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Correlation Study on Some Rice Landraces of Assam for Yield and Ancillary Traits under Organic and Conventional Cultivation Method

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ABSTRACT: The degree of genetic amelioration is determined by the quantum of genetic variability and the degree to which heritable and nonheritable variants are associated to the traits. The present investigation was carried out in Sali, 2018 to understand the correlation for yield attributing traits in some indigenous rice landraces of Assam. Here, 10 indigenous rice landraces and one check variety were evaluated for quantitative and grain characters. Under the organic cultivation method correlation analysis revealed that grain yield hactare^{-1} had a positive and significant correlation with ear bearing tiller, and harvest index indicating the importance of these traits for yield improvement. Similarly, for the conventional cultivation method correlation analysis revealed that grain yield hactare^{-1} had a positive and significant correlation with ear bearing tiller. The selection of any of these characters will have a direct response on the grain yield of the indigenous cultivars. Head rice recovery (HRR) an important market value character is significantly negatively correlated with kernel length (KL) and grain length (GL).

Keywords: correlation, indigenous, landraces.

INTRODUCTION

Rice is a staple food for a significant portion of the world's population, especially in Asia, where it serves as a primary source of nutrition and sustenance. Rice, a vital cereal crop belonging to the genus Oryza within the family Poaceae, exhibits a rich diversity with twenty-two wild and two cultivated species. The cultivated species, *Oryza sativa* and *Oryza glaberrima*, stand out among them. Oryza sativa, a cultivated diploid species, possesses 24 chromosomes of the AA genome.

The global repository of sativa rice germplasm is conventionally classified into three sub-species: *Indica, Japonica*, and *Javanica*. These sub-species thrive in tropical, temperate, and intermediate climates, respectively. Understanding the relationship between yield and the contributing characters was required for an effective selection strategy. Information on the degree and direction of the relationship between yield and its contributing characteristics can be obtained through the analysis of yield and yield-related components through correlations. Grain yield, a multifaceted trait in the realm of rice cultivation, is intricately governed by numerous genes, subject to environmental influences, and characterized by the nature of genetic variability. Traits influencing grain yield, whether directly or indirectly, gain prominence if they exhibit high heritability and positive correlations with the ultimate yield. In breeding programs, breeders have traditionally embraced indirect selection methods based on plant traits. However, researchers have increasingly found indirect selection based on yield components to be more efficient than direct selection for yield across various crop species.

The success of any breeding program hinges on the presence of genetic variability and the extent of desirable heritable traits. Morphological traits play a pivotal role in augmenting rice production, particularly those associated with new plant types that contribute to enhanced yield. Identifying promising parents based on divergence is a critical step in any breeding initiative.

Plant breeders commonly employ a strategy of selecting for yield component traits, recognizing their indirect role in bolstering overall yield. The relationship between rice yield and its contributing characters has been extensively studied at the phenotypic level. Given the complex and quantitative nature of grain yield, which stems from the combined function of various constituent traits, a comprehensive approach to selection must encompass a consideration of multiple yield component traits.

Furthermore, the grain yield is a complicated feature depending on several component characters and it reacts poorly to the direct selection (Thorat *et al.*, 2019). Understanding the correlation between yield and its components serves as a foundational effort in formulating effective strategies for plant selection (Anis *et al*., 2016; Prasad *et al*., 2001). This correlation analysis has proven instrumental in identifying valuable traits that can serve as selection criteria to improve grain yield in rice. The present study seeks to unravel the causal relationships among morphological traits within ten rice varieties, contributing valuable insights to the ongoing pursuit of optimizing rice cultivation and increasing overall grain yield.

MATERIALS AND METHODOLOGY

The Instructional-cum-Research (ICR) Farm of the Assam Agricultural University in Jorhat, Assam, which is geographically situated at a height of 87 meters above mean sea level, 26°45'N latitude, and 94°12'E longitude, was the site of the current study. In Sali 2018, the experiment was conducted on June 12, 2018, for seeding, and July 12, 2018, for transplanting. Ten indigenous cultivars and a common check variety named Ranjit made up the experimental sample. Table 1 provides a detailed description of the genotypes' origin, predigree, and sources. A Randomized block design (RBD) was employed in the study, with two environments—conventional and organic—and three replications. Two seedlings of each genotype per hill were transplanted in a row that was five meters long, with a distance of 20 centimeters between rows and 15 centimeters between plants within each row. Every genotype was transplanted onto 2 m × 5 m plots. Fertilizer was applied in the conventional plot as urea, single super phosphate, and muriate of potash following the recommendations of 20 kg N, 10 kg P_2O_5, and 10 kg K_2O per hectare; in the organic plot, FYM was applied per the recommendations of 5 tons per hectare. Phenological data on days to 50% flowering was obtained for plots of each genotype. At maturity, five plants were randomly selected from each accession to record data on quality characters such as head rice recovery percentage, hulling percentage, milling percentage, kernel length, kernel breadth, and length/breadth (L/B) ratio, as well as yield component traits such as plant height, productive tillers per plant, panicle length, grains per panicle, and test weight. To gather data for the test weight under investigation, a random grain sample was chosen from each plot and reproduced using standard procedures. For each trait, means of the replicates were used in the data analyses. Pearson' s Correlation analysis between character pairs was computed at probability levels of $P < 0.05$ and $P < 0.01$ in Microsoft Excel using trait average for the trait pairs among genotypes. Significance of correlation coefficients (r) at p = 0.05 or 0.01 is indicated by * or **, respectively.

RESULTS AND DISCUSSION

Correlation between different character pairs occur because of either linkage or pleiotropy. Correlation studies provide information on the nature and extent of association between any two characters. From this it would be possible to bring about genetic up-gradation in one trait by the selection of the other trait of a pair. Pearson' s Correlation analysis between character pairs was conducted for all traits using diverse genotypes.

The correlation analysis showed 23 significant associations between all traits measured under organic cultivation method (Table 2). Significant positive correlations were observed between trait pairs, ear bearing tiller (EBT) and plant height (PH) (r^2 = 0.704**); grain length (GL) and grain length breadth ratio (GLBR) (r^2 = 0.865**) ; grain length breadth ratio (GLBR) and kernal length breadth ratio (KLBR) (r^2 =0.999 **) and kernel length (KL) and kernal length breadth ratio (KLBR) (r^2 = 0.843**). Significant positive correlations were also observed between plant height (PH) and harvest index (HI) (r^2 = 0.759**); ear bearing tiller (EBT) and harvest index (HI) (r^2 =0.857**) ; harvest index (HI) and grain yield per hectare (GYH) (r^2 = 0.841**) and hulling percentage (HP) and milling percentage (MP) (r^2 = 0.931**). Head rice recovery (HRR) is significantly negatively correlated with kernel length (KL) and grain length (GL) (r^2= -0.664*).

From the correlation study between traits under conventional method showed 20 significant association under conventional cultivation method (Table 3). Significant positive correlations were observed between trait pairs, grain length (GL) and grain length breadth ratio (GLBR) (r^2 = 0.874**) ; grain length breadth ratio (GLBR) and kernal length breadth ratio (KLBR) (r^2 =0.997 **) and kernel length (KL) and kernal length breadth ratio (KLBR) (r^2 = 0.841**). Significant positive correlations were also observed between ear bearing tiller (EBT) and harvest index (HI) (r^2 =0.89**) ;ear bearing tiller (EBT) and grain yield per hectare (GYH) (r^2 = 0.794); harvest index (HI) and grain yield per hectare (GYH) (r^2 = 0.953**) and hulling percentage (HP) and milling percentage (MP) (r^2 = 0.691*).

Correlation of characters is an important parameter to estimate relative influence of various characters on yield (Chaubey and Richharia 1993). The correlation coefficient of ear bearing tillers is high with grain yield plot^{-1} both under organic and conventional growing condition (Table 2 & 3). Similar results were also reported by Ravindra Babu *et al*. (2012); Janardhanam *et al*. (2001); Kavitha and Reddy (2001); Yogameenakshi *et al*. (2004); Sharma & Sharma (2007). This reveals that grain yield could be improved through ear bearing tillers plant^{-1} under both growing condition. Hence, the trait should be taken as selection to improve grain yield in organic condition also. Similarly, harvest index is also another important character for improvement of grain yield plot^{-1} as indicated from the estimates of high correlation coefficient. Harvest index has significant negative correlation with plant height. Thus, traditional varieties which are of short stature should be taken as a selection index for improving grain yield.

The head rice recovery is an important parameter for grain characters which determine the market value of the product. Zhang (2007) emphasized on improvement of appearance and eating quality of rice grains with the improvement of living standards of the consumers. The correlation coefficient of this grain characters were determined under both organic and conventional situations. High coefficient of correlation was found between grain length and grain L/B, grain breadth with kernel breadth, kernel length with kernel L/B for both the growing conditions (Table 2 & 3). Hulling (%) with milling (%) were found to be significant, depicting that improvement of the later characters can be done by selecting the correlated traits under study.

Table 1 : Details of the rice genotype used during the experiment.

Genotype number	Genotype name	Pedigree	Source	Origin
V1	*Begi Lahi*	Indigenous	Farmer's field	Kakopothar, Tinsukia
V2	*Jahinga Sali*	Indigenous	Farmer's field	Kakopothar, Tinsukia
V3	*Kola Joha*	Indigenous	Farmer's field	Kakopothar, Tinsukia
V4	*Kola Sali*	Indigenous	Farmer's field	Kakopothar, Tinsukia
V5	*Nekera Lahi*	Indigenous	Farmer's field	Kakopothar, Tinsukia
V6	*Malbhog Lahi*	Indigenous	Farmer's field	Kakopothar, Tinsukia
V7	*Solpuna*	Indigenous	Farmer's field	Kakopothar, Tinsukia
V8	*Lothow Bora*	Indigenous	Farmer's field	Kakopothar, Tinsukia
V9	*Ronga Sali*	Indigenous	Farmer's field	Kakopothar, Tinsukia
V10	*Mugi Joha*	Indigenous	Farmer's field	Kakopothar, Tinsukia
V11	*Ranjit*	Improved	Farmer's field	Kakopothar, Tinsukia

Table 2 : Correlation coefficient of quantitative and grain character for 11 Assam rice cultivars under organic cultivation method.

	PH	EBT	GPP	FLA	PL	GL	GB	GLBR	KL	KB	KLBR	TGW	D50F	HI	HP	MP	HRR	GYH
PH	1																	
EBT	-0.704**	1																
GPP	-0.257	-0.092	1															
FLA	0.242	-0.053	-0.004	1														
PL	0.43	-0.408	0.342	0.352	1													
GL	0.172	-0.445	-0.075	-0.434	0.073	1												
GB	0.284	-0.267	-0.646*	0.145	-0.011	0.12	1											
GLBR	0.026	-0.263	0.228	-0.468	0.096	0.865**	-0.389	1										
KL	0.172	-0.445	-0.075	-0.434	0.073	1	0.12	0.865**	1									
KB	0.284	-0.267	-0.646*	0.145	-0.011	0.12	1	-0.389	0.12	1								
KLBR	0.021	-0.246	0.243	-0.458	0.109	0.843**	-0.425	0.999**	0.843**	-0.425	1							
TGW	0.494	-0.536	-0.47	0.132	0.109	0.672*	0.658*	0.287	0.672*	0.658*	0.252	1						
D50F	0.111	-0.202	0.372	0.106	0.674*	-0.128	0.199	-0.234	-0.128	0.199	-0.24	0.006	1					
HI	-0.759**	0.857**	0.083	-0.043	-0.306	-0.139	-0.162	-0.048	-0.139	-0.162	-0.046	-0.253	-0.008	1				
HP	0.18	0.128	-0.591	-0.306	-0.444	0.287	0.054	0.265	0.287	0.054	0.262	0.156	-0.677*	-0.087	1			
MP	0.261	0.006	-0.635*	-0.166	-0.507	0.113	0.179	0.035	0.113	0.179	0.029	0.149	-0.725*	-0.278	0.931**	1		
HRR	-0.173	0.386	-0.08	0.376	0.128	-0.664*	-0.068	-0.571	-0.664*	-0.068	-0.549	-0.349	0.18	0.173	-0.489	-0.389	1	
GYH	-0.442	0.616*	-0.011	0.106	0.003	0.167	-0.052	0.187	0.167	-0.052	0.184	0.142	0.066	0.841**	-0.045	-0.277	0.12	1

(Significance levels: *Significant at *P* <0.05, 0.602; ** significant at *P* <0.01, 0.74)
(PH = plant height, EBT = ear bearing tiller, GPP =grain yield per plant, FLA=flag leaf area, PL = panicle length, GL = grain length, GB = grain breadth, GLBR = grain length by breath ratio, KL = kernal length, KB = kernal breadth, KLBR = kernal length by breath ratio, TGW = thousand grain weight, D50F =days to 50 % flowering, HI = harvest index, HP = hulling percentage, MP = milling percentage, HRR = head rice recovery, GYH= grain yield per hectare)

Table 3 : Correlation coefficient of quantitative and grain character for 11 Assam rice cultivars under conventional cultivation method.

	PH	EBT	GPP	FLA	PL	GL	GB	GLBR	KL	KB	KLBR	TGW	D50F	HI	HP	MP	HRR	GYH
PH	1																	
EBT	-0.82**	1																
GPP	-0.167	-0.001	1															
FLA	0.308	-0.216	0.022	1														
PL	0.012	0.042	0.438	-0.39	1													
GL	0.085	-0.378	-0.079	-0.429	-0.13	1												
GB	0.092	-0.195	-0.597	0.109	-0.179	0.185	1											
GLBR	0.053	-0.258	0.188	-0.458	-0.05	0.874**	-0.309	1										
KL	0.085	-0.378	-0.079	-0.429	-0.13	1	0.185	0.874**	1									
KB	0.092	-0.195	-0.597	0.109	-0.179	0.185	1	-0.309	0.185	1								
KLBR	0.053	-0.233	0.204	-0.451	-0.042	0.841**	-0.362	0.997**	0.841**	-0.362	1							
TGW	0.318	-0.572	-0.505	0.18	-0.365	0.556	0.76	0.155	0.556	0.76**	0.097	1						
D50F	-0.034	0.019	0.572	0.075	0.689*	-0.218	-0.138	-0.154	-0.218	-0.138	-0.153	-0.201	1					
HI	-0.88**	0.89**	0.128	-0.046	-0.052	-0.215	-0.012	-0.205	-0.215	-0.012	-0.203	-0.305	0.153	1				
HP	0.104	-0.157	-0.443	0.251	-0.713	0.137	0.447	-0.08	0.137	0.447	-0.1	0.409	-0.798**	-0.099	1			
MP	0.206	-0.286	-0.56	0.269	-0.687*	0.073	0.333	-0.107	0.073	0.333	-0.128	0.475	-0.789**	-0.273	0.691*	1		
HRR	-0.299	0.482	0.205	-0.139	0.774**	-0.589	-0.056	-0.539	-0.589	-0.056	-0.52	-0.514	0.619*	0.343	-0.61*	-0.591	1	
GYH	-0.823**	0.794**	0.254	-0.106	0.15	-0.068	-0.018	-0.062	-0.068	-0.018	-0.065	-0.25	0.35	0.953**	-0.264	-0.46	0.407	1

(Significance levels: *Significant at *P* <0.05, 0.602; ** significant at *P* <0.01, 0.74)
(PH = plant height, EBT = ear bearing tiller, GPP =grain yield per plant, FLA=flag leaf area, PL = panicle length, GL = grain length, GB = grain breadth, GLBR = grain length by breath ratio, KL = kernal length, KB = kernal breadth, KLBR = kernal length by breath ratio, TGW = thousand grain weight, D50F =days to 50 % flowering, HI = harvest index, HP = hulling percentage, MP = milling percentage, HRR = head rice recovery, GYH= grain yield per hectare)

CONCLUSION

Based on the findings regarding the associations among grain yield and its components, it is reasonable to infer that the strategic selection of genotypes through correlation analysis facilitates the concurrent enhancement of multiple traits contributing to both yield and grain quality in rice. This phenomenon may be attributed to the pleiotropic effects of specific genes and/or the involvement of common regulatory factors, resulting in either positive or negative relationships at the associated yield-contributing traits. Consequently, it becomes crucial to acknowledge the impact of selected or desired yield-contributing traits on grain quality. It is noteworthy that the ultimate marketability of developed rice is significantly influenced by grain quality considerations alone in the realm of rice cultivation.

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Conflict of Interest. None.

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