

Assessment of Correlation of Morphological, Panicle, and Physiological Traits with Seed Yield in Rice (*Oryza sativa* L.)

ABSTRACT

Thirty-six rice varieties were evaluated at the instructional farm, College of Agriculture, IGKV, Raipur (C.G.) during (the year) ... delete 2021-22 and 2022-23 under the *Khari* season. The correlation studies with different morphological, panicle, and physiological traits were carried out and suggested that traits number of tillers, productive tiller, number of leaves, total dry weight, (SCMR) .. please write the full name value of flag leaf, second leaf, third leaf, net assimilation rate, specific leaf weight, light interception, Harvest index, panicle weight plant⁻¹, total grain panicle⁻¹, fertile grains panicle⁻¹, number of primary branches panicle⁻¹, and number of fertile grains on primary branch content were positively correlated at $p < 0.001$ significant level, while Flag leaf length, angle of top three leaves, specific leaf area, sterile grains panicle⁻¹, number of sterile grains on primary branch, and number of sterile grains on secondary branch were negatively associated with grain yield during both the years. Hence, these traits could be considered the principal traits. Thus, correlation analysis suggested that these parameters are indicators for high-yielding cultivars.

Keywords: -Rice, correlation analysis, plant architecture, growth traits, Yield attributes.

INTRODUCTION

(*Oryza sativa* L.) is one of the most important (essential primary nutritive source) ... replace with (primary nutritional sources) of food grain crops (Li *et al.*, 2021). It is consumed as food by more than 85% ... put (of the) population in the world and 90% of Asia and it belongs to the grass family Poaceae (Kulendra *et al.*, 2020 and Bagri *et al.*, 2022). It is also grown in 115 countries, it is also known as "Global grain" (Singh *et al.*, 2021). About 21 % of calories come from rice crops (and) ... replace with (which) play an essential role in global food security (Mohidem *et al.*, 2022).

In rice leaf orientation patterns, leaves are the main source of photosynthesis and (it plays) ... change to play an important role in crop growth and grain yield.

Mostly the 42-45% flag leaf contribution in rice crop yield as compared to other leaves. (Mahesh *et al.*, 2022). A relatively wide leaf angle and lower leaf orientation value will increase leaf shade and decrease photosynthetic efficiency, whereas plants with a relatively narrow leaf angle and high leaf orientation value will display a plant architecture that is more efficient in capturing light for photosynthesis, improving grain filling, and increasing grain yield (Ku *et al.*, 2010).

Panicle architecture is one of the most important traits related to rice grain yield and affects crop productivity. Panicle length strongly affects panicle architecture. Thus, panicle length is a key factor determining the diversity of panicle architecture in rice (Agata *et al.*, 2020). Panicle branching patterns (that are)...delete mainly regulated by the number of primary and secondary branches directly determine the total grain number. Many high-yielding rice cultivars tend to have longer primary branches and produce more secondary branches than standard varieties. Therefore, **the length of panicle rachis and primary branch** influence total grain number, rice productivity, and branching number (Mohapatra and Sahu, 1991).

Efforts are being made (in the direction of)...replace with (to) breaking the yield barriers (that are)...delete present in rice breeding schemes. Additionally, grain yield is a complicated characteristic (that is)...delete **depends** on a large number of component characteristics viz. morphological, panicle, and physiological and it does not react well to direct selection. (In order)...delete to enhance grain yield, it will be beneficial to (have knowledge regarding)...replace with (know) the relationship (that exists)...delete between grain yield and the characteristics of its constituent parts. For this reason, the current study was carried out (in order)...delete to (gain an)...delete **understand** (of)...delete the relationship between grain production and the characteristics of its constituent parts.

MATERIAL AND METHODS

The thirty-two improved rice cultivars along with four local checks (MTU-1001, Rajeshwari, Swarna, and MTU-1010) i.e. the material used for the study consisted of a total 36 improved rice cultivars under upland irrigated conditions, taken from IGKV, Raipur (C.G.) under the IRRI project. The experiment was conducted under irrigated conditions at the experimental field, and the laboratory analysis was conducted in the Department of Plant Physiology, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Krishak Nagar, Raipur (C.G.) during *Kharif* season 2021-22 and 2022-2023. The experiment was laid out in a Randomized complete block design with two replications. The observations were recorded on different morphological; panicle and physiological traits. These traits were chosen following the standard evaluation system for Rice (IRRI, 1996), and data was subjected to statistical analysis to estimate the correlation of phyllotaxy and panicle architecture with seed yield in rice crops according to Searle (1961). **...please mention all the traits that you depend on them in your study.** Correlation coefficient analysis measures the mutual relationship between various characters at genotypic (g), phenotypic (p), and environmental levels with the help of the formula suggested by Lerner (1958). The schedule of various recommended cultural operations was carried out during the investigation.

RESULT AND DISCUSSION

The correlation coefficient serves as a statistical tool employed to measure the magnitude of the association among two or more variables. It plays a pivotal role in assessing the usefulness of the selection procedure. Consequently, correlation offers valuable insights into the extent of the relationship among various contributing traits.

Association of plant architecture with seed yield attributing traits

The correlation analysis measured the joint relationship between various plant traits and determined the traits on which the selection can be made for improvement in yield under irrigated conditions. The correlations between seed yield and plant architecture traits such as number of tillers (NT), productive tiller (PT), number of leaves (NL), days to 50% flowering (DFF), total dry weight (TDW), flag leaf length (FLL), flag leaf width (FLW), flag leaf area (FLA), leaf area (LA), plant height (PH) were carried out and presented in Table 1.

During year both years, the correlation analysis exhibited that seed yield

was significantly correlated with traits viz., number of tillers (0.695**), productive tiller

UNDER PEER REVIEW

(0.591**), number of leaves (0.695**), and total dry weight (0.887**, 0.909**) with $p < 0.01$ significance level in a positive manner, while; the traits flag leaf length (-0.55**) at the flowering stage were found to be negatively associated with seed yield.

Mohan and Pavithran (2007) found that the ideal number of tillers yielded higher economic yields. Grain yield in cereals can be raised by raising the harvest index, biomass production, or both Yoshida (1981).

Makino *et al.* (2022) also reported that flag leaf length was negatively correlated with seed yield in rice crops. This result was in close agreement with the present study.

Association of seed yield with phyllotaxy and growth traits

Similarly, the correlation analysis was carried out between seed yield and growth characters (Table 2). The data suggested that the seed yield was positively correlated with SCMR value of flag leaf, second leaf, third leaf (0.955**, 0.943**, 0.941** respectively), net assimilation rate (NAR) (0.961**), specific leaf weight (SLW) (0.898**), and light interception (LI) (0.926**) with $p < 0.01$ significance level, whereas; angles of flag leaf (FLA), second leaf (SELA), and third leaf (TLA) (-0.916**, -0.853**, -0.793** respectively), and specific leaf area (SLA) (-0.778**) were also found to be negatively associated with seed yield.

Guru *et al.* (2017) Grain yield, SCMR, and CCI (chlorophyll content index) have all demonstrated a much positive correlation with flag leaf thickness. Higher chlorophyll content per unit area in thicker leaves could be the cause of this, leading to better photosynthesis. Leaf photosynthesis in many crops was found to have a strong positive correlation with SLW, a measure of leaf thickness, according to Bowes *et al.* (1972).

Association of seed yield with panicle architecture traits

Similarly, the correlation analysis was carried out between seed yield and panicle architecture traits. The data suggested that the seed yield was positively correlated with viz., Harvest index (HI) (0.899**), panicle weight plant⁻¹ (PWP) (0.909**), total grain panicle⁻¹ (TGP) (0.619**), fertile grains panicle⁻¹ (FGP) (0.781**), number of primary branches panicle⁻¹ (NPB) (0.643**), and number of fertile grains on primary branch (PFBG) (0.643**) with $p < 0.01$ significance level, while; the traits sterile grains panicle⁻¹ (SGP) (-

0.772**),numberofsterilegrainsonprimarybranch(PBSG)

UNDER PEER REVIEW

(-0.872**), and the number of sterile grains on the secondary branch (SBSG) (-0.569**) were found in association with seed yield (in a negative manner)...replace with (negatively)(Table 3).

A significant positive correlation between the length of panicles and the quantity of tillers in rice cultivars was observed by Kumar (1992). Grain yield in cereals can be raised by raising the harvest index, biomass production, or both Yoshida (1981). Gautam *et al.* (2023) investigated that between the number of spikelets and the length of the secondary branches, there is no discernible correlation. Ashrafuzzaman *et al.* (2009) reported that the correlation between grain yields and their component in rice lines was noted by Konate *et al.* (2016). However, grain yield per plant exhibits a strong positive correlation with stem weight and biomass. At both the genotypic and phenotypic levels, grain yield per plant/kernel weight was positively and significantly correlated with days to maturity (Habib *et al.* 2005). Grain weight, grain length/breadth ratio, and grain length are all positively correlated. Both phenotypic and genotypic levels of correlation between panicle length were found to be positive and significant. These outcomes were also observed by Ramkrishnan *et al.* (2006).

REFERENCE

- Agata, A., Ando, K., Ota, S., Kojima, M., Takebayashi, Y., Takehara, S., and Hobo, T. 2020. Diverse panicle architecture results from various combinations of Pr15/GA20ox4 and Pbl6/APO1 alleles. *Communications Biology*, 3(1):302.
- Ashrafuzzaman M, Rafiqul Islam, Razi Ismail, Shahidullah S.M., Hanafi M.M. 2009. Evaluation of Six Aromatic Rice Varieties for Yield and Yield Contributing Characters. *Int. J Agric. Biol.* 11(5):616-620.
- Bagri, J. P., Singh, T., Lilhare, S., Rai, S., and Dwivedi, V. K. 2022. Influence of nitrogen levels and varieties on growth, yield and quality of rice (*Oryza sativa* L.). *Pharmal Innovation Journal*; 11(8): 1520-1522.
- Bowes, G., Ogren, W.L., and Hageman, R.H. 1972. Light Saturation, photosynthesis rate, RuDP carboxylase activity, and specific leaf weight in soybeans grown under different light intensities *Crop Science*, 12(1), 77-79.
- Gautam, A., and Shrestha, A. 2023. Evaluation of panicle architecture traits in rice genotypes using PTRAP. *Nepal Agriculture Research Journal*, 15(1), 115-124.
- Guru, T., Padma, V., Reddy, D.V.V., Rao, P.R., Sanjeeva Rao, D., Ramesh, T., and Radhakrishna, K. V. 2017. Natural variation of top three leaf traits and their association with grain yield in rice hybrids. *Indian Journal of Plant Physiology*, 22(1), 141-146.
- Habib, S.H., Bashar, M.K., Khalequzzaman, M., Ahmed, M.S., Rashid ESMH. 2005. Genetic analysis and morphological selection criteria for traditional Broin rice germplasm. *J. Boil. Sci.* 5(3), 315-318.

IRRI.1996.<http://www.knowledgebank.irri.org/images/docs/rice-standard-evaluation-system.pdf>

Konate,A.K.,Zongo,A.,Kam,H.,Sanni,A.andAudebert,A.2016.Geneticvariabilityandcorrelationanalysisofriceinbreedlinesbasedonagromorphologicaltraits.AfricanJournalofAgricultural Research.11(35): 3340-3346.

Ku,L.X.,Zhao,W.M.,Zhang,J.,Wu, L.C., Wang,C. L.,Wang,P. A.,andChen, Y. H.2010.Quantitativetraitlocimappingofleafangleandleaforientationvalueinmaize(*ZeamaysL.*).TheoreticalandAppliedGenetics, 121,951-959.

KulendraJaiswal,D.,Bhambri,M.C.,andSonboir,H.L.2020.Effectofvariousqualityricecultivarsandcropmanagementpracticesongrowthandyieldofrice(*OryzasativaL.*).Pharmalnnovation Journal;SP-9(9): 30-33.

Lerner,M.,1958.Thegeneticbasisofselection.Johnwheatgrasseedproduction. Agron.J.,51:515-518.Willeyand sons. NewYork. pp:145

Li, G., Zhang, H., Li, J., Zhang, Z., and Li, Z. 2021. Genetic control of paniclearchitecturein rice. The Crop Journal,9(3), 590-597.

Mahesh,G.,ChandraMohan,Y.,SaidaNaik,D.,andNarenderReddy,S.2022.Studyonflag leafanditspenultimateleavesfortheirassociationwithgrainyieldinrice(*OryzasativaL.*). InternationalJournal BiologicalForum,14(2):270-274.

UNDER PEER REVIEW

- Makino, Y., Hirooka, Y., Homma K., Kondo, R., Liu, T.S., Tang, L., Nakazaki, T., Xu,Z., and Shiraiwa, T., 2022. Effect of flag leaf length of erect panicle rice on the canopy structure and biomass production after heading. *Plant Production Science*, 25(1):1-10.
- Mohan, K.V. and Pavithran, K. 2007. Chronology of tiller emergence and tiller orientation in rice (*Oryza sativa* L.). *Crop Improvement* 14(4):307-310. Ramakrishnan SH, Anandakumar CR, Sarvanan S, Malini N. 2006. Association analysis of some yield traits in rice (*Oryza sativa* L.). *J. Appl. Sci. Res.* 2(7), 402-404.
- Mohapatra, P.K., and Sahu, S.K. 1991. Heterogeneity of primary branch development and spikelet survival in rice panicle in relation to assimilates of primary branches. *J. Exp. Bot.* 42, 871-879.
- Mohidem, N. A., Hashim, N., Shamsudin, R., and Che Man, H. 2022. Rice for food security: Revisiting its production, diversity, rice milling process, and nutrient content. *Agriculture*, 12(6), 741.
- Searle, S.R. 1961. Phenotypic, Genotypic and environmental correlations. *Biometrics*, 47:474-480.
- Singh, M., Chouhan, P., and Chaudhari, P. 2021. Agromorphological characterization of indigenous germplasm accessions of rice (*Oryza sativa* L.). *Journal of Pharmacognosy and Phytochemistry*, 10(2), 1378-1385.
- Yoshida S. 1981. Physiological analysis of rice yield. In: *Fundamentals of Rice Crop Science*. International Rice Research Institute, Makita City, Philippines: 231-25.

UNDER PEER REVIEW

Table 1: Correlation study of plant architecture attributes of long, medium, and short-duration rice varieties.

	SYP	PH (F)	PH (M)	NT(F)	PT	NL	DFF	FLL	FLW	FA	LA	TDW(F)	TDW(M)
SYP	1												
PH (F)	-0.454*	1											
PH (M)	-0.456*	1**	1										
NT(F)	0.695**	-0.865**	-0.861**	1									
PT	0.591**	-0.866**	-0.863**	0.913**	1								
NL	0.695**	-0.865**	-0.861**	1**	0.913**	1							
DFF	-0.153	0.408	0.405	-0.419*	-0.424*	-0.419	1						
FLL	-0.55**	0.87**	0.866**	-0.941**	-0.873**	-0.941**	0.521*	1					
FLW	-0.161	0.852**	0.846**	-0.739**	-0.752**	-0.74**	0.505*	0.818**	1				
FA	-0.475*	0.904**	0.899**	-0.93**	-0.88**	-0.93**	0.528**	0.985**	0.903**	1			
LA	-0.061	0.792**	0.786**	-0.67**	-0.721**	-0.67**	0.547**	0.809**	0.925**	0.863**	1		
TDW(F)	0.887**	-0.274	-0.281	0.456*	0.401	0.456*	-0.029	-0.297	0.055	-0.226	0.147	1	
TDW(M)	0.909**	-0.277	-0.283	0.468*	0.412	0.468*	-0.046	-0.307	0.048	-0.236	0.145	0.996**	1

Correlation is significant at 0.001 level (two-tailed)
 ### Correlation is significant at 0.001 level (two-tailed)

Table2:Correlationstudyofphyllotaxyandgrowthattributesoflong,medium,andshort-durationricevarieties.

	SYP	FLA	SELA	TLA	FSV	SSV	TSV	LAI	NAR	SLA	SLW	LI
SYP	1											
FLA	-0.916**	1										
SELA	-0.863**	0.974**	1									
TLA	-0.793**	0.937**	0.979**	1								
FSV	0.955**	-0.954**	-0.895**	-0.836**	1							
SSV	0.943**	-0.967**	-0.931**	-0.876**	0.98**	1						
TSV	0.941**	-0.968**	-0.933**	-0.878**	0.978**	0.999**	1					
LAI	-0.062	0.355	0.471*	0.599**	-0.175	-0.25	-0.253	1				
NAR	0.961**	-0.943**	-0.901**	-0.849**	0.959**	0.961**	0.962**	-0.155	1			
SLA	-0.778**	0.904**	0.947**	0.974**	-0.793**	-0.83**	-0.831**	0.604**	-0.827**	1		
SLW	0.898**	-0.976**	-0.974**	-0.957**	0.925**	0.948**	0.947**	-0.438*	0.928**	-0.95**	1	
LI	0.926**	-0.951**	-0.905**	-0.844**	0.972**	0.977**	0.977**	-0.22	0.937**	-0.792**	0.918**	1

*** Correlation is significant at 0.001 level (two-tailed)
 ** Correlation is significant at 0.01 level (two-tailed)
 * Correlation is significant at 0.05 level (two-tailed)

Table3:Correlationstudyofpaniclearchitectureattributesoflong,medium,andshort-durationricevarieties.

	SYP	PL	PBL	SBL	NPB	NSB	GL	GW	L:BR	PBFG	PBSG	SBFG	SBSG	TGP	FGP	SGP	PWP	TW	HI
SYP	1																		
PL	0.025	1																	
PBL	-0.144	0.309	1																
SBL	-0.302	0.323	0.345	1															
NPB	0.643**	-0.216	-0.235	-0.217	1														
NSB	-0.075	-0.143	0.127	0.116	0.219	1													
GL	0.44*	0.23	0.11	-0.064	0.157	-0.014	1												
GW	0.285	0.502*	0.282	0.031	0.217	0.045	0.699**	1											
L:BR	-0.007	-0.513*	-0.304	-0.147	-0.13	-0.015	-0.091	-0.751**	1										
PBFG	0.684**	0.208	0.115	-0.08	0.396*	0.091	0.468*	0.486*	-0.274	1									
PBSG	-0.872**	-0.034	0.115	0.163	0.538**	0.134	-0.344	-0.196	-0.007	-0.535**	1								
SBFG	0.286	0.188	0.414	0.047	0.063	0.224	0.111	0.099	-0.095	0.387	-0.149	1							
SBSG	-0.569**	0.116	-0.018	0.161	-0.216	0.183	-0.244	-0.042	-0.108	-0.319	0.617**	0.312	1						
TGP	0.619**	0.012	0.004	-0.124	0.768**	0.314	0.325	0.441*	-0.3	0.824**	-0.389	0.315	-0.14	1					
FGP	0.781**	0.056	-0.012	-0.144	0.776**	0.209	0.389	0.448*	-0.271	0.883**	-0.624**	0.338	-0.319	0.96**	1				
SGP	-0.772**	-0.121	0.056	0.127	-0.277	0.276	-0.321	-0.145	-0.033	-0.461*	0.953**	0.166	0.692**	-0.173	-0.441*	1			
PWP	0.909**	-0.102	-0.22	-0.247	0.752**	0.053	0.365	0.251	-0.01	0.674**	-0.758**	0.261	-0.468*	0.734**	0.837**	-0.604**	1		
TW	0.274	-0.287	0.128	0.027	0.187	0.011	0.469*	0.113	0.335*	0.181	-0.191	0.089	-0.028	0.195	0.205	-0.11	0.333	1	
HI	0.899**	-0.173	-0.268	-0.428*	0.678**	-0.019	0.297	0.116	0.107	0.498*	-0.788**	0.241	-0.574**	0.532**	0.674**	-0.674**	0.899**	0.316	1

Correlation is significant at 0.001 level (two-tailed)### Correlation is significant at 0.001 level (two-tailed)