Assessment of Correlation of Morphological,and Physiological Traitswith SeedYieldin Rice(*Oryzasativa*L.)

ABSTRACT

Thirty-six rice varieties were evaluated at the instructional farm, College ofAgriculture,IGKV,Raipur(C.G.)duringtheyears 2021-22and2022-23undertheKharifseason.Thecorrelationstudieswithdifferentmorphological,andphysiologicaltraitswerecarriedoutandsuggestedthattraitse.g. numberoftillers,productive tiller, number of leaves, total dry weight, SCMR value of flag leaf, secondleaf, third leaf, net assimilation rate, specific leaf weight, light interception, Harvestindex, panicle weight plant^{-1}, total grain panicle^{-1}, fertile grains panicle^{-1}, number ofprimary branches panicle^{-1}, and number of fertile grains on primary branch contentwere positively correlated at $p<0.001$ significant level**,** while Flag leaf length, angle oftopthreeleaves,specificleafarea,sterilegrainspanicle^{-1},numberofsterilegrainsonthe primary branch, and number of sterile grains on the secondary branch were negativelyassociatedwithgrainyieldduring boththeyears.Hence,thesetraitscouldbeconsideredas theprincipaltraits.Thus,correlationanalysissuggestedthattheseparameterscontribute to the seed yield of rice.

Keywords: -Correlationanalysis,SCMR, NAR,Plantarchitecture,HI,Yieldattributes.

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important essential primary nutritivesource of food grain crops (Li *et al.,* 2021). It is consumed as food by more than 85%population in the world and 90% of Asia and grown in 115 countries henceit is also known as “Global grain” (Singh *et al*., 2021). About 21 % of calories comefrom rice crops and it plays an essential role in global food security (Mohidem *et al.,*2022). Rapid increase of population and decrease in agricultural land are the challenges in the future to feed each one. For this reason we need high yielding varieties of rice. There are morphological (number of tillers, productive tiller, panicle weight plant^{-1}, total grain panicle^{-1}, fertile grains panicle^{-1}, number of primary branches panicle^{-1}, and number of fertile grains) and physiological traits (total dry weight, SCMR value of flag leaf, second leaf, third leaf, net assimilation rate, specific leaf weight, light interception, Harvest index) which are contribute towards the high grain yield in rice.

In rice leaf orientation patterns, leaves are essential for crop growth and grain yield since they are the primary source of photosynthesis. In comparison to other leaves, the flag leaf contributes 42–45% of the rice crop production.This is primarily because it plays a major role in the synthesis of photo-assimilates that are translocated to the panicle, as well as in the high levels of chlorophyll, leaf N, and photosynthetic enzymes per unit leaf area (Liu *et al.,* 2014; Mahesh *et al.,* 2022). According to Wang *et al.* (2020) found that leaves with more erectness have lower midday heat loads. This reduces the risk of overheating, maximizes water usage efficiency, and decreases water consumption related to daily carbon uptake. The rice crop with a narrow leaf angle and a high leaf orientation value will be better able to absorb light for photosynthesis, improve grain filling, and increase grain yield (Ku *et al.* 2010),. It has a major role in grain output in agriculture through enhanced glucose transport from the leaf to the spikelet during grain filling. Many of the techniques used to increase rice yield potential also involve canopy architecture, HI, and total biomass production, according to many predictions (Akter *et al.,* 2019; Shindo *et al.,* 2020).

Panicle architecture is one of the most important traits related to rice grain yield and affects crop productivity. According to Agata *et al.* (2020), panicle architecture is significantly influenced by panicle length, which also plays a crucial role in rice seed output. Many rice cultivars that yield more have longer primary branches and more secondary branches than conventional varieties. The length of the panicle rachis and the primary branch, thus, affects the overall grain quantity, rice production, and branching number (Mohapatra and Sahu, 1991).

Efforts are being made in the direction of breaking the yield barriers that arepresentinricebreedingschemes.Additionally,grainyieldisacomplicatedcharacteristic that is dependent on a large number of component characteristics viz.morphological, physiological and it does not react well to direct selection. Increasing rice production is necessary to feed the growing population and will improve crop yield. Agricultural land is being held by fewer people on a daily basis. Thus, adding yield-enhancing characteristics to plants is a smart idea to boost their potential for yield, which is the main focus of this study, in order to increase rice output. The connection between the properties of grain's component parts and grain production. This is why the current study was conducted to learn more about the connection between grain production and the properties of its component elements.

MATERIALANDMETHODS

The thirty-two improved rice cultivars along with four local checks (MTU-1001,Rajeshwari, Swarna, and MTU-1010) used for the study under upland irrigated conditions. All these 36 rice cultivars were collected from IGKV,Raipur (C.G.) under the IRRI project. The experiment was conducted under irrigatedconditions at the experimental field, and the laboratory analysis was conducted in theDepartmentofPlantPhysiology,CollegeofAgriculture,IndiraGandhiKrishiVishwavidyalaya, Krishak Nagar, Raipur (C.G.) during *Kharif* season 2021-22 and2022-2023. The experiment was laid out in a Randomized complete block design with tworeplications. The observations were recorded for different morphological,andphysiologicaltraits.Thesetraitswerechosenfollowingthestandardevaluationsystemfor Rice (IRRI, 1996), and data was subjected to statistical analysis to estimate thecorrelationofphyllotaxyandpaniclearchitecturewithseedyieldinricecropsaccording to Searle (1961). Correlation coefficient analysis measures the mutual relationshipbetweenvariouscharactersatgenotypic(g),phenotypic(p),andenvironmentallevelswith the help of the formula suggested by Lerner (1958). The schedule of variousrecommendedculturaloperationswas carriedoutduringthe investigation.

RESULTANDDISCUSSION

Thecorrelationcoefficientservesasa statisticaltoolemployedtomeasurethemagnitude of the association among two or more variables. It plays a pivotal role inassessing the usefulness of the selection procedure. Consequently, correlation offersvaluableinsightsintotheextentoftherelationshipamongvariouscontributingtraits.

Associationofplantarchitecturewithseed yieldattributingtraits

The correlation analysis measured the joint relationship between various planttraits and determined the traits on which the selection can be made for improvementin yield under irrigated conditions. The correlations between seed yield and plantarchitecture traits such as number of tillers (NT), productive tiller (PT), number ofleaves (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)werecarriedoutandpresented inTable1.

During year both years, the correlation analysis suggested that seed yield wassignificantlycorrelatedwithtraitsviz.,numberoftillers(0.695**),productivetiller(0.591**), number of leaves (0.695**), and total dry weight (0.887**, 0.909**) withp<0.01significancelevelinapositivemanner,while;thetraitsflagleaflength(-0.55**)atthefloweringstagewerefoundnegativelyassociatedwith seedyield.Mohanan and Pavithran (2007) found that the ideal number of tillers yieldedhigher economic yields.

Makino*et.al*.(2022)alsoreportedthatflagleaflengthwasnegativelycorrelatedwithseedyieldinricecrop.Thisresultwasincloseagreementwiththe presentstudy.

Associationofseedyieldwith phyllotaxyand growthtraits

Similarly, the correlation analysis was carried out between seed yield andgrowth characters (Table 2). The data suggested that the seed yield was positivelycorrelated with SCMR value of flag leaf, second leaf, third leaf (0.955**, 0.943**,0.941**respectively),netassimilationrate(NAR)(0.961**),specificleafweight(SLW)(0.898**), and light interception (LI) (926**) with p<0.01 significance level, whereas;anglesofflagleaf(FLA),secondleaf(SELA),andthirdleaf(TLA)(-0.916**,-0.853**,
-0.793** respectively), and specific leaf area (SLA) (-0.778**) were also found inassociatedwith seedyield negatively.Guru*etal*.(2017)Grainyield,SCMR,andCCI(chlorophyllcontentindex)haveall demonstratedamuchpositivecorrelationwithflagleafthickness.Higherchlorophyll content per unit area in thicker leaves could be the cause of this, leadingto better photosynthesis. Banjare*et al.* (2024) reported that SLW, a measure of leaf thickness, had a high positive connection with leaf photosynthesis in numerous crops.

Associationofseedyieldwithpaniclearchitecture traits

Similarly, the correlation analysis was carried out between seed yield andtraits related to panicle architecture. The data suggested that the seed yield was positivelycorrelatedwithviz.,Harvestindex(HI)(0.899**),panicleweightplant^{-1}(PWP)(0.909**), total grain panicle^{-1} (TGP) (0.619**), fertile grains panicle^{-1} (FGP)

(0.781**),numberofprimarybranchespanicle^{-1}(NPB)(0.643**),andnumberoffertilegrainsonprimarybranch(PBFG)(0.643**)withp<0.01significancelevel,while;thetraitssterilegrainspanicle^{-1}(SGP)(-0.772**),numberofsterilegrainsonthe primarybranch(PBSG)(-0.872**), and number of sterile grains on the secondary branch (SBSG) (-0.569**) werefoundinassociationwith seedyield negatively(Table3).Grain yield in cereals can be raised by raising the harvest index, biomass production, or both Yoshida (1981).Gautam*etal.*(2023)investigated,thatbetweenthenumberofspikeletsandthelengthof the secondary branches, there is no discernible correlation. Ashrafuzzaman *et al.*,(2009) reported that the correlation between grain yields and their component in ricelineswasnotedbyKonate*etal.*(2016).However,grainyieldperplantexhibitsastrongpositivecorrelationwithstemweightandbiomass.Bothatthegenotypicandphenotypic levels, grain yield per plant/kernel weight was positively and significantlycorrelatedwithdaystomaturity(Habib*etal*.2005).Grainweight,grainlength/breadthratio, and grain length are all positively correlated. Both phenotypic and genotypiclevels of correlation between panicle length were found to be positive and significant.Theseoutcomes werealso observedbyRamkrishnan*et al.*(2006).

Acknowledgments

We sincerely appreciate the support provided by the Department of Plant Physiology, IGKV, Raipur; the SARTHI Government of Maharashtra Scholarship program, which provided the funds needed to complete this study; and plant breeder Dr. Sanjay Katiyar, an IRRI scientist, who lent us the rice varieties for his course.

Authors' Contributions

Every named author has contributed significantly, directly, and intellectually to the data collection, analysis, experimentation, and manuscript preparation.

Conclusion

The significance of many characteristics in predicting yield potential, including tiller number, top three leaf angles, LAI, SLA, SLW, NAR, and LI. However, the relationships between these traits and yield can vary significantly across different groups of long, medium, and mid-early duration varieties and environments. As a result, clarifying these relationships in certain situations can offer insightful information for breeding initiatives targeted at raising rice output. The primary objective of this research is to establish a correlation between different rice varieties' morpho-physiological properties, and seed yield characteristics. When the characteristics that have a major impact on yield are identified.

COMPETING INTERESTS

There are no competing interests, according to the authors.

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Table 1: Correlationstudyofplantarchitectureattributes oflong,medium,andshort-durationricevarieties.

	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)##**Correlationissignificantat0.001level(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)##**Correlationissignificantat0.001level(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)##**Correlationissignificantat0.001level(two-tailed)