Correlation and Path Coefficient analysis in F_2 segregating Population of cross RNR-15048 x Dokra-Dokri in rice (*Oryza sativa* L.).

ABSTRACT

The present experiment was conducted to study the correlation and path coefficient analysis in F_2 segregating population of the cross, RNR-15048 x Dokra-Dokri taken up in augmented complete block design with two checks at ICAR-IIRR, Hyderabad during the *Kharif*-2022. Character association of the yield attributing traits revealed significant positive association of single plant yield with plant height, panicle length, total number of tillers, number of productive tillers, panicle weight, number of filled grains, total grains per panicle, spikelet fertility and thousand grain weight. Hence, selection for these traits couldbe rewarding.

Path coefficient analysis revealed that traits like number of productive tillers per plant, panicle weight, total grains per panicle, thousand grain weight, Panicle length, Total number of but also positive and significant correlation with grain yield per plant. This suggests that the correlation is driven by indirect effects, highlighting the importance of considering these causal factors when selecting traits for yield improvement. The residual effect in the present study was 0.576 at phenotypic level indicating characters examined in this study effectively explained both the direct and indirect impacts on the dependent variable to a certain degree.

Keywords:F_2 segregating population, Correlation coefficient, Path analysis,direct selection, Residual effect.

1. INTRODUCTION

Rice stands as one of the world's most vital cereal crops, serving as a key food and protein source for approximately half of the global population. Its significance extends beyond nutrition to have substantial economic and food security implications, especially in many Asian countries. Globally, rice is cultivated across 162.76 million hectares, yielding a total of 495.87 million tonnes with an average productivity of 4.55 tonnes per hectare.Despite the considerable advancements in rice production and productivity brought about by the Green Revolution, further improvements have been constrained by a yield plateau, influenced by various biotic and abiotic factors. Ensuring future food security poses a significant challenge, especially for rice breeders in India, where rice is crucial for both food and nutritional security. To overcome the current yield limits, there is a need for rice varieties with higher productivity and adaptable agronomic traits. Hybridization presents a highly effective and practical approach for generating the desired variability which relies on the capacity to identify and select superior genotypes through a careful selection process. Selection criteria are usually based on yield or its components and can be executed either directly or indirectly.When traits are correlated, selecting for one trait can influence other related traits as well. Grain yield is affected by various

component traits and understanding the association between predictor factors and responder variables and their direct and indirect impacts on yield is crucial for effective yield improvement (Meena*et al.* 2020). While correlation measures the degree of association between two traits, it does not explain the causal relationships. Path coefficient analysis, as introduced by Dewey and Lu (1959), offers insights into the direct and indirect effects of traits on yield. This method, when combined with correlation analysis, helps to clarify the cause-and-effect relationships between different traits (Jayasudha and Sharma, 2010). Such comprehensive analysis supports breeders for estimating the degree and direction of association thereby employing suitable methods of selection. Therefore, the objective of the current study is to investigate the character associations and path analysis among traits in F_2segregating generation for yield improvement.

2. MATERIALS AND METHODS

The experiment was carried out at Indian Council of Agricultural Research-Indian Institute of Rice Research (ICAR-IIRR), Rajendranagar, Hyderabad, during *kharif* 2022. The experimental trial was laid out in F1 plot in ICAR-IIRR field using Augmented Randomized Complete Block Design (ARCBD) consisting of 105 F_2 segregating population derived from cross RNR-15048 x Dokra-Dokri presented in Table1. The experimental area contains a total of five blocks. Prior determining individuals in each block,two checks were initially randomized. Each block was given a total of 24 entries, which included 22F_2'S and 2 checks.Twenty-five days old seedlings were transplanted in the main field with a spacing of 20 x 15 cm.All recommended cultural operations and plant protection measures were taken to ensure uniform and healthy crop stand as previously reported in Bharath*et al.* (2023). Eleven traits, namely, Plant Height (cm), Panicle length (PL) (cm), Total Number of Tillers per plant (TNT), No. of Productive Tillers per plant (NPT), Panicle weight (PW), No. of filled grains per panicle (NFG), No. of unfilled grains per panicle (NUFG), Total No. of grains per panicle (TGP), Spikelet fertility (SF) (%), 1000 grain weight (TGW)(gm), and Single plant yield (SPY) (gm) were recorded in every individual F_2 plant.

Table 1. Details of the parents of the intra-specific cross studied in the present investigation

Parents	Details
RNR-15048	Short slender grain type with low glycemic index (51.72), good cooking quality,test weight of 12.9 g and resistant to blast developed from the cross between MTU1010 and JGL 3855.
Dokra-Dokri	Longest and boldest grain with 14 mm long, high in protein (6.06%) low in fiber with high test weight of 40.5 g.

2.1 Statistical analysis

Correlation was worked out using the formulae suggested by Weber and Moorthy (1952).Partitioning of the correlation coefficients into direct and indirect effects was carried out

using the procedure suggested by Wright (1921) and elaborated by Dewey and Lu (1959). The characterization of path coefficients was carried out as suggested by Lenka and Mishra (1973).

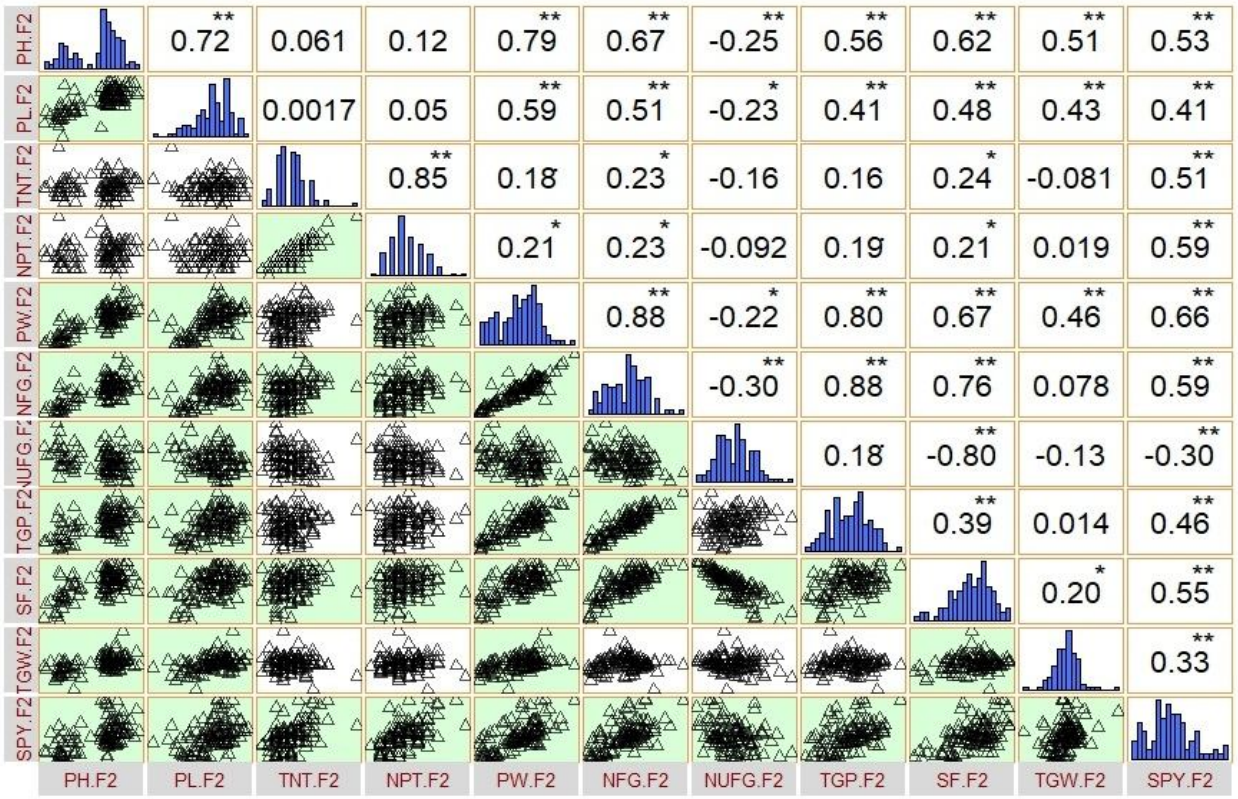
3. RESULTS AND DISCUSSION

3.1 Correlation Coefficient Analysis

In order to identify the critical traits that may be used for crop improvement through appropriate breeding program, Selection based on Correlation is essential as it providesthorough understanding of the strength and direction of the relationship between yield and its relative traits given in Table 1, Fig.1. The trait plant height had shown a significant positive correlation with panicle length, panicle weight, No. of Filled grains, Total no. of grains, Spikelet fertility, thousand grain weight and Single plant yield while negative significant correlation with number of unfilled grains per panicle.These results are in unison withSaketh *et al*. (2023) for single plant yield, Devi *et al*. (2022), Deepthi *et al*. (2022), Faysal *et al*. (2022), Heera *et al*. (2023), Thuy *et al*. (2023) for Panicle length.Panicle length registered significant positive correlation with panicle weight, number of filled grains per panicle, Total no. of grains, spikelet fertility, thousand grain weight and single plant yield.These results are in unison withSanthipriya *et al*. (2017), Kiran *et al*. (2023)for number of filled grains per panicle and with total grains per panicle by Bhargava *et al*. (2021).The total number of tillers per plant exhibited a positive significant association with number of productive tillers per plant, number of filled grains, spikelet fertility and single plant yield.Number of productive tillers per plant exhibited a positive significant association with panicle weight, number of filled grains, spikelet fertility and single plant yield while negative non-significant association with number of unfilled grains.Similar findings with number of filled grains per panicle were reported by Archana *et al*. (2018) and Sahithi *et al*. (2023).Panicle weight exhibited significant positive correlation with number of filled grains, total grains per panicle, spikelet fertility, thousand grain weight and single plant yield while negative significant association with number of unfilled grains per panicle.Number of filled grains per panicle exhibited positive significant association with total grains per panicle, spikelet fertility and single plant yield while negative significant association with number of unfilled grains per panicle.Number of unfilled grains per panicle registered negative significant association with spikelet fertility and single plant yield.Total number of grains per panicle exhibited positive significant association with spikelet fertility and single plant yield.Spikelet fertility registered a positive significant correlation with panicle length, panicle weight, Number of filled grains per panicleand single plant yield while negative significant association with number of unfilled grains. Similar findings of Spikelet fertility with number of filled grains per panicle were reported by Nath and Kole (2021) and Sahithi *et al*. (2022).Thousand grain weight registered a positive significant association with plant height, panicle length, panicle weight and single plant yield.Single plant yield had significant positive association with plant height, panicle length, total number of tillers, number of productive tillers, panicle weight, number of filled grains, total grains per panicle, spikelet fertility and thousand grain weight.Similar findings of positive significant association of single plant yield with plant height were reported by Panika *et al*. (2022), Sahithi *et al*. (2023), Pathak *et al*. (2024).With panicle length by Abdul Fiyaz *et al*. (2011), Panika *et al*. (2022), Farheen *et al*. (2023), Kiran *et al*. (2023).With panicle weight by Kulsum *et al*. (2022), Panika *et al*. (2022), Surjaye*et al*. (2022).With filled grains by Deepthi*et al*. (2022), Ratnam *et al*. (2022), Kiran *et al*. (2023) with thousand grain weight by Kondi *et al*.

(2022), Surjaye*et al*. (2022), Satish Chandra *et al.* (2024) and negative significant association with number of unfilled grains per panicle by Fentie *et al.* (2021).

Fig 1 .Estimates of correlation coefficients between yield and yield component traits in F_2 segregating population of cross RNR-15048 x Dokra-Dokri



** Significant at 5%, ** Significant at 1%;*

PH- Plant height (cm), **PL**- Panicle length (cm), **TNT**- Total number of tillers per plant, **NPT**- Number of productive tillers per plant, **PW**- Panicle weight (gm), **NFG**- Number of filled grains per panicle, **NUFG**- Number of Unfilled grains per panicle, **TGP**- Total grains per panicle, **SF**- Spikelet fertility, **TGW**- Thousand grain weight (gm) and **SPY**- Single plant yield (gm).

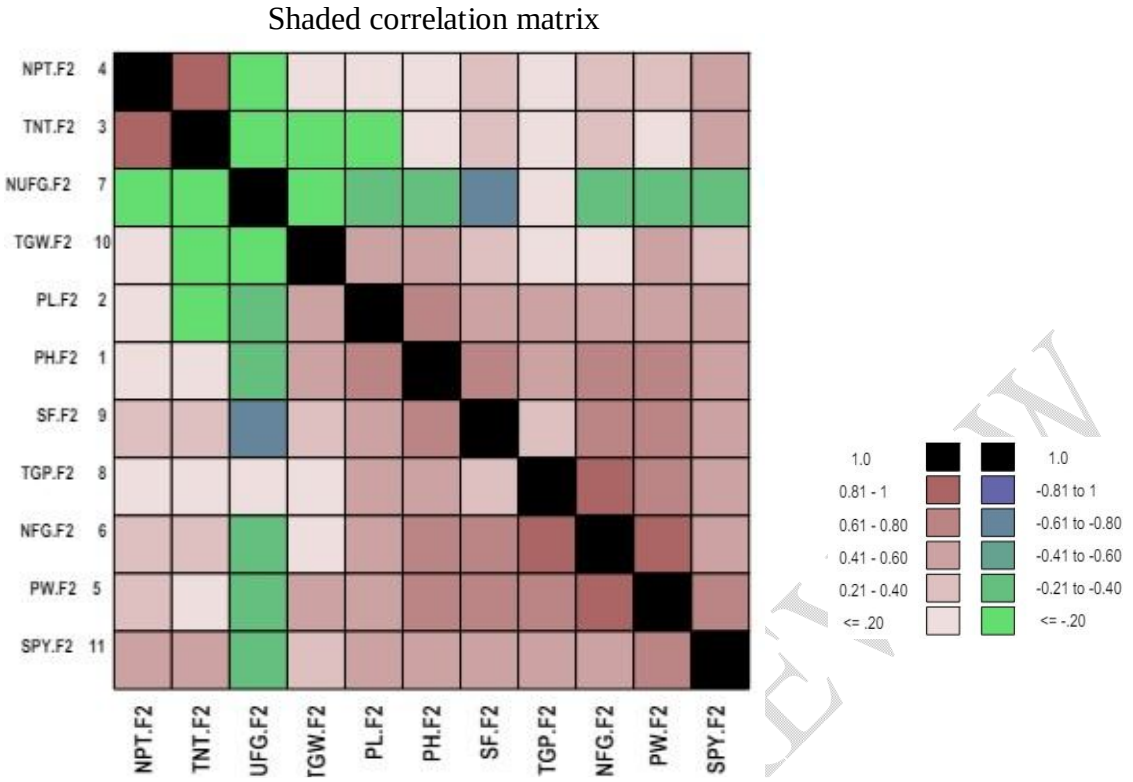


Fig. 2: Correlogram visualizing the correlation among yield and yield traits.

3.2 Path Coefficient Analysis

Simple correlation alone does not accurately reflect how different traits contribute to yield. Therefore, phenotypic correlations were decomposed into direct and indirect effects using path coefficient analysis. This technique distinguishes between the direct impact of traits and their indirect influence through other attributes, providing a more precise interpretation of the cause-and-effect relationships (Wright, 1921). The estimates of path coefficient analysis for yield and yield component characters are furnished in Table 2, Fig.3. Among all the characters, the number of productive tillers per plant (0.4733) exerted maximum positive direct effect on plant yield followed by panicle weight (0.398), Total grains per panicle (0.207) and thousand grain weight (0.091) which also showed significant and positive association with grain yield per plant in correlation studies. Similar results of maximum positive direct effect on plant yield were reported by Sudeepthi *et al.* (2020), Bhargava *et al.* (2021) for number of productive tillers per plant, thousand grain weight and Total grains per panicle; Kalaiselvan *et al.* (2019) andParimala *et al.* (2020) for thousand grain weight.Further, Panicle length (0.055), Total number of tillers per plant (0.005) and Plant height (0.0046) recorded low to moderate positive direct effects on grain yield per plant. Similar result for Plant height, total number of tillers per plant was obtained by Hani and Thouseem 2024; for plant height and Panicle length by Paramanik et al. (2023), Maneesha *et al.* (2024).However, association of these traits was noticed to be positive and significant with grain yield per plant. This suggests that the correlation is driven by indirect effects, highlighting the importance of considering these indirect causal factors when selecting traits for yield improvement.In contrast to positive direct effect, maximum negative direct effect on single plant yield was exhibited by Number of Unfilled grains per panicle (-0.249), Number

of filled grains per panicle (-0.133) and Spikelet fertility (-0.04).Similar results of negative direct effect were reported for Number of filled grains per panicle, Number of Unfilled grains per panicle by Hani and Thouseem 2024 and for Spikelet fertility by Kalaiselvan et al. (2019) and Bhargava *et al.* (2021).The residual effect in the present study was 0.576 at phenotypic level indicating characters examined in this study effectively explained both the direct and indirect impacts on the dependent variable to a certain degree.

Table 2. Phenotypic path coefficient analysis representing direct and indirect effects on single plant yield by its related traits in F_2 population of cross RNR-15048 x Dokra-Dokri.

	PH	**PL**	**TNT**	**NPT**	**PW**	**NFG**	**NUFG**	**TGP**	**SF**	**TGW**	**SPY**
PH	**0.0046**	0.0033	0.0003	0.0005	0.0036	0.0031	-0.0012	0.0026	0.0028	0.0023	0.5297
PL	0.0397	**0.0554**	-0.0001	0.0028	0.0329	0.0281	-0.0125	0.0228	0.0266	0.0237	0.4132
TNT	0.0003	0	**0.0059**	0.005	0.0011	0.0014	-0.0009	0.0009	0.0014	-0.0006	0.503
NPT	0.0558	0.0238	0.4018	**0.4733**	0.0998	0.1079	-0.0436	0.0898	0.0996	0.0089	0.5909
PW	0.3163	0.2365	0.0716	0.084	**0.3986**	0.3498	-0.0887	0.317	0.2665	0.1842	0.6551
NFG	-0.0891	-0.0676	-0.0307	-0.0304	-0.117	**-0.1333**	0.0398	-0.1179	-0.1015	-0.0103	0.5916
NUFG	0.063	0.0563	0.0388	0.023	0.0555	0.0744	**-0.2493**	-0.0453	0.1989	0.0334	-0.2991
TGP	0.1173	0.0856	0.0334	0.0394	0.1652	0.1837	0.0377	**0.2077**	0.0819	0.003	0.4633
SF	-0.0247	-0.0192	-0.0094	-0.0084	-0.0267	-0.0304	0.0319	-0.0158	**-0.04**	-0.0081	0.5548
TGW	0.0465	0.0391	-0.0086	0.0017	0.0423	0.0071	-0.0123	0.0013	0.0185	**0.0915**	0.328

Residual effect: 0.576; Direct effects are represented in bold values

PH- Plant height (cm), **PL**- Panicle length (cm), **TNT**- Total number of tillers per plant, **NPT**- Number of productive tillers per plant, **PW**- Panicle weight (gm), **NFG**- Number of filled grains per panicle, **NUFG**- Number of Unfilled grains per panicle, **TGP**- Total grains per panicle, **SF**- Spikelet fertility, **TGW**- Thousand grain weight (gm and **SPY**- Single plant yield (gm).

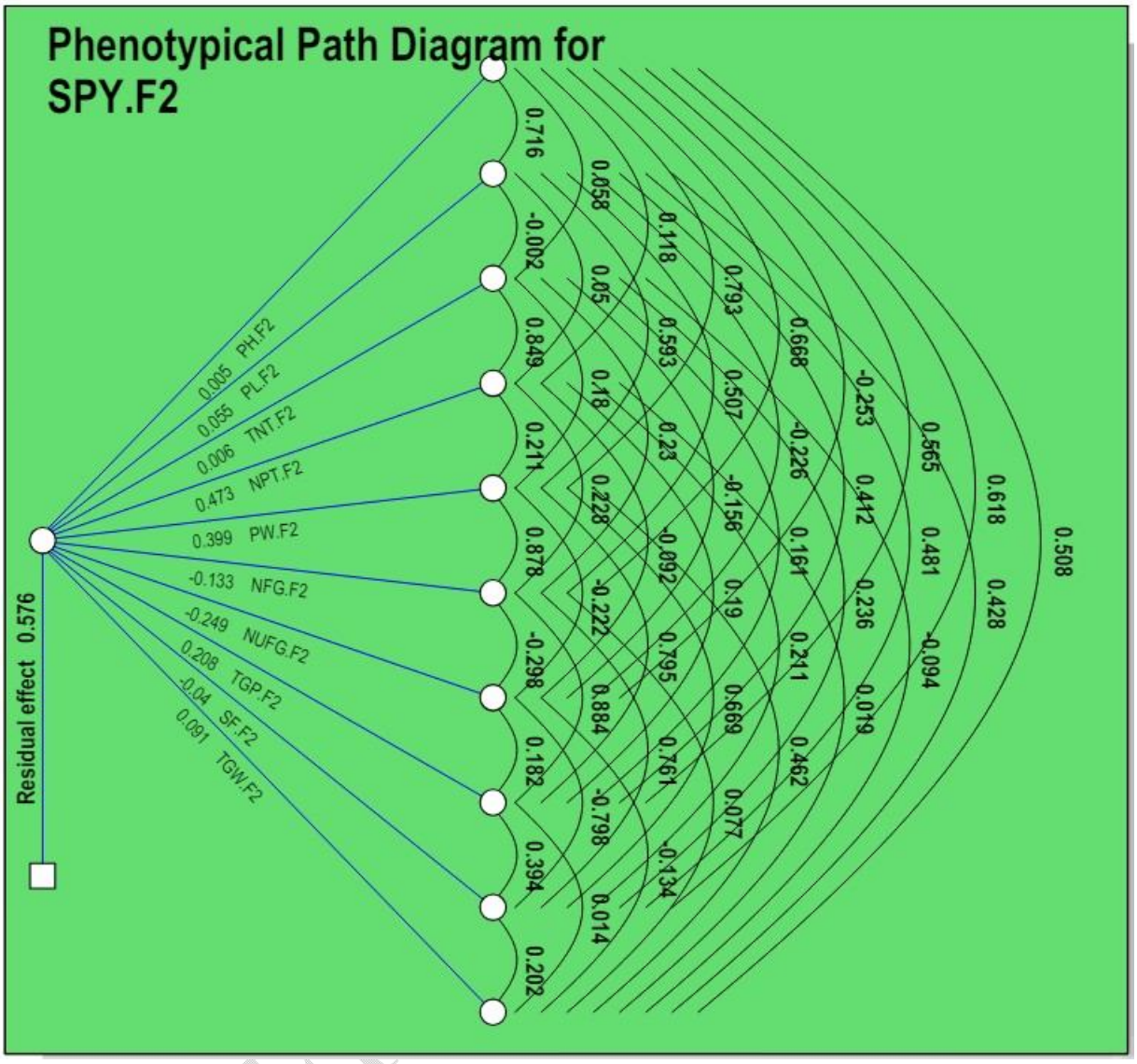


Fig.3. Phenotypical path diagram depicting direct and indirect effect of different traits on Single plant yield.

4. CONCLUSION

Corrleation studiesrevealed significant positive association of plant height, panicle length, number of productive tillers, panicle weight, number of filled grains, total grains per panicle, spikelet fertility and thousand grain weightwithsingle plant yield indicating that the above traits can be considered for selection process.Some of the characters could not produce significant correlation with single plant yield which might be either due to very high negative direct effects. Critical analysis of results obtained from character association and path analysis indicated that number of productive tillers per plant, panicle weight, Total grains per panicle, thousand grain weight, Panicle length, Total number of tillers per plant possessed both positive

association and high positive direct effects. Hence, directselection for these traits could bring improvement in yield and yield components.

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