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DIRECT SELECTION PARAMETERS AND CORRELATION STUDY IN AEROBIC RICE GENOTYPES

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Abstract

Estimates of correlations between yield and yield components were positive in nature that represents for obtaining high response to selection in improving yield in aerobic rice. Selection would be quite efficient in improving yield and yield components in context of germplasm collections evaluated. Panicle bearing tillers plant^{-1}, DM and PH exhibited negative associations with S/P were observed. Occurrence of negative correlations along with majority of positive correlations between important yield components, a reasonable compromise would be required for attaining their proper balance for obtaining maximum combined contribution towards manifestation of grain yield.BY/P and HI exerted the Positive direct effects on GY/P. Thus, BY/P and HI emerged important direct yield components on which emphasis should be given to improve grain yield. Harvest–index exhibited high order of positive indirect effect on GY/P viaTW, DFF and FLA. In addition to emerging as most important direct yield contributors owing to their very high positive direct effects on GY/P, BY/P and HI, having considerable positive indirect effects via different characters, also appeared as most important indirect yield components.

Key words : Aerobic rice, correlation, path coefficient, GCV, PCV, heritability, genetic advance.

Introduction

Yield is a complex end product of a number of components characters most of which are under polygenic control. The success of selection in improving plant characters depends mainly on presence substantial genetic variability and nature of heritability and gene action. The genetic variability is the raw material of plant breeding programme on which selection acts to evolve superior genotypes. The phenotypic, genotypic and environmental coefficients of variation can be used for assessing and comparing the nature and magnitude of variability existing for different characters in the breeding materials. Estimates of heritability help in estimating expected progress through selection. The genetic advance provides indication of expected selection response by taking into account the existing genetic variability and heritability of the character. 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 it. 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 view of meager information available on these aspects in aerobic rice, the present investigation was undertaken to evaluate the germplasm lines for various characters under aerobic condition; to compute correlation coefficients among different character pairs; to find out direct and indirect effects of various characters on grain yield by path coefficient analysis.

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Materials and Methods

The present investigation was carried out at Crop Research Centre, Masodha, N.D. University of Agriculture & Technology, Faizabad. The crosses were made during *Kharif*, 2012 and the germplasm lines, hybrids along with parental lines and check varieties were evaluated during *Kharif*, 2013. Geographically this place is located in between 26.47^{0}N latitude, 82.12^{0}E longitude and at an altitude of 113 meters above from mean sea level.

Germplasm evaluation

The 56-germplasm lines along with three checks *viz*., Shusksamrat, NDR 2064 and NDR 359 were evaluated in augmented design during *Kharif*, 2013. The experimental field was sub-divided in to 4 blocks of 17 plots each. The checks were allocated randomly in each block, while remaining 14 plots in a block were used for accommodating the un-replicated test genotypes. Rice varieties under aerobic condition were directly sown on 23th June 2013 at 2-3 cm soil depth in dry and pulverized soil by hand plough with the seed rate of 60 Kg ha^{-1} to maintain 3-4 seeds per hill. This method gave uniform seedling emergence for all the plots in 6-8 days. The experimental field under aerobic condition was irrigated for 15 days till plants reached 2-3 leaves. At this stage seedlings were thinned to keep 2 seedlings per hill so as maintain uniform plant number. Experimental plots were maintained at near saturation and re-watered only when soil moisture reached below 15 cm. Standard cultural procedures were adopted. Phosphorus (40 kg ha^{-1} P_2O_5) and potassium (40 kg ha^{-1} K_2O) were applied as recommended before sowing/planting in aerobic and transplanted conditions. Urea was used as source of N in three splitdoses. The first application was made at 21 days after sowing, the second at active tiller initiation and the third at panicle initiation stages. The total nitrogen amount applied was 80 kg ha^{-1}. All plant protection measures were taken. Weeds were controlled by treating plot by pre-emergence herbicide (Petrilachlore) after three days of sowing followed by one hand weeding.

Direct selection parameters

The high estimates of genotypic and phenotypic coefficient of variation and high heritability in broad sense along with moderate genetic advance were recorded for GY/P, S/P, SF, TW, HI, and BY/P (table 1). The high to very high estimates of GCV, PCV and heritability with moderate genetic advance for above-mentioned six characters indicated that these would be ideal traits for improvement through selection in context of materials evaluated owing to existence of high genetic variability

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

Characters	Days to maturity	Plant height (cm)	Panicle length (cm)	Panicle bearing tillers/plant	Spikelets per panicle	Flag leaf area (cm^2)	Spikelet fertility (%)	1000-grain weight(g)	Biological yield per plan(g)	Harvest index (%)	Grain yield/ plant(g)
Days to 50% flowering	-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		0.034	0.000	0.296*	-0.108	-0.195	0.098	-0.149	-0.052	-0.141	-0.243*
Plant height (cm)			-0.089	0.005	-0.007	-0.073	0.020	-0.258*	0.287*	-0.211	0.148
Panicle length(cm)				0.342**	0.240	0.017	-0.249*	-0.166	-0.102	0.075	-0.093
Panicle bearing tillers/plant					-0.201	-0.024	0.114	-0.037	0.215	-0.283*	-0.017
Spikelets per panicle						-0.058	-0.866**	-0.149	-0.107	0.163	0.066
Flag leaf area (cm^2)							0.394**	0.237	-0.167	0.203	0.002
Spikelet fertility (%)								0.224	-0.049	0.016	-.0.069
1000- grain weight (g)									-0.054	0.482**	0.510**
Biological yield/plant (g)										-0.686**	0.487**
Harvest index											0.277

*, ** Significant at 5% and 1% probability levels, respectively.

represented by high coefficients of variation and high transmissibility denoted by high heritability for them. The high estimates of direct selection parameters observed for the above six characters are broadly in agreement with earlier reports (Rao *et al*., 2011; Ovung *et al*., 2012). Plant height had moderate PCV and GCV values with high heritability and moderate genetic advance to suggest that reasonable response to selection may be obtained for this character owing to high transmissibility even if variability happens to be moderate. Inspite of recording high heritability in broad sense, DFF and DM resulted low genetic advance owing to low variability represented by low value of PCV and GCV which indicated that improving these two trait through selection in context of present material would be difficult due to lack of genetic variability. Flag leaf area and EBT/P possessed moderate PCV, GCV and heritability with low genetic advance to indicate that selection would not be much effective in improving these traits. Panicle length having two estimates of all the four parameters appeared very poor index in selection.

Correlation coefficients

In the present investigation, simple correlation coefficients were computed among 12 characters (table 2). Grain yield per plant showed strong positive correlation with TW, followed by BY/P and HI. 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 been reported in rice by earlier workers (Jayasudha and Sharma, 2010; Rao *et al*., 2011; Kiani, 2012; Sudharani *et al*., 2013 and Venkanna *et al*., 2014). The HI showed highly significant and positive correlation with TW besides having strong positive association with grain yield. The above characters except FLA had strong positive association with grain yield that 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 rice reported by earlier workers (Mohamed *et al*., 2012; Sudharani *et al*., 2013 and Lakshmi *et al*., 2014). Days to 50 per cent flowering, PH, FLA and PL had very high positive correlations with each other. This indicated that the taller genotypes possessed greater FLA and PL besides having late flowering, which appears logical. The positive associations between these characters have also been reported by Sudharani *et al.* (2013) and Lakshmi *et al.* (2014). Similarly, S/P were strongly correlated with PH and PL.

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

Character	Days to 50% flowering	Days to maturity	Plant height (cm)	Panicle length (cm)	Panicle Bearing tillers/ plant	Spikelet/ Panicle (%)	Flag leaf area (cm^2)	Spikelet fertility (%)	1000-grain weight (cm)	Biological yield/ plant (gm)	Harvest index (%)	Grain yield/plant
Days to 50% flowering	**0.032**	-0.008	0.001	-0.003	0.003	0.001	0.006	0.002	0.004	-0.005	0.007	0.112
Maturity days	-0.001	**0.004**	0.000	0.000	-0.001	-0.001	-0.001	0.000	-0.001	0.000	-0.001	-0.243
Plant height (cm)	0.001	0.002	**0.043**	-0.004	0.000	0.000	-0.003	0.001	-0.011	0.012	-0.009	0.148
Panical length (cm)	0.004	0.000	0.004	**-0.041**	0.014	-0.010	-0.001	0.010	0.007	0.004	-0.003	-0.093
Panicle bearing tillers/plant	0.002	-0.007	0.000	-0.008	**0.022**	-0.005	-0.001	0.003	-0.001	0.005	-0.006	-0.017
Spikelet/panicle (%)	-0.002	0.005	0.000	-0.011	0.009	**-0.047**	0.003	0.041	0.007	0.005	-0.008	0.066
Flag leaf area (cm^2)	0.001	-0.001	0.000	0.000	0.000	0.000	**0.003**	0.001	0.001	-0.001	0.001	0.002
Spikelet fertility (%)	-0.006	-0.010	-0.002	0.024	-0.011	0.085	-0.039	**-0.098**	-0.022	0.005	-0.002	-0.069
1000-grain weight (cm)	0.006	-0.008	-0.014	-0.009	-0.002	-0.008	0.013	0.012	**0.056**	-0.003	0.027	0.510
Biological yield/plant (gm)	-0.170	-0.063	0.352	-0.125	0.264	-0.131	-0.205	-0.060	-0.066	**1.228**	-0.842	0.487
Harvest index (%)	0.245	-0.158	-0.235	0.084	-0.315	0.182	0.226	0.018	0.537	-0.764	**1.113**	0.277

Residual factors = 0.2224, **Bold figures indicate direct effects.**

Panicle bearing tillers per plant, DM and PH exhibited negative associations with S/P were observed. 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 Jayasudha and Sharma (2010), Rao *et al*. (2011), Sudharani *et al*. (2013) and Lakshmi *et al*. (2014).

Path coefficient analysis

In the present study, the path coefficient analysis was carried by out using simple correlation coefficients between twelve characters. The high positive direct effects on GY/P were exerted by BY/P and HI. Thus, BY/P and HI 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 Jayashudha and Sharma (2011) 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 GY/P via PH and EBT/P while BY/P exhibited high order negative indirect effect on GY/P viaHI, FLA, DFF, S/P and PL. Harvest–index exhibited high order of positive indirect effects on GY/P viaTW, DFF, FLA and S/P but it showed considerable negative indirect effects on GY/P via BY/P, EBT/P, PH and DM. In addition to emerging as most important direct yield contributors owing to their very high positive direct effects on GY/P, BY/P and HI, having considerable positive indirect effects via different characters, also appeared as most important indirect yield components. Babar *et al*. (2009), Jayashudha and Sharma (2011) and Gopikannan and Ganesh (2014) have also identified BY/P and HI as important direct and indirect yield contributing characters. In the present study, path analysis identified BY/P followed by HI 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.

Conclusion

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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