotypic (P) and Genotypic (G) Path coefficient analysis of yield and yield contributing characters in boro rice

Character		*Days to 50% Flowering*	*Plant Height (cm)*	*No. of tillers/ plant*	*No of prod. Tillers/ Plant*	*Panicle Length (cm)*	*No.of filled grains/ Panicle*	*No.of unfilled grains/ Panicle*	*Days to maturity*	*1000 Grain Weight (g)*	*Grain Yield/ Plant (g)*
Days to 50% flowering	**P**	**-0.2492**	0.0053	-0.0362	-0.0537	-0.0002	-0.0254	-0.0419	0.2293	-0.0244	-0.1963*
	G	**1.6064**	0.0053	-0.0525	-0.0608	-0.0020	-0.0324	-0.0436	-1.6138	-0.0307	-0.2242**
Plant Height (cm)	**P**	-0.0095	**0.1391**	0.0308	0.0176	0.0048	0.0858	0.0979	0.0098	0.0104	0.3867 **
	G	0.0730	**0.1172**	0.0402	0.0329	0.0652	0.1232	0.1091	-0.0967	0.0145	0.4785**
Number of tillers / plant	**P**	0.0552	0.0262	**0.1635**	0.0879	0.0010	-0.0004	0.1000	-0.0527	0.0535	0.4341**
	G	-0.4418	0.0247	**0.1908**	0.1120	0.0168	0.0049	0.0956	0.4454	0.0777	0.5261**
Number of prod.	**P**	0.0586	0.0107	0.0630	**0.2281**	0.0011	0.0777	0.0606	-0.0492	0.0565	0.5072**
tillers / plant	**G**	-0.4703	0.0185	0.1029	**0.2077**	0.0137	0.1220	0.0809	0.4401	0.0811	0.5968**
Panicle Length (cm)	**P**	0.0045	0.0664	0.0161	0.0250	**0.0100**	0.0218	0.0607	-0.0019	0.0455	0.2481**
	G	-0.0322	0.0758	0.0317	0.0283	**0.1008**	0.0427	0.0956	-0.0210	0.0595	0.3812**
Number of filled	**P**	0.0214	0.0405	-0.0002	0.0601	0.0007	**0.2950**	0.0464	-0.0160	-0.1228	0.3251**
grains/panicle	**G**	-0.1402	0.0389	0.0025	0.0682	0.0116	**0.3714**	0.0483	0.1085	-0.1512	0.3580**
Number of un filled	**P**	-0.0279	-0.0364	-0.0437	-0.0369	-0.0016	-0.0365	**-0.3747**	0.0284	-0.0460	-0.5752**
grains/panicle	**G**	0.1932	-0.0352	-0.0502	-0.0463	-0.0266	-0.0494	**-0.3629**	-0.1962	-0.0575	-0.6311**
Days to maturity	**P**	-0.2439	0.0058	-0.0368	-0.0479	-0.0001	-0.0201	-0.0454	**0.2342**	-0.0245	-0.1786*
	G	1.6119	0.0070	-0.0528	-0.0568	0.0013	-0.0251	-0.0443	**-1.6083**	-0.0306	-0.1976*
1000 GrainWeight (g)	**P**	0.0224	0.0054	0.0323	0.0475	0.0017	-0.1337	0.0636	-0.0211	**0.2711**	0.2892**
	G	-0.1612	0.0056	0.0485	0.0550	0.0196	-0.1834	0.0681	0.1608	**0.3061**	0.3191**

Genotypic residual effect = 0.514 Phenotypic residual effect = 0.6 BOLD values are direct effects

significant negative association with days to 50 per cent flowering (-0.1963), number of unfilled grains per panicle (-0.5752),and days to maturity(-0.1786). Grain yield per plant showed positive significant association with plant height, number of tillers per plant, number of productive tillers per plant, panicle length, number of filled grains per panicle. This indicated that all these characters were important for yield improvement. Similar kind of association was revealed by Abdul Fiyaz *et al* [1]. for plant height [8]. number of productive tillers per plant, number of filled grains per panicle [13]. Hence, these characters could be considered as criteria for selection for higher yield as these were mutually and directly associated with grain yield. The characters like panicle length and 1000 grain weight also positively associated with grain yield per plant it indicates that these characters can be considered for selection for higher yield. The study of phenotypic correlation studies showed that selection of plants with more number of filled grains per panicle, more number of productive tillers per plant, plant height and panicle length would result in improvement of yield.

Correlation gives only the relation between two variables whereas path coefficient analysis allows separation of the direct effect and their indirect effects through other attributes by partitioning the correlations Hence, this objective was undertaken in the present investigation. Based on the data recorded on the genotypes in the present investigation, the genotypic and phenotypic correlations were estimated to determine direct and indirect effects of yield and yield contributing characters. As discussed in character association based on the importance of phenotypic effects the present results of phenotypic path coefficient of yield and yield contributing characters discussed here under which were presented in Table 2.0 and Fig 1.0. The association of different component characters among themselves and with yield is quite important for devising an efficient selection criterion for yield.

The total correlation between yield and component characters may be some times misleading, as it might be an over-estimate or under-estimate because of its association with other characters. Hence, indirect selection by correlated response may not be some times fruitful. When many characters are affecting a given character, splitting the total correlation into direct and indirect effects of cause as devised by [12]. would give more meaningful interpretation to the cause of association between the dependent variable like yield and independent variables like yield components. This kind of information will be helpful in formulating the selection criteria, indicating the selection for these characters is likely to bring about on overall improvement in single plant yield directly. Path coefficient analysis revealed that number of filled grains per panicle exerted the highest positive direct effect on grain yield followed by 1000 grain weight, days to maturity, number of productive tillers per plant and number of tillers per plant, plant height. The negative direct effect on grain yield by number of unfilled grains per panicle, days to 50 per cent flowering. These results were conformity with [7] for days to 50 per cent flowering, plant height, number of productive tillers per plant and panicle length [5] for number of filled grains per panicle, 1000 grain weight [6]. Path analysis revealed that number of filled grains per panicle, 1000 grain weight numbers of productive tillers per plant, number of filled grains per panicle, days to maturity and number of productive tillers per plant and number of tillers per plant, plant height are the most important characters which could be used as selection criteria for effective improvement on grain yield. Therefore, it is suggested that preference should be given to these characters in the selection programme to isolate superior lines with genetic potentiality for higher yield in rice genotypes.

CONCLUSION

A critical analysis of correlation and direct and indirect effects indicated that emphasis should be directed towards selection of parents having higher number of productive tillers per plant coupled with higher number of filled grains per panicle,1000 grain weight, plant height, longer panicle length. As the yield component, filled grains per panicle is intern dependent on panicle length and plant height, attention should be paid towards increasing the panicle length, maintaining optimum plant height. Thus, a plant with medium height, sturdy culm with increased panicle length, higher number of filled grains per panicle and productive tillers per plant would be more desirable for selection to realize higher yield.

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