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CORRELATION STUDY FOR YIELD CONTRIBUTING TRAITS IN AEROBIC RICE (*ORYZA SATIVA* L.)

Yashlok Singh, P.K. Singh, V.N. Pathak[1], Varucha Misra* and A.K. Mall*

N.D. University of Agriculture & Technology, Kumarganj, Faizabad-224 221 (U.P.) India
[1]SMMT Post Graduate College, Ballia-277 001 (UP) India
*ICAR-Indian Institute of Sugarcane Research, Lucknow-226 002 (U.P.) India

Abstract

The germplasm evaluation experiment involved evaluation of 56 genotypes of aerobic along with three checks for twelve characters under aerobic condition in augmented design during *Kharif,* 2013. Grain yield per plant showed very strong positive correlation with 1000-grain weight, followed by biological yield per plant and harvest-index. Therefore, these characters emerged as most important associates of grain yield in aerobic rice. In the present study, majority of significant estimates of correlations between yield and yield components were positive in nature. This represents highly favorable situation for obtaining high response to selection in improving yield and yield components in aerobic rice. Thus, selection practiced for improving these traits individually or simultaneously would bring improvement in other due to correlated response.

Key words: Aerobic, Rice Correlation, path analysis and yield.

Introduction

In the majority of the world's rice areas, crop production will suffer as a consequence of climate change unless measures for improved crop adaptation to rising temperature, submergence, salinity and drought are taken. Traditional lowland rice with continuous flooding in India has relatively high water inputs. Now the scenario has been changed because of increasing water scarcity, there is a need to develop alternative systems that require less water. The above challenges can be met by exploiting genetic resources with conventional and biotechnological approaches to produce highly productive and well-adapted varieties. To mitigate threats to productivity posed by intensification, diversification, water shortages and climate changes will require innovative approaches to develop resource management and germplasm options. Rice is grown under many different conditions. In Asia, more than 80 per cent of the developed freshwater resources are used for irrigation purposes and about half of which is used for rice production (Barker *et al.,* 1998).

Cultivation of aerobic rice appears to be one of the potential approaches for meeting the challenge of sustaining rice production under water scarcity. Aerobic rice is the new concept to further decrease water requirements in rice production in water short areas. Aerobic rice is defined as high yielding rice grown in non-puddled and non-flooded aerobic soil (Bouman and Toung, 2001). It is usually grown under supplementary irrigation and with fertilizer inputs (Wang *et al*., 2002).

Materials and methods

The present investigation was carried out at the Crop Research Farm, Masodha, N.D. University of Agriculture and Technology, Narendra Nagar (Kumarganj), Faizabad. The germplasm along with check varieties were evaluated during *Kharif*, 2013. Geographically this place is located in between 26.470N latitude, 82.120E longitude and at an altitude of 113 meters above from mean sea level. This area falls in sub-tropical climatic zone. The climate of district Faizabad is semi-arid with hot summer and cold winter. The germplasm evaluation experiment involved evaluation of 56 germplasm lines along with three checks *viz*., Shusksamrat, NDR 2064 and NDR 359. The 56 germplasm lines along with three checks were evaluated in augmented design during *Kharif*, 2013. The experimental field was sub-divided in to 4 blocks of 17

***Author for correspondence :** E-mail: Ashutosh.Mall@icar.gov.in

plots each. The three checks were allocated randomly to three plots in each block, while remaining 14 plots in a block were used for accommodating the unreplicated test genotypes.

Results and Discussion

The estimates of simple correlation coefficients computed between twelve characters under study are presented in table 1. The grain yield per plant exhibited highly significant and positive correlation with 1000-grain weight (0.510) and biological yield per plant (0.487) and significant positive correlation with harvest-index (0.277) while significant and negative correlation was recorded between grain yield per plant and days to maturity (-0.243). Harvest-index showed highly significant and positive correlation with 1000-grian weight (0.482) but it had highly significant and negative correlation with biological yield per plant (-0.686) and negative significant correlation with panicle bearing tillers per plant (-0.283). Biological yield per plant exhibited positive and significant correlation with plant height (0.287). The 1000- grain weight had negative association of significant nature with plant height (-0.258). Spikelet fertility possessed highly significant and positive associations with flag leaf area (0.394) along with negative and highly significant correlation with Spikelet per panicle (-0.866) and negative and significant association with panicle length (-0.249). Spikelet per panicle possessed significant and positive association with panicle length (0.240). Panicle bearing tillers per plant recorded positive and highly significant correlation with panicle length (0.342) and positive and significant correlation with days to maturity (0.296). days to 50% flowering was positively correlation with days to maturity (0.240). The estimates of correlation coefficients between remaining character pairs were found to be non-significant in this analysis.

Grain yield or economic yield, in almost all the crops, is the complex character which manifests from multiplicative interactions of several other characters that are termed as yield components. The genetic architecture of grain yield in rice as well as other crops is based on the balance or overall net effect produced by various yield components directly or indirectly by interacting with one another. Therefore, selection for yield *per se* alone would not matter much as such unless accompanied by the selection for various component characters responsible for conditioning. Thus, identification of important components and information about their association with yield and with each other are very useful for developing efficient breeding strategy for evolving high yielding varieties. The correlation coefficient is the measure of degree of symmetrical association between two variables or characters which help us in understanding the nature and magnitude of association among yield and yield components. In the present investigation, simple correlation coefficients were computed among 12 characters (table 1). Grain yield per plant showed highly significant and positive correlation with 1000-grain weight, followed by biological yield per plant and harvest-index. Therefore, these characters emerged as most important associates of grain yield in aerobic rice. The strong positive association of grain yield with the characters mentioned above has also being reported in aerobic rice by earlier workers Kiani (2012); Sudharani *et al.* (2013); Venkanna *et al*. (2014). The harvest-index showed highly significant and positive correlation with 1000-grian weight besides having strong positive association with grain yield. The above characters except flag leaf area had strong positive association with grain yield which augurs well for providing correlated response during selection for improving these characters. The above observations of strong positive associations between yield and yield components are in agreement with the available literature in aerobic rice reported by earlier workers Mohamed *et al.* (2012); Sudharani *et al.* (2013); Lakshmi *et al.* (2014). Days to 50% flowering, plant height, flag leaf area and panicle length had very high positive correlations with each other. This indicated that the taller genotypes possessed greater flag leaf area and panicle length besides having late flowering which appears logical. The positive associations between these characters have also been reported by Eradasappa *et al*., (2007); Sudharani *et al.* (2013); Lakshmi *et al.* (2014). Similarly, spikelets per panicle were strongly correlated with plant height and panicle length.

In the present study, majority of significant estimates of correlations between yield and yield components were positive in nature. This represents highly favourable situation for obtaining high response to selection in improving yield and yield components in aerobic rice. Thus, selection practiced for improving these traits individually or simultaneously would bring improvement in other due to correlated response. This suggested that selection would be quite efficient in improving yield and yield components in context of germplasm collections evaluated. The negative and highly significant correlation with Spikelet's per panicle. Panicle bearing tillers per plant, days to maturity and plant height exhibited negative associations with Spikelet's per panicle were observed. In order to take care of occurrence of negative correlations along with majority of positive correlations between important yield components, a reasonable compromise would be required for attaining their proper

Table 1: Estimates of simple correlation coefficients between 12 characters in aerobic rice

Characters	DM	PH (cm)	PL (cm)	EBT/P	S/P	FLA (cm^2)	SF (%)	TW (g)	BY/P (g)	HI (%)	GY/P (g)
Days To 50 Per Cent Flowering (DFF)	-0.240	0.016	-0.096	0.095	0.032	0.193	0.060	0.109	-0.139	0.220	0.112
Days To Maturity (DM)		0.034	0.000	0.296*	-0.108	-0.195	0.098	-0.149	-0.052	-0.141	-0.243*
Plant Height (PH)			-0.089	0.005	-0.007	-0.073	0.020	-0.258*	0.287*	-0.211	0.148
Panicle Length (PL)				0.342**	0.240	0.017	-0.249*	-0.166	-0.102	0.075	-0.093
Panicle Bearing Tillers per Plant EBT/P					-0.201	-0.024	0.114	-0.037	0.215	-0.283*	-0.017
Spikelets per Panicle (S/P)						-0.058	-0.866**	-0.149	-0.107	0.163	0.066
Flag Leaf Area (FLA)							0.394**	0.237	-0.167	0.203	0.002
Spikelet Fertility(SF)								0.224	-0.049	0.016	-.0.069
1000-Grain Weight (TW)									-0.054	0.482**	0.510**
Biological Yield per Plant (BY/P)										-0.686**	0.487**
Harvest Index (HI)											0.277

*, ** Significant at 5 and 1 per cent probability levels, respectively.

Table 2: Direct and indirect effects of 13 characters on grain yield per plant in aerobic rice

Character	DFF	DM	PH (cm)	PL (cm)	EBT/P Plant	S/P (%)	FLA (cm^2)	SF (%)	TW (cm)	BY/P (gm)	HI (%)
Days To 50 Per Cent Flowering (DFF)	**0.032**	-0.008	0.001	-0.003	0.003	0.001	0.006	0.002	0.004	-0.005	0.007
Days To Maturity (DM)		**0.004**	0.000	0.000	-0.001	-0.001	-0.001	0.000	-0.001	0.000	-0.001
Plant Height (PH)			**0.043**	-0.004	0.000	0.000	-0.003	0.001	-0.011	0.012	-0.009
Panicle Length (PL)				**-0.041**	0.014	-0.010	-0.001	0.010	0.007	0.004	-0.003
Panicle Bearing Tillers per Plant EBT/P					**0.022**	-0.005	-0.001	0.003	-0.001	0.005	-0.006
Spikelets per Panicle (S/P)						**-0.047**	0.003	0.041	0.007	0.005	-0.008
Flag Leaf Area (FLA)							**0.003**	0.001	0.001	-0.001	0.001
Spikelet Fertility(SF)								**-0.098**	-0.022	0.005	-0.002
1000-Grain Weight (TW)									**0.056**	-0.003	0.027
Biological Yield per Plant (BY/P)										**1.228**	-0.842
Harvest Index (HI)											**1.113**

Residual factors = 0.2224, Bold figures indicate direct effects.

balance for obtaining maximum combined contribution towards manifestation of grain yield. However, occurrence of positive and significant or non-significant correlations revealed a far less complex situation in respect of character associations encountered in the present study than generally encountered in rice. This would make easier to attain proper balance between yield and yield components in context of aerobic rice germplasm used in present study. The estimates of correlation coefficients obtained in present study are broadly in conformity with previous reports in aerobic rice by Rao *et al*. (2011) and Lakshmi *et al.* (2014).

Path Coefficient

The direct and indirect effects of eleven characters on grain yield per plant estimated by path coefficient analysis using simple correlations are given in Table 1.

The highest positive direct effect on grain yield per plant was exerted by biological yield per plant (1.228) followed by harvest-index (1.113). The direct effects of remaining eleven characters were too low to be considered important. Biological yield per plant exhibited high order of positive indirect effects on grain yield per plant *via* plant height (0.352) and panicle bearings tillers per plant (0.264). In contrast high order of negative indirect effects were extended by biological yield per plant on grain yield per plant *via* harvest-index (-0.842), flag leaf area (-0.205), days to 50% flowering (-0.170), spikelets per panicle (-0.131) and panicle length (-0.125). Harvest–index exhibited high order positive indirect effects on grain yield per plant via 1000-grain weight (0.537), days to 50% flowering (0.245), flag leaf area (0.226) and spikelet per panicle (0.182), while it executed high negative indirect effect on grain yield per plant via., biological yield per plant (-0.764), panicle bearing tillers per plant (-0.315), plant height (-0.235) and days to maturity (-0.158). The rest of the estimates of indirect effects obtained in the path analysis were negligible. The estimate of residual factors (0.1151) obtained in path analysis was low.

Path coefficient analysis is a tool to partition the observed correlation coefficient into direct and indirect effects of yield components on grain yield. Path analysis provides more clear picture of character associations for formulating efficient selection strategy. Path coefficient analysis differs from simple correlation that it points out the causes and their relative importance, whereas, the later measures simply the mutual association ignoring the causation. The concept of path coefficient was developed by Sewall Wright (1921) and technique was first used for plant selection by Dewey and Lu (1959). Path analysis has emerged as a powerful and widely used technique for understanding the direct and indirect contributions of different characters to economic yield in crop plants so that the relative importance of various yield contributing characters can be assessed. In the study, the path coefficient analysis was carried out using simple correlation coefficients between twelve characters. The high positive direct effects on grain yield per plant were exerted by biological yield per plant and harvest-index. Thus, biological yield per plant and harvest-index emerged as most important direct yield components on which emphasis should be given during simultaneous selection aimed at improving grain yield in aerobic rice. These characters have also been identified as major direct contributors towards grain yield by Pankaj *et al.* (2013) and Gopikannan and Ganesh (2014). The direct effects of remaining characters were too low to be considered important. Biological yield per plant exerted considerable positive direct effects on grain yield per plant via days to 50% flowering and panicle bearing tillers per plant while biological yield per plant exhibited negative indirect effect on grain yield *via* harvest-index, flag leaf area, Days to 50% flowering and panicle length. Harvest–index exhibited high order of positive indirect effect on grain yield per plant via 1000-grain weight, Days to 50% flowering and flag leaf area. In addition to emerging as most important direct yield contributors owing to their very high positive direct effects on grain yield, biological yield per plant and harvest-index, having considerable positive indirect effects via different characters, also appeared as most important indirect yield components. Jayashudha and Sharma (2011) and Gopikannan and Ganesh (2014) have also identified biological yield and harvest-index as important direct and indirect yield contributing characters. The indirect effects of remaining characters were too low to be considered important. In the path analysis identified biological yield per plant followed by harvest-index as most important direct as well as indirect yield contributing traits or components which merit due consideration at time of devising selection strategy aimed at developing high yielding varieties in aerobic rice.

In contrary to most of the previous reports in aerobic rice, comparatively small proportion of direct and indirect effects of different characters attained high order values in the present study. Majority of the estimates of direct and indirect effects were too low to be considered of any consequence. This may be attributed to presence of very high genetic variability and diversity in the fairly large number of germplasm lines. The existence of different character combinations in diverse germplasm lines might have led to different types of character association in different lines. Thus, presence of several contrasting types of character associations or inter-relationships might have resulted into cancellation of contrasting associations by each other ultimately leading to lowering of the net impact or effect.

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