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CHARACTER ASSOCIATION STUDIES AND PATH COEFFICIENT ANALYSIS OF AGRO-MORPHOLOGICAL TRAITS IN LANDRACES OF RICE IN BIHAR

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ABSTRACT

The study aimed to investigate the correlation between various traits and grain yield per plant, as well as to pinpoint the specific traits that directly or indirectly influence yield. It was conducted at the Rice Breeding Section in Pusa, Samastipur during the kharif season of 2018, spanning from June 26 to December 28. Twenty-three landraces of rice were planted using a Randomized Complete Block Design (R.C.B.D.) with three replications. Days to fifty percent flowering showed a positive relationship with days to maturity, plant height, stem thickness, panicle length of main axis, root volume, and panicle number per plant. The width of leaf blade, 1000 grain weight, and grain width showed non-significant and positive relationships with days to maturity. Plant height showed critical and positive relationship with panicle length of main axis, 1000 grain weight, root volume, whereas it showed significant and negative correlation with no. of panicle per plant. Stem thickness showed non-significant and positive relationship with root volume, though it showed critical and negative connection with number of panicles per plant. Panicle length of main axis showed significant and positive relationship with length of leaf blade, while it showed significant and negative correlation with grain length and decorticated grain length. The 1000 grain weight showed non-significant and negative relationship with number of panicles per plant.
***Keywords* :** Correlation, R.C.B.D., replication.

Introduction

Rice, scientifically known as *Oryza sativa*, holds immense cultural, historical, and economic significance in various regions across the world, particularly in Asia. The rice crop plays a significant role in the global food supply, particularly in Asia, its history of origin, domestication, and evolutionary genetics remain elusive (Gatto *et al.*, 2021 and Lu *et al.*, 2022). D. Chatterjee's classification of the genus *Oryza* indicates that rice has a diverse genetic heritage, with numerous wild species alongside the two cultivated ones, *Oryza sativa* and *Oryza glaberrima*. In India, rice is often referred to as 'Prana,' symbolizing its vital role as a staple food and its deep cultural importance. Similarly, in Japan and other Asian countries, rice holds metaphorical significance, representing aspects of identity and self. The global importance of rice cannot be overstated. It is the primary food for a significant portion of the world's population, providing crucial calories and nutrients. With over 90% of rice production and consumption occurring in Asia, countries like China and India play pivotal roles in its cultivation and supply. Rice cultivation extends beyond Asia, with significant production also occurring in Africa and Latin America. While North America, Europe, and Australia contribute to rice production, their output is comparatively limited due to factors such as climate and agricultural practices. The primary rice-producing states in India include West Bengal, Uttar Pradesh, Punjab, Andhra Pradesh, Odisha, Bihar, Tamil Nadu, and Madhya Pradesh. Globally, rice is cultivated across 167.1 million hectares, yielding a production of 782 million tonnes and a productivity of 4678 kg per hectare. In India specifically, rice is cultivated over

46.15 million hectares, resulting in a production of 116.47 million tonnes and a productivity of 2638 kg per hectare (Deepika *et al.,* 2023). Overall, rice stands as the single most important food crop globally, shaping landscapes, cultures, and economies across continents and serving as a cornerstone of food security for millions of people.

Indeed, landraces and wild species of rice carry a wealth of genetic diversity that can be harnessed for modern breeding programs. These genetic resources contain valuable genes for traits such as high yield potential, improved quality, and resistance to various biotic and abiotic stresses, including diseases, pests, drought, and salinity. By incorporating genes from landraces and wild species into breeding programs, researchers can develop new rice varieties with enhanced traits, leading to increased productivity, sustainability, and resilience in agricultural systems. This approach allows breeders to address the challenges posed by changing environmental conditions, pests, and diseases while also meeting the demands of a growing global population. Through careful selection and hybridization, breeders can introduce desirable traits from landraces and wild species into elite rice cultivars, creating improved varieties that exhibit a broader genetic base and improved adaptability to diverse environments. This process, often referred to as "genetic enhancement" or "genetic improvement," plays a crucial role in ensuring food security and agricultural sustainability in the face of ongoing environmental and socio-economic changes. The work of researchers like Saxena *et al.,* (1988) underscores the importance of preserving and utilizing genetic diversity in rice to develop innovative solutions for the challenges facing agriculture today. By tapping into the genetic potential of landraces and wild species, breeders can continue to evolve rice varieties that not only meet the needs of farmers and consumers but also contribute to the long-term resilience and sustainability of agricultural systems worldwide.

Material and Methods

The research work was conducted at the Rice Breeding Section, Pusa Farm, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, during the kharif season of 2018, from June 26 to December 28. The geographical coordinates of the university farm are approximately 25.98°N latitude and 85.67°E longitude, with an elevation of 51.8 meters above mean sea level.

Twenty-three landraces of rice (Table 1) were selected for the investigation, and the experimental design followed was Randomized Complete Block Design (RCBD) with three replications. The rice seedlings were initially raised in nursery seedbeds for 25 days and then manually transplanted into puddled plots prepared for sowing. Standard spacing of 20 x 15 cm was maintained, and all recommended package of practices were followed during the growth period. Observations were recorded randomly from five plants within each replication for fifteen traits(DFF=Days to 50% flowering, DTM=Days to maturity, PH=Plant height, ST=Stem thickness, PLM=Panicle length of main axis (cm), PPP=No. of panicles per plant, LLB=Length of leaf blade(cm), WLB=Width of leaf blade(cm), GW=1000-grain weight ,GL=Grain length, GWI=Grain width, DGL=Decorticated grain length (mm), DGW=Decorticated grain width(mm), RV=Root volume (mm^3), GY/P= Grain yield Per plant). Measurements were taken according to the guidelines provided by the Indian Institute of Rice Research, Hyderabad. Root volume was measured using the water displacement method, while other measurements were taken using measuring tape, measuring scales, and graph papers for grain length. Correlation coefficient estimates were calculated according to standard method (Al-jibouri, 1958) and path analysis was conducted according to method of Dewey and Lu, 1958. This comprehensive approach to data collection and analysis allows for a thorough evaluation of the selected rice cultivars' performance and characteristics, providing valuable insights for further breeding and agricultural research.

Table 1 : List of genotypes.

S.No.	Genotype	Source
1	PUSA SUGANDHA -2	IARI, PUSA
2	RAJBHOG	RAU, PUSA
3	KARAHANI	RAU, PUSA
4	KARIYWA	RAU, PUSA
5	DIHAWAN	RAU, PUSA
6	MOTI	RAU, PUSA
7	SUGAPANKHI	RAU, PUSA
8	JADHAN	RAU, PUSA
9	LALKA DHAN	RAU, PUSA
10	DUDHA LADU	RAU, PUSA
11	JASWA-3	IGKV, RAIPUR
12	PARWA PANKHI	IGKV, RAIPUR
13	KANKIRBI	RAU, PUSA
14	CSR-30	CSIR, KARNAL
15	SUGANDHA	RAU, PUSA
16	KASTURI	BAU, SABOUR
17	LALMATI	BAU, RANCHI
18	BASMATI-570	PAU, LUDHIANA
19	MARCHA-1	RAU, PUSA
20	MARCHA -2	RAU, PUSA
21	TARORI BASMATI	IARI, PUSA
22	SATHI-1	RAU, PUSA
23	SATHI-2	RAU, PUSA

Table 2: Correlation Matrix of 15 traits

Sl. No.	Character	DFF	DTM	PH (cm)	ST (mm)	PLM	PPP	LLB (cm)	WLB (cm)	GW (g)	GL (mm)	GWI (mm)	DGL (mm)	DGW (mm)	RV (mm^3)	GY/P
1.	DFF	1.000														
2.	DTM	0.947**	1.000													
3.	PH (cm)	0.647**	0.642**	1.000												
4.	ST (mm)	0.429**	0.399**	0.166	1.000											
5.	PLM	0.417**	0.349**	0.268*	0.147	1.000										
6.	PPP	-0.584**	-0.572**	-0.529**	-0.408**	-0.210	1.000									
7.	LLB (cm)	-0.073	-0.174	0.022	-0.155	0.624**	0.108	1.000								
8.	WLB (cm)	0.121	0.110	0.104	-0.126	0.370**	0.042	0.321**	1.000							
9.	GW (g)	0.108	0.154	0.296*	-0.070	0.034	0.115	-0.017	0.161	1.000						
10.	GL (mm)	-0.140	-0.082	-0.054	-0.092	-0.444**	0.220	-0.438**	0.050	0.531**	1.000					
11.	GWI (mm)	0.103	0.134	0.027	0.230	-0.074	0.021	-0.208	-0.301*	0.209	0.044	1.000				
12.	DGL (mm)	-0.144	-0.106	-0.112	-0.093	-0.450**	0.220	-0.456**	0.050	0.474**	0.904**	0.094	1.000			
13.	DGW (mm)	-0.017	-0.003	-0.045	0.180	0.073	0.014	-0.134	-0.232	-0.050	-0.263*	0.438**	-0.222	1.000		
14.	RV (mm^3)	0.803**	0.832**	0.739**	0.300*	0.381**	-0.512**	-0.006	0.314**	0.184	-0.115	0.023	-0.138	-0.049	1.000	
15.	GY/P (g)	-0.080	-0.060	-0.388**	0.010	0.097	0.473**	0.152	0.285*	0.282*	0.173	0.203	0.202	0.132	-0.090	1.000

** Significant at 1% level * significant at 5% level

DFF=Days to 50% flowering, DTM=Days to maturity, PH=Plant height, ST=Stem thickness, PLM=Panicle length of main axis(cm), PPP=No. of panicles per plant, LLB=Length of leaf blade(cm), WLB=Width of leaf blade(cm), GW=1000-grain weight, GL=Grain length, GWI=Grain width, DGL=Decorticated grain length(mm), DGW=Decorticated grain width(mm),RV=Root volume(mm^3), GY/P= Grain yield Per plant

Table 2, shows correlation among different traits. Days to maturity (0.947**) showed high positive correlation with Days to fifty percent flowering. Plant height showed significant correlation with Days to fifty percent flowering (0.647**) and Days to maturity (0.642**). Stem thickness showed high positive correlation with Days to fifty percent flowering (0.429**). Panicle length of main axis showed positive, highly significant correlation with Days to fifty percent flowering (0.417**) and Days to maturity (0.349**). Number of panicles per plant showed highly significant negative correlation with Days to fifty percent flowering (-0.584**), Days to maturity (-0.572**), Plant Height (-0.529**) and Stem thickness (-0.408**). Length of leaf blade showed highly significant correlation with panicle length of main axis (0.624**). Width of leaf blade showed positive and significant correlation with panicle length of main axis (0.370**) and length of leaf blade (0.321**). Grain length showed significant negative correlation with panicle length of main axis (-0.444**) and length of leaf blade (-0.438**) and positive correlation with grain width (0.570**). Decorticated grain length was highly correlated with grain length (0.904**), root volume showed highly significant correlation with days to 50% flowering (0.803**), Days to maturity (0.832**) and plant height (0.739**). Grain yield showed high positive correlation with No. of panicle per plant (0.473**) and significant negative correlation with plant height (-0.388**). This result is in confirmation with the findings of Madhvilatha *et al.* (2005); Muthuswamy and Anadakumar (2006) and Rashid *et al.* (2014), Ambili and Radhakrishnan (2011) and Girish *et al.* (2006).

Table 3 : Path Coefficient for Different Traits

Sl. No.	Character	DFF	DTM	PH (cm)	ST (mm)	PLM	PPP	LLB (cm)	WLB (cm)	GW (g)	GL (mm)	GWI (mm)	DGL (mm)	DGW (mm)	RV (mm^3)
1.	DFF	**0.054**	0.051	0.035	0.023	0.023	-0.032	-0.004	0.007	0.006	-0.008	0.006	-0.008	-0.001	0.043
2.	DTM	0.405	**0.428****	0.274	0.170	0.149	-0.244	-0.074	0.047	0.066	-0.035	0.057	-0.045	-0.001	0.356
3.	PH (cm)	-0.415	-0.411	**-0.641**	-0.106	-0.172	0.339	-0.014	-0.066	-0.189	0.035	-0.017	0.072	0.029	-0.473
4.	ST (mm)	0.051	0.048	0.020	**0.119**	0.018	-0.049	-0.018	-0.015	-0.008	-0.011	0.027	-0.011	0.022	0.036
5.	PLM	-0.058	-0.049	-0.037	-0.021	**-0.140**	0.029	-0.087	-0.052	-0.005	0.062	0.010	0.063	-0.010	-0.053
6.	PPP	-0.217	-0.213	-0.197	-0.152	-0.078	**0.372**	0.040	0.016	0.043	0.082	0.008	0.082	0.005	-0.191
7.	LLB (cm)	-0.025	-0.059	0.008	-0.053	0.212	0.037	**0.340***	0.109	-0.006	-0.149	-0.071	-0.155	-0.045	-0.002
8.	WLB (cm)	0.029	0.026	0.025	-0.030	0.088	0.010	0.077	**0.239**	0.039	0.012	-0.072	0.012	-0.055	0.075
9.	GW (g)	0.027	0.039	0.074	-0.018	0.009	0.029	-0.004	0.040	**0.250**	**0.133**	0.052	0.119	-0.013	0.046
10.	GL (mm)	0.001	0.000	0.000	0.000	0.002	-0.001	0.002	0.000	-0.002	**-0.003**	0.000	-0.003	0.001	0.000
11.	GWI (mm)	0.011	0.014	0.003	0.025	-0.008	0.002	-0.022	-0.032	0.022	0.005	**0.107**	0.010	0.047	0.003
12.	DGL (mm)	-0.018	-0.013	-0.014	-0.011	-0.055	0.027	-0.056	0.006	0.058	0.111	0.012	**0.123**	-0.027	-0.017
13.	DGW (mm)	-0.003	-0.001	-0.009	0.034	0.014	0.003	-0.025	-0.043	-0.009	-0.049	0.082	-0.042	**0.187**	-0.009
14.	RV (mm^3)	0.078	0.081	0.072	0.029	0.037	-0.050	-0.001	0.030	0.018	-0.011	0.002	-0.013	-0.005	**0.097**
15.	GY/P (g)	-0.080	-0.060	-0.388**	0.010	0.097	0.473**	0.152	0.285*	0.282*	0.173	0.203	0.202	0.132	-0.090

** Significant at 1% level * significant at 5% level

DFF=Days to 50% flowering, DTM=Days to maturity, PH=Plant height, ST=Stem thickness, PLM=Panicle length of main axis(cm), PPP=No. of panicles per plant, LLB=Length of leaf blade(cm), WLB=Width of leaf blade(cm), GW=1000-grain weight, GL=Grain length, GWI=Grain width, DGL=Decorticated grain length(mm), DGW= Decorticated grain width(mm),RV=Root volume (mm^3), GY/P= Grain yield Per plant

Table-3, shows path coefficient values of different traits. Days to 50% flowering had low direct effect (0.054) on yield and significant indirect effect via days to maturity (0.405) on yield. Days to maturity had significant direct effect on yield (0.428) and negative indirect effect via plant height (-0.411). plant height (-0.641) had negative direct effect on yield. Stem thickness (0.119) has non-significant direct positive effect on yield, whereas panicle length of main axis (-0.140) had negative direct effect on yield. Number of panicles per plant (0.372) had positive direct effect on yield and positive indirect on yield via plant height (0.339). length of leaf blade (0.034) had positive direct effect on yield. Grain width (0.250) had positive significant effect on yield. Grain length had negative and non-significant direct effect on grain yield per plant, but indirect positive effect via grain width (0.133) and decorticated grain length (0.111), grain width had non-significant direct effect on grain yield per plant and indirect via different traits were non-significant. Decorticated grain length (0.123) showed direct positive effect and decorticated grain width (0.187) had direct positive effect on grain yield but was non-significant. Root volume (0.097) had low direct effect on grain yield per plant. Above findings were in accordance with findings of Ambili *et al.* (2011), Selvraj *et al*. (2011), Mahto *et al.* (2003), Chandan and Nilanjaya (2014).

Conclusion

Correlation table depicts the association between two variables. Study showed that genotypic correlation was greater than phenotypic correlation indicating inherent association between characters. It indicated that panicle number per plant, width of leaf blade and 1000 grain weight showed significant positive association with grain yield per plant and significant negative association for plant height. Hence, selection for any one of these characters would bring in simultaneous improvement of other characters and finally improvement in grain yield.

Path coefficients analysis involving the direct and indirect effect of components traits on grain yield per plant. Path coefficient analysis was carried out by using simple correlation coefficient. It revealed that very high positive direct effect was exhibited by days to 50% flowering, length of leaf blade,1000 grain weight, grain length, root volume and decorticated grain length and very high negative direct effect by days to maturity, plant height, stem thickness, panicle length of main axis, decorticated grain length. Hence, selection based on these characters would be more effective for yield improvement.

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