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Character Association and Path Coefficient Analysis in Selected Genotypes of Rice (*Oryza sativa* L.)

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ABSTRACT: To develop new paddy varieties suitable for Odisha state, it is required to standardise the selection criteria. Yield is a crucial trait that receives significant attention in every breeding program. To uncover the factors influencing yield and their effects, an experiment involving 50 rice genotypes was conducted and both correlation and path coefficients were analysed for 15 morphological traits and yield components on grain yield. Out of these characters studied 11 characters *viz.*, days to 50% flowering, days to maturity, plant height, number of productive tillers plant^{-1}, panicle length, test weight, straw yield plant^{-1}, grain length, grain breadth, biological yield plant^{-1} and harvest index showed highly significant and positive correlation with grain yield both at genotypic and phenotypic level. Days to maturity and harvest index exhibited high positive direct effect on grain yield, both at genotypic and phenotypic levels. In addition, straw yield plant^{-1}, biological yield plant^{-1}, grain breadth and grain L/B ratio also recorded high positive direct effect at genotypic level. Hence, selection based on days to maturity, harvest index, straw yield plant^{-1}, biological yield plant^{-1}, grain breadth and grain L/B ratio could result in bringing simultaneous improvement of grain yield in further breeding programs.

Keywords: Rice, Grain yield, Yield components, Character association, Path analysis.

INTRODUCTION

Rice (*Oryza sativa* L.) is a monocotyledonous plant that belongs to the Poaceae family and the Oryzoideae subfamily. Majority of people living in this subcontinent depends on rice crop for their lively hood activities and thus holds immense significance as an essential part of their daily existence. (Akter *et al.*, 2018). Rice serves as the primary fundamental grain in the diet and the primary calorie provider for over 50% of the global population. According to estimates provided by the United Nations, the world's population is anticipated to grow from 6.3 billion in 2003 to reach 8.5 billion by the year 2030 (Premkumar *et al.*, 2015). Approximately 90% of the global rice production takes place in Asia, often referred to as the "Rice Bowl of the World." In this region, rice serves as a significant source of daily caloric intake, contributing to about 50% to 80% of daily nutritional needs (Pratap *et al.*, 2012). Roughly 11 percent of the world's cultivated land is dedicated to rice cultivation, and it holds the second position in terms of production, following wheat (Anis *et al.*, 2016). The demand for rice is on increase both at state as well as at national levels. In India at present rice production is about 129 million metric tonnes (FAO, 2022) and it is estimated that this has to be enhanced to 137.3 million metric tonnes by 2050 AD (CRRI Vision, 2050 (2013). Therefore, it is essential to increase the rice production in accordance with the expanding population. To increase the production, development of new high yielding varieties through strategic breeding programs is essential.

Yield is a complex trait primarily governed by a combination of various yield component characters besides environmental factors. Therefore, it is crucial to assess how the yield is related to its component characters and how these traits interact with one another. Understanding both the direction and strength of correlation is employed to evaluate how the improvement in one trait may result in enhancements or simultaneous changes in other traits.

Character association allows breeders to understand the common features shared by traits, providing valuable insights for improving genetics through selective breeding. Many economically important plant traits were frequently linked in diverse ways. The correlation analysis helps to assess the degree to which these identified traits were related to crop yield and other characteristics. The correlation coefficient offers valuable insights into both the strength and closeness of the connection between two variables. By investigating the correlation between yield and its constituent elements, plant breeders can enhance their knowledge on contribution of different components to the overall yield in different varieties or hybrids. Studies on character associations can assist plant breeders in discerning how enhancing one trait might result in alterations in other traits, facilitating the selection of favorable genotypes with optimal trait combinations. The data obtained from the correlation analyses of these traits, whether based on observable characteristics or genetic factors, plays a pivotal role in helping plant breeders to develop improved rice varieties that have the potential for higher yields.

Examining path coefficients is a valuable approach to assess how various agro-morphological traits impact grain yield and offer valuable insights into the factors influencing yield. While correlation offers insights into the characters associated with other characters, it doesn't offer a precise depiction of the direct and indirect impacts of the individual characters. Hence, integrating correlation with path analysis would provide a better understanding of the cause-and-effect relationship between different pairs of characters to formulate precise and effective selection criterion for enhancing grain yield.

The present study was undertaken to obtain information on character associations and path coefficient analysis in selected genotypes of rice.

MATERIAL AND METHODS

Fifty accessions (Table 1) of rice (*Oryza sativa* L.) were collected from different stations of Andhra Pradesh, Odisha and West Bengal. The collected genotypes were sown during *kharif* 2022-23 at Ranadevi Post Graduate Research Farm, M. S. Swaminathan School of Agriculture, Centurion University of Technology and Management. Twenty one day old seedlings were transplanted in main field, maintaining a spacing of 20 cm × 15 cm. The test entries were transplanted using a Randomized Block Design replicated thrice. Throughout the experiment, several agro-morphological, traits related to grain yield were recorded for each genotype. These traits included days to 50% flowering, days to maturity, plant height (cm), panicle length (cm), number of productive tillers plant^{-1}, total number of grains panicle^{-1}, filled grains panicle^{-1}, test weight (1000 grains) (g), spikelet fertility percentage (%), grain length (mm), grain breadth (mm), grain L/B ratio, straw yield plant^{-1} (g), biological yield plant^{-1} (g), harvest index (%).

The mean of ten randomly selected plants from each plot was subjected to statistical analysis. Correlation coefficients were computed using the formulae recommended by Johnson *et al.* (1955). The path coefficient analysis was performed as per procedure suggested by Wright (1921), which was subsequently adapted for plant selection by Dewey and Lu (1959). This technique was employed to assess both the direct and indirect impacts of different traits on grain yield plant^{-1}.

Path coefficient analysis is particularly valuable for dissecting correlations into direct and indirect effects, aiding in the identification of traits with the most substantial influence on grain yield plant^{-1}.

Table 1: Sources of rice genotypes collected for the current study.

SOURCE	GENOTYPES
ARS, Maruteru, Andhra Pradesh	MTU 1001, MTU 1010 (**Check**), MTU 1075, MTU1153, MTU 1156, MTU 7029
ARS, Nellore, Andhra Pradesh	NLR 145, NLR 28523, NLR 3041, NLR 33359, NLR 33892, NLR 34449, NLR 4001, NLR 40054, NLR 40058, NLR 40065, NLR 9674
Bankura, West Bengal	Bina 11, Bullet, CR 1017, Gopalbhog, IR 64, Lalat, Lalsita, Pooja, Pratikshya, Rajlaxmi, Sita, Super Shyamali
BCKV, Nadia, West Bengal	Barsha, Black Rice, Dhiren, Khandagiri, Lalgarh, Lathisal, Maharaj, Santoshi, Sonamukhi, Tulaipanji
Paralakhemundi, Odisha	RNR 15048 (**Check**)
Purulia, West Bengal	BB 11 (Banga Bandhu), Damini, GB 1 (Gontra Bidhan 1), GB 3 (Gontra Bidhan 3), IET 5656, Jaya, Nilanjana, Rajendra Mahsuri, Rajendra Sweta, Ranjit

ARS: Agricultural Research Station; **BCKV:** Bidhan Chandra Krishi Vishwavidyalaya

RESULTS AND DISCUSSION

In the present investigation, correlation coefficient analysis was employed to assess the interrelationships among 15 distinct morphological traits and yield components on grain yield to identify the specific traits that could be prioritized during selection process for enhancing grain yield. The data on correlation coefficients, both phenotypic and genotypic, are presented in Tables 2 & 3 and Fig. 1 & 2, respectively. It was observed that, genotypic correlation coefficients displayed higher values than their corresponding phenotypic correlation coefficients in most cases. This suggests a strong and inherent relationship existing between the two characters. In certain instances, the observed phenotypic correlation was slightly stronger, which could be attributed to environmental influence on genetic correlation. This implies that non-genetic factors, such as environmental influences, may have contributed to the development of the genetic correlation (Kumari and Parmar 2020).

The genotypic correlations between morphological, yield and its contributing characters with grain yield are detailed in Table 2. Highly significant positive association was observed between grain yield plant^{-1} and days to 50% flowering (0.266), days to maturity

(0.286), plant height (0.368), number of productive tillers plant^{-1} (0.331), panicle length (0.286), total grains panicle^{-1} (0.492), test weight (0.527), straw yield plant^{-1} (0.272), grain length (0.485), grain breadth (0.483), biological yield plant^{-1} (0.677) and harvest index (0.475). However, a negative but significant association was recorded between grain yield plant^{-1} with grain L/B ratio (-0.166). The significant positive correlation between grain yield and the above contributing traits indicated that simultaneous selection for the increased values of above traits, leads to higher grain productivity. Phenotypic correlations also revealed highly significant positive correlations between grain yield plant^{-1} and various other characters. These included days to 50% flowering (0.239), days to maturity (0.253), plant height (0.357), number of productive tillers plant^{-1} (0.355), panicle length (0.255), test weight (0.485), grain length (0.262), grain breadth (0.417), straw yield plant^{-1} (0.280), biological yield plant^{-1} (0.661) and harvest index (0.487) (Table 3). This implies that when selection is done for the enhancement of one of these traits, it will lead to an increase in the associated characters as well. Similar results were reported earlier by Akter *et al.* (2018), Ahmed *et al.* (2021), Archana *et al.* (2018), Bhutta *et al.* (2018), Dhurai *et al.* (2014), Islam *et al.* (2019), Lakshmi *et al.* (2021), Lalitha *et al.* (2019), Premkumar *et al.* (2015), Seyoum *et al.* (2012), Sahu *et al.* (2019), Sadhana *et al.* (2022) and Tiwari *et al.* (2019).

A perusal of the associations among other yield component traits related to grain yield (Table 2 and 3), it was found that highly significant and positive correlation between days to 50% flowering with days to maturity, plant height, panicle length, total grains panicle^{-1}, straw yield plant^{-1}, grain breadth and biological yield plant^{-1}; days to maturity with plant height, panicle length, total grains panicle^{-1}, straw yield plant^{-1}, grain breadth and biological yield plant^{-1}; plant height with number of productive tillers plant^{-1}, panicle length, total grains panicle^{-1}, straw yield plant^{-1}, grain breadth, biological yield plant^{-1} and test weight; number of productive tillers plant^{-1} with panicle length, grain length, grain L/B ratio and biological yield plant^{-1}; panicle length with total grains panicle^{-1}, straw yield plant^{-1}, biological yield plant^{-1}; total grains panicle^{-1} with filled grains panicle^{-1} and biological yield plant^{-1}; filled grains panicle^{-1} with spikelet fertility; spikelet fertility with test weight, grain length and harvest index; test weight with grain length, grain breadth, harvest index and biological yield plant^{-1}; straw yield plant^{-1} with grain breadth and biological yield plant^{-1}; grain length with grain L/B ratio and harvest index; grain breadth with biological yield plant^{-1} and harvest index. Similar results were earlier reported by Lalitha *et al.* (2019), Hossain *et al.* (2020), Faysal *et al.* (2022), Rao *et al.* (2020), Lakshmi *et al.* (2021), Kumari and Parmer (2020), Muthuramu and Ragavan (2020), Akter *et al.* (2018), Archana *et al.* (2018), Katiyar *et al.* (2019), Mukesh *et al.* (2018) and Moosavi *et al.* (2015).

The path coefficient analysis provided insights into the direct and indirect effects of various traits on grain yield. The path coefficients indicated the strength and direction of these effects (Table 4 & 5). The genotypic path analysis revealed that days to maturity (2.405) recorded highest positive direct effect on grain yield plant^{-1} followed by harvest index (1.164), straw yield plant^{-1} (0.542) and biological yield plant^{-1} (0.538). Grain breadth (0.217) and plant height (0.122) recorded moderate direct effect. At the phenotypic level, harvest index (1.120) exhibited the highest positive effect followed by straw yield plant^{-1} (0.852). Biological yield plant^{-1} (0.234) recorded moderate positive direct effect. Similar findings were also reported by Gupta *et al.* (2020) for days to maturity, by Mathew *et al.* (2022), Manivelan *et al.* (2022) and Sarangi *et al.* (2022) for harvest index, Lohiteswararao *et al.* (2021) for straw yield plant^{-1} and plant height, Kumari and Parmar (2020) for grain breadth. The high negative direct effect was recorded for the days to 50% flowering (P_g =-2.314; P_p =-0.076), whereas correlation with grain yield (G = 0.266; P = 0.239) was highly significant and positive, suggests that focus of selection of parents should be for ideal optimum time for both flowering and harvesting to maximize the yield of rice.

A perusal of correlation coefficients and direct effects of the traits on grain yield indicated that high positive direct effects along with highly significant positive association was recorded between grain yield and days to maturity, harvest index, straw yield plant^{-1} and biological yield plant^{-1} indicating that selection should be focused on above traits to obtain increased grain yield in rice crop.

The analysis of results suggest that the characters examined in the study play a significant role in explaining the variation in grain yield, with only a minimal residual effect (G=0.02694; P=0.04741). Genetically, these fifteen components under study made a substantial contribution, accounting for approximately 96-98% of the variability in yield.

CONCLUSIONS

The correlation coefficients and direct effects of the traits related to grain yield indicated that there are strong positive direct effects and highly significant positive associations between grain yield and the following traits *viz*., days to maturity, harvest index, straw yield and biological yield. These findings suggest that for improvement of rice grain yield, selection should be focused on the above mentioned characteristics to achieve higher grain yields.

From the results obtained from the present study, it can be concluded that selection for intermediate to long duration genotypes with higher straw yield, biological yield, grain breadth, grain L/B ratio and semi dwarf to intermediate plant height will be useful for obtaining higher grain yield in rice crop during *kharif* season.

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Table 2: Estimates of genotypic correlation coefficients among 16 yield and its attributing traits in 50 genotypes of rice (*Oryza sativa* L.).

	DFF	**DM**	**PH**	**NPT**	**PL**	**TGP**	**FGP**	**SF**	**TW**	**SYP**	**GL**	**GB**	**L/B**	**BYP**	**HI**	**GYP**
DFF	**1.000**	0.999**	0.503**	-0.046	0.239**	0.211**	-0.125	-0.318**	0.037	0.788**	-0.253**	0.392**	-0.417**	0.688**	-0.499**	**0.266****
DM		**1.000**	0.508**	-0.027	0.248**	0.210**	-0.125	-0.316**	0.042	0.795**	-0.270**	0.410**	-0.442**	0.704**	-0.489**	**0.286****
PH			**1.000**	0.307**	0.479**	0.167*	-0.099	-0.230**	0.199*	0.463**	-0.010	0.404**	-0.334**	0.526**	-0.181*	**0.368****
NPT				**1.000**	0.386**	0.043	-0.060	-0.273**	0.133	0.147	0.223**	-0.103	0.253**	0.266**	0.051	**0.331****
PL					**1.000**	0.342**	0.117	-0.085	0.198*	0.287**	0.077	0.065	-0.053	0.358**	-0.104	**0.286****
TGP						**1.000**	0.541**	-0.121	-0.262**	0.351**	-0.226**	-0.017	-0.120	0.449**	0.037	**0.492****
FGP							**1.000**	0.195*	-0.117	0.126	0.018	-0.003	-0.097	0.140	-0.011	**0.068**
SF								**1.000**	0.329**	-0.278**	0.256**	0.026	0.079	-0.168*	0.321**	**0.038**
TW									**1.000**	-0.075	0.719**	0.446**	0.124	0.203*	0.479**	**0.527****
SYP										**1.000**	-0.281**	0.230**	-0.309**	0.878**	-0.696**	**0.272****
GL											**1.000**	-0.041	0.658**	-0.033	0.569**	**0.485****
GB												**1.000**	-0.750**	0.448**	0.216**	**0.483****
L/B													**1.000**	-0.354**	0.079	**-0.166***
BYP														**1.000**	-0.292**	**0.677****
HI															**1.000**	**0.475****
GYP																**1.000**

*****: Significance at p = 0.05 level; ******: Significance at p = 0.01 level

DFF - Days to 50% flowering, **DM** - Days to maturity, **PH** - Plant height (cm), **NPT** - Number of productive tillers per plant, **PL** - Panicle length (cm), **TGP** - Total grains per panicle, **FGP** - Filled grains per panicle, **SF** - Spikelet fertility (%), **TW** – 1000 grain weight (g), **GYP** - Grain yield per plant (g), **SYP** - Straw yield per plant (g), **GL** - Grain length (mm), **GB** - Grain breadth (mm), **L/B** – Grain L/B ratio, **BYP** - Biological yield per plant (g), **HI** - Harvest index (%).

Table 3: Estimates of phenotypic correlation coefficients among 16 yield and its attributing traits in 50 genotypes of rice (*Oryza sativa* L.).

	DFF	DM	PH	NPT	PL	TGP	FGP	SF	TW	SYP	GL	GB	L/B	BYP	HI	GYP
DFF	1.000	0.992**	0.482**	-0.043	0.192*	0.085	-0.123	-0.291**	0.039	0.754**	-0.170*	0.350**	-0.393**	0.640**	-0.473**	0.239**
DM		1.000	0.481**	-0.025	0.203*	0.083	-0.122	-0.285**	0.041	0.756**	-0.183*	0.365**	-0.417**	0.653**	-0.465**	0.253**
PH			1.000	0.298**	0.423**	0.061	-0.095	-0.218**	0.188*	0.455**	-0.001	0.355**	-0.302**	0.501**	-0.168*	0.357**
NPT				1.000	0.305**	0.019	-0.058	-0.232**	0.128	0.167*	0.108	-0.084	0.218**	0.289**	0.060	0.355**
PL					1.000	0.054	0.090	-0.047	0.172*	0.254**	0.055	0.082	-0.064	0.302**	-0.073	0.255**
TGP						1.000	0.188*	-0.005	-0.078	0.125	-0.045	0.016	-0.072	0.171*	0.001	0.152
FGP							1.000	0.182*	-0.111	0.122	0.025	-0.005	-0.091	0.125	-0.016	0.057
SF								1.000	0.295**	-0.256**	0.205*	0.028	0.068	-0.165*	0.285**	0.026
TW									1.000	-0.073	0.472**	0.402**	0.108	0.186*	0.447**	0.485**
SYP										1.000	-0.191*	0.216**	-0.293**	0.850**	-0.678**	0.280**
GL											1.000	-0.026	0.439**	-0.045	0.340**	0.262**
GB												1.000	-0.758**	0.396**	0.171*	0.417**
L/B													1.000	-0.315**	0.099	-0.133
BYP														1.000	-0.260**	0.661**
HI															1.000	0.487**
GYP																1.000

*****: Significance at p = 0.05 level; ******: Significance at p = 0.01 level

DFF - Days to 50% flowering, **DM** - Days to maturity, **PH** - Plant height (cm), **NPT** - Number of productive tillers per plant, **PL** - Panicle length (cm), **TGP** - Total grains per panicle, **FGP** - Filled grains per panicle, **SF** - Spikelet fertility (%), **TW** – 1000 grain weight (g), **GYP** - Grain yield per plant (g), **SYP** - Straw yield per plant (g), **GL** - Grain length (mm), **GB** - Grain breadth (mm), **L/B** – Grain L/B ratio, **BYP** - Biological yield per plant (g), **HI** - Harvest index (%).

Table 4: Direct and indirect effects (genotypic) among 16 yield and its components in 50 genotypes of rice (*Oryza sativa* L.).

	DFF	DM	PH	NPT	PL	TGP	FGP	SF	TW	SYP	GL	GB	L/B	BYP	HI	GYP
DFF	**-2.314**	2.402	0.061	0.006	0.023	-0.016	-0.002	0.008	-0.009	0.427	0.024	0.085	-0.218	0.370	-0.581	**0.266****
DM	-2.310	**2.405**	0.062	0.003	0.024	-0.016	-0.002	0.008	-0.010	0.430	0.025	0.089	-0.231	0.379	-0.570	**0.286****
PH	-1.163	1.222	**0.122**	-0.039	0.047	-0.013	-0.001	0.006	-0.049	0.251	0.001	0.088	-0.175	0.283	-0.211	**0.368****
NPT	0.106	-0.065	0.037	**-0.126**	0.038	-0.003	-0.001	0.007	-0.033	0.080	-0.021	-0.022	0.132	0.143	0.059	**0.331****
PL	-0.553	0.597	0.058	-0.049	**0.098**	-0.027	0.001	0.002	-0.049	0.155	-0.007	0.014	-0.027	0.192	-0.121	**0.286****
TGP	-0.488	0.506	0.020	-0.005	0.034	**-0.078**	0.007	0.003	0.064	0.190	0.021	-0.004	-0.063	0.242	0.043	**0.492****
FGP	0.289	-0.300	-0.012	0.008	0.011	-0.042	**0.012**	-0.005	0.029	0.068	-0.002	-0.001	-0.051	0.076	-0.013	**0.068**
SF	0.736	-0.759	-0.028	0.034	-0.008	0.009	0.002	**-0.025**	-0.081	-0.151	-0.024	0.006	0.041	-0.091	0.374	**0.038**
TW	-0.086	0.101	0.024	-0.017	0.019	0.021	-0.001	-0.008	**-0.246**	-0.041	-0.067	0.097	0.065	0.109	0.557	**0.527****
SYP	-1.823	1.911	0.056	-0.019	0.028	-0.027	0.002	0.007	0.019	**0.542**	0.026	0.050	-0.162	0.472	-0.810	**0.272****
GL	0.586	-0.649	-0.001	-0.028	0.008	0.018	0.000	-0.006	-0.177	-0.152	**-0.093**	-0.009	0.344	-0.018	0.663	**0.485****
GB	-0.907	0.985	0.049	0.013	0.006	0.001	0.000	-0.001	-0.109	0.124	0.004	**0.217**	-0.392	0.241	0.251	**0.483****
L/B	0.965	-1.063	-0.041	-0.032	-0.005	0.009	-0.001	-0.002	-0.031	-0.168	-0.061	-0.163	**0.523**	-0.191	0.092	**-0.166***
BYP	-1.591	1.693	0.064	-0.033	0.035	-0.035	0.002	0.004	-0.050	0.476	0.003	0.097	-0.185	**0.538**	-0.340	**0.677****
HI	1.154	-1.177	-0.022	-0.006	-0.010	-0.003	0.000	-0.008	-0.117	-0.377	-0.053	0.047	0.041	-0.157	**1.164**	**0.475****

Residual Effect = 0.02694 *: Significance at p = 0.05 level; **: Significance at p = 0.01 level

DFF - Days to 50% flowering, **DM** - Days to maturity, **PH** - Plant height (cm), **NPT** - Number of productive tillers per plant, **PL** - Panicle length (cm), **TGP** - Total grains per panicle, **FGP** - Filled grains per panicle, **SF** - Spikelet fertility (%), **TW** – 1000 grain weight (g), **GYP** - Grain yield per plant (g), **SYP** - Straw yield per plant (g), **GL** - Grain length (mm), **GB** - Grain breadth (mm), **L/B** – Grain L/B ratio, **BYP** - Biological yield per plant (g), **HI** - Harvest index (%).

Table 5: Direct and indirect effects (phenotypic) among 16 yield and its components in 50 genotypes of rice (*Oryza sativa* L.).

	DFF	DM	PH	NPT	PL	TGP	FGP	SF	TW	SYP	GL	GB	L/B	BYP	HI	GYP
DFF	**-0.076**	0.042	0.022	-0.001	0.008	0.001	0.007	0.004	-0.002	0.642	-0.006	0.013	-0.036	0.150	-0.530	**0.239****
DM	-0.075	**0.043**	0.022	-0.001	0.009	0.001	0.007	0.004	-0.002	0.644	-0.007	0.013	-0.038	0.153	-0.521	**0.253****
PH	-0.037	0.021	**0.046**	0.008	0.018	0.001	0.006	0.003	-0.011	0.388	0.000	0.013	-0.028	0.117	-0.188	**0.357****
NPT	0.003	-0.001	0.014	**0.028**	0.013	0.000	0.003	0.003	-0.007	0.143	0.004	-0.003	0.020	0.068	0.067	**0.355****
PL	-0.015	0.009	0.019	0.008	**0.043**	0.001	-0.005	0.001	-0.010	0.216	0.002	0.003	-0.006	0.071	-0.082	**0.255****
TGP	-0.006	0.004	0.003	0.001	0.002	**0.016**	-0.011	0.000	0.005	0.106	-0.002	0.001	-0.007	0.040	0.001	**0.152**
FGP	0.009	-0.005	-0.004	-0.002	0.004	0.003	**-0.060**	-0.003	0.006	0.104	0.001	0.000	-0.008	0.029	-0.018	**0.057**
SF	0.022	-0.012	-0.010	-0.006	-0.002	0.000	-0.011	**-0.015**	-0.017	-0.218	0.008	0.001	0.006	-0.039	0.320	**0.026**
TW	-0.003	0.002	0.009	0.004	0.007	-0.001	0.007	-0.004	**-0.058**	-0.063	0.017	0.014	0.010	0.044	0.501	**0.485****
SYP	-0.057	0.032	0.021	0.005	0.011	0.002	-0.007	0.004	0.004	**0.852**	-0.007	0.008	-0.027	0.199	-0.759	**0.280****
GL	0.013	-0.008	0.000	0.003	0.002	-0.001	-0.001	-0.003	-0.027	-0.163	**0.037**	-0.001	0.040	-0.011	0.381	**0.262****
GB	-0.027	0.016	0.016	-0.002	0.004	0.000	0.000	0.000	-0.023	0.184	-0.001	**0.036**	-0.069	0.093	0.191	**0.417****
L/B	0.030	-0.018	-0.014	0.006	-0.003	-0.001	0.005	-0.001	-0.006	-0.249	0.016	-0.027	**0.091**	-0.074	0.111	**-0.133**
BYP	-0.048	0.028	0.023	0.008	0.013	0.003	-0.007	0.002	-0.011	0.724	-0.002	0.014	-0.029	**0.234**	-0.292	**0.661****
HI	0.036	-0.020	-0.008	0.002	-0.003	0.000	0.001	-0.004	-0.026	-0.577	0.013	0.006	0.009	-0.061	**1.120**	**0.487****

Residual Effect = 0.04741   *****: Significance at p = 0.05 level; ******: Significance at p = 0.01 level

DFF - Days to 50% flowering, **DM** - Days to maturity, **PH** - Plant height (cm), **NPT** - Number of productive tillers per plant, **PL** - Panicle length (cm), **TGP** - Total grains per panicle, **FGP** - Filled grains per panicle, **SF** - Spikelet fertility (%), **TW** – 1000 grain weight (g), **GYP** - Grain yield per plant (g), **SYP** - Straw yield per plant (g), **GL** - Grain length (mm), **GB** - Grain breadth (mm), **L/B** – Grain L/B ratio, **BYP** - Biological yield per plant (g), **HI** - Harvest index (%).

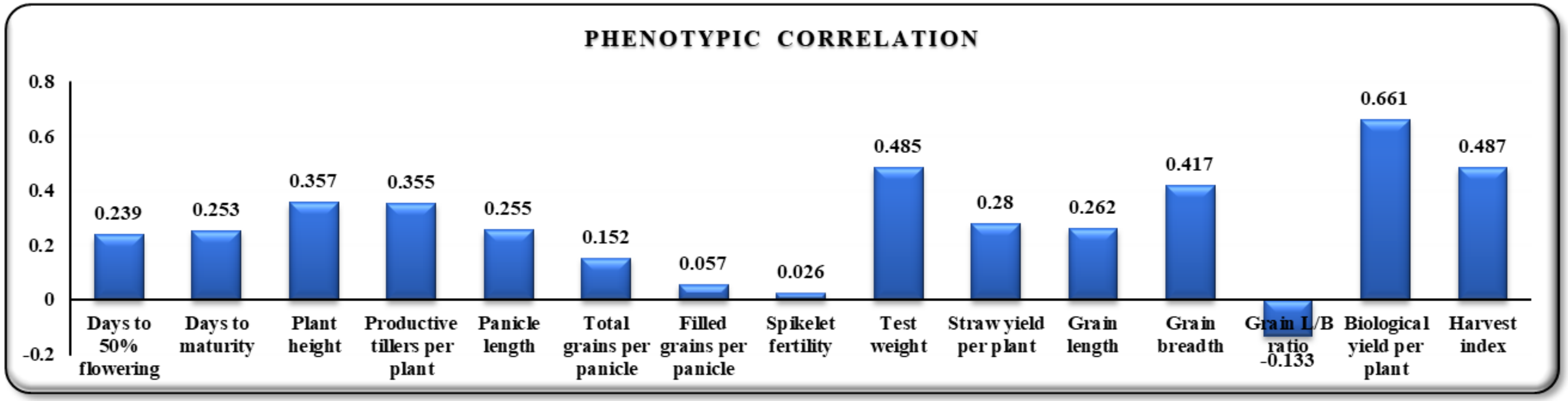

Fig 1. Graph representing significant relationship between grain yield and other characters at phenotypic level.

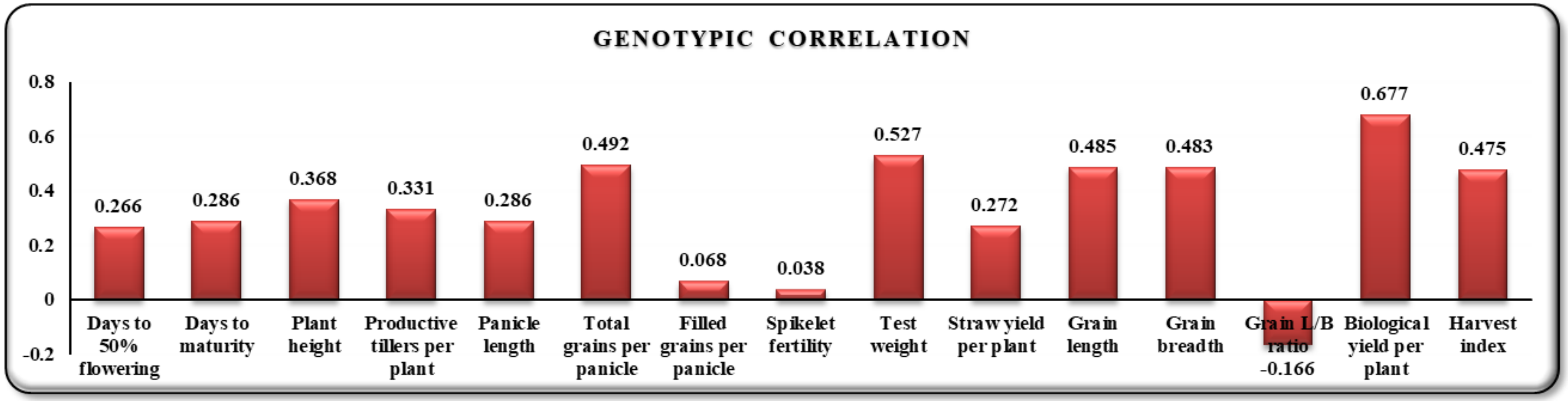

Fig 2. Graph representing significant relationship between grain yield and other characters at genotypic level.

REFERENCES

Ahmed, A. N., Sarma, M. K., Bhuyan, J., Deka, S. D., Choudhury, H., Zaman, S. and Sharma, A. A. (2021). Genetic variability and character associations in rice cultivars of north bank plain zone of Assam for traits associated with adaptation under moisture stress and grain yield. *Biological Forum – An International Journal, 13*(1), 446-451.

Akter, N., Khalequzzaman, M., Islam, M. Z., Mamun, M. A. A. and Chowdhury, M. A. Z. (2018). Genetic variability and character association of quantitative traits in jhum rice genotypes. *SAARC Journal of Agriculture, 16*(1), 193-203.

Anis, G., Sabagh, A. E., Ghareb, A. and Rewainy, I. E. L. (2016). Evaluation of promising lines in rice (*Oryza sativa* L.) to agronomic and genetic performance under Egyptian conditions. *International Journal of Agronomy and Agricultural Research, 8*(3), 52-57.

Archana, R. S., Sudha, M., Vishnu, V. and Fareeda, G. (2018). Correlation and path coefficient analysis for grain yield, yield components and nutritional traits in rice (*Oryza sativa* L.). *International Journal of Chemical Studies, 6*(4), 189-195.

Bhutta, M. A., Munir, S. A. N. A., Qureshi, M. K., Shahzad, A. N., Aslam, K. A. S. H. I. F., Manzoor, H. and Shabir, G. (2019). Correlation and path analysis of morphological parameters contributing to yield in rice (*Oryza sativa*) under drought stress. *Pakisthan Journal of Botany, 51*(1), 73-80.

Central Rice Research Institute (CRRI) - *Indian Council of Agricultural Research.* Cuttack (Odisha). - VISION - 2050. http://www.crri.nic.in/ebookcrrivision2050. Final 16 Jan 2013.

Dewey, D. R. and Lu, K. (1959). A correlation and path-coefficient analysis of components of crested wheatgrass seed production. *Agronomy Journal, 51*(9), 515-518.

Dhurai, S. Y., Reddy, D. M. and Bhati, P. K. (2014). Correlation and path coefficient analysis for yield and quality traits under organic fertilizer management in rice (*Oryza sativa* L.). *Electronic Journal of Plant Breeding, 5*(3), 581-587.

FAO - Food and Agriculture Organization of the United Nations (2016) FAO Rice Market Monitor: FAO. https://www.fao.org/markets-and-trade/commodities/rice/en/. Accessed 08 Jan 2022.

Faysal, A. S. M., Ali, L., Azam, M. G., Sarker, U., Ercisli, S., Golokhvast, K. S. and Marc, R. A. (2022). Genetic variability, character association and path coefficient analysis in transplant Aman rice genotypes. *Plants, 11*(21), 1-15.

Gupta, S., Upadhyay, S., Koli, G. K., Rathi, S. R., Bisen, P., Loitongbam, B., Singh, P. K. and Sinha, B. (2020). Trait association and path analysis studies of yield attributing traits in rice (*Oryza sativa* L.) germplasm. *International Journal of Bio-resource and Stress Management, 11*(6), 508-517.

Hossain, M. S., Ivy, N. A., Raihan, M. S., Kayesh, E. and Maniruzzaman, S. (2020). Genetic variability, correlation and path analysis of floral, yield and its component traits of maintainer lines of rice (*Oryza sativa* L.). *Bangladesh Rice Journal, 24*(1), 1-9.

Islam, M. Z., Mian, M. A. K., Ivy, N. A., Akter, N. and Rahman, M. M. (2019). Genetic variability, correlation and path analysis for yield and its component traits in restorer lines of rice. *Bangladesh Journal of Agricultural Research, 44*(2), 291-301.

Johnson, H. W., Robinson, H. F. and Comstock, R. E. (1955). Genotypic and phenotypic correlations in soybeans and their implications in selection. *Agronomy Journal, 47*(10), 477-483.

Katiyar, D., Srivastava, K. K., Prakash, S., Kumar, M. and Gupta, M. (2019). Study correlation coefficients and path analysis for yield and its component characters in rice (*Oryza sativa* L.). *Journal of Pharmacognosy and Phytochemistry, 8*(1), 1783-1787.

Kumari, N. and Parmar, M. B. (2020). Correlation and path coefficient analysis for grain yield and yield components in rice (*Oryza sativa* L.) under aerobic condition. *International Journal of Chemical Studies, 8*(2), 927-930.

Lakshmi, M. S., Suneetha, Y. and Srinivas, T. (2021). Genetic variability, correlation and path analysis for grain yield and yield components in rice genotypes. *Journal of Pharmacognosy and Phytochemistry, 10*(1), 1369-1372.

Lalitha, R., Mothilal, A., Arunachalam, P., Senthil, N. and Hemalatha, G. (2019). Genetic variability, correlation and path analysis of grain yield, grain quality and its associated traits in EMS derived M_4 generation mutants of rice (*Oryza sativa* L.). *Electronic Journal of Plant Breeding, 10*(3), 1140-1147.

Lohiteswararao, R. V., Kumar, P., Sravani, P., Raju, K. K. and Gogada, R. (2021). Correlation and path analysis of grain yield and its attributes of traditional rice (*Oryza sativa* L.) genotypes. *The Pharma Innovation, 10*(12), 1055-1058.

Manivelan, K., Juliet Hepziba, S., Suresh, R., Theradimani, M., Renuka, R. and Gnanamalar, R. P. (2022). Inherent variability, correlation and path analysis in lowland rice (*Oryza sativa* L.). *Biological Forum – An International Journal, 14*(2), 771-778.

Mathew, A., Lavanya, G. R. and Kumar, R. (2022). Variability, correlation and path analysis for grain yield characters of rice (*Oryza sativa* L.) genotypes. *International Journal of Environment and Climate Change, 12*(11), 1258-1267.

Moosavi, M., Ranjbar, G., Zarrini, H. N. and Gilani, A. (2015). Correlation between morphological and physiological traits and path analysis of grain yield in rice genotypes under Khuzestan conditions. *Biological Forum – An International Journal, 7*(1), 43-47.

Mukesh, M., Vidyabhushan, J., Anand, K., Mankesh, K. and Shweta, K. (2018). Correlation and path coefficient analysis in rice (*Oryza sativa* L.) genotypes for yield and its attributing traits. *Journal of Pharmacognosy and Phytochemistry, 7*(4), 285-290.

Muthuramu, S. and Ragavan, T. (2020). Genotypic correlation and path coefficient analysis for yield traits in rainfed rice (*Oryza sativa* L.). *Journal of Pharmacognosy and Phytochemistry, 9*(2), 1621-1623.

Pratap, N., Singh, P. K., Shekhar, R., Soni, S. K. and Mall, A. K. (2012). Genetic variability, character association and diversity analyses for economic traits in rice (*Oryza sativa* L.). *SAARC Journal of Agriculture, 10*(2), 83-94.

Premkumar, R., Gnanamalar, R. P. and CR, A. (2015). Correlation and path coefficient analysis among grain yield and kernel characters in rice (*Oryza sativa* L.). *Electronic Journal of Plant Breeding, 6*(1), 288-291.

Rao, S., Rao, S., Ahamed, L., Babu, R. and Rama Rao, G. (2020). Character association and path analysis of yield and yield component traits in rice (*Oryza sativa* L.). *The Andhra Agricultural Journal, 67*(4), 288–296.

Sadhana, P., Raju, C. D., Rao, L. V. and Kuna, A. (2022). Studies on variability, correlation and path coefficient analysis for yield and quality traits in rice (*Oryza sativa* L.) genotypes. *Electronic Journal of Plant Breeding*, *13*(2), 670-678.

Sahu, S., Sharma, D., Sao, R. and Rao, G. V. (2019). Association analysis of yield and yield contributing traits in traditional varieties of rice (*Oryza sativa* L.). *International Journal of Chemical Studies, 7*(6), 848-852.

Sarangi, D. N., Senapati, B. K., Pradhan, B., Kar, R. K., Mohanty, M. R. and Das, S. (2022). Character association and path analysis for yield, iron content and component traits in indigenous rice germplasm. *Biological Forum – An International Journal, 14*(4), 701-704.

Seyoum, M., Alamerew, S. and Bantte, K. (2012). Genetic variability, heritability, correlation coefficient and path analysis for yield and yield related traits in upland rice (*Oryza sativa* L.). *Journal of plant sciences, 7*(1), 13-22.

Tiwari, D. N., Tripathi, S. R., Tripathi, M. P., Khatri, N. and Bastola, B. R. (2019). Genetic variability and correlation coefficients of major traits in early maturing rice under rainfed lowland environments of Nepal. *Advances in Agriculture,* 2019*,* 1-9.

Wright, S. (1921). Correlation and causation. *Journal of Agricultural Research*, *20*, 557-585.

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