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Relationship between Morphological Traits in Rice Restorer Lines at F_3 Generation using Multivariate Analysis

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ABSTRACT

In order to evaluate the relationship between morphological characters in rice lines two populations at F3 generation were grown in research field of Agricultural Sciences and Natural Resource University, Sari, Iran, during 2012. Statistical analysis on important agronomic traits showed that maximum standard deviation belonged to total grain number followed by filled grains per panicle and grain yield. Result of correlation analysis revealed positive and significant relation of grain yield per plant with panicle length, panicle per plant, total grain number and filled grains per panicle. Path coefficient analysis indicated that filled grains per panicle had highest direct effect on yield followed by panicle length, plant height, and panicle per plant. Panicle per plant had highest indirect effect on grain yield. This study revealed that selection based on filled grains per panicle, panicle length and panicle per plant will be highly effective for yield improvement in rice breeding programs.

Key Words: Rice, Correlation, Path analysis, Yield, Yield component, F_3 generation.

INTRODUCTION

Rice (Oryza sativa L.) is the most important crop in the world, and used as staple food by more than half of the world population. Except Antarctica it is grown in all the continents, occupying 159 million hectare area and producing 683 million tones (equivalent to 456 million tons of milled rice) (FAO,2009). Selection is an important technique in plant breeding and breeders uses this method for improving the architecture of a crop by management of available genetic variability (Gravois and McNew, 1993; Mehetre et al, 1994). Although correlation coefficient was important to determine traits, which had directly affect on grain yield, could not determine indirect effects of these traits on yield. In path analysis, the correlation coefficient between two traits is separated into the

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components which measure the direct and indirect effects (Ahmadizadeh et al, 2011). Correlation and path coefficient analysis have been successfully used for plant selection for increasing yields of different crops and provide information about the cause and effect relationship between direct pairs of variables which would in turn help in bringing improvement in seed yield (Tandekar et al, 2008).Bhadru et al, (2011) with study on 93 rice genotypes involving hybrids and their parental lines reported that plant height, filled grains per panicle, days to 50 percent flowering and panicle weight had a significant positive association with yield and also had a positive direct effect on yield both at the phenotypic and genotypic levels. Satish Chandra et al., (2009) with study of path coefficient analysis noted that the numberof grains per panicle exerted the highest direct effect on grain yield followed by days to 50 percent flowering, 1000-grain weight and number of productive tillers per plant. In another investigation Seyoum et al, (2012) studied fourteen rice genotypes and demonstrated that grain per panicle had maximum positive direct effect and highly significant genotypic correlation coefficient with grain yield. selection of parents based on yield alone is often misleading (Abdus et al, 2009; Selvaraj et al, 2011) because grain yield is a complex polygenic character controlled by many genes interacting with the environment and is the product of many factors called yield components.The objective of the present study was to study the relationship between traits, and to determine the direct and indirect effects of effective traits on grain yield.

MATHERIAL AND METHODES

Plant materials used in the present study consisted of two F3 populations (IR60819/ Pajohesh and IR58110 /Pajohesh) that were grown in field of Sari Agricultural Sciences, and Natural Resource University, Sari, Iran, during 2012.The observations were recorded on three randomly selected plants for nine traits including yield and its component traits.Up to 53 superior genotypes were selected based on morphological performance in studied F3 populations and important agronomic traits like, plant height (cm), panicles per plant, panicle length (cm), 1000-grain weight (g),grain length (mm), grain width (mm), filled grains per panicle and grain yield/plant (g) were recorded on those genotypes based on the standard evaluation system (SES) of rice (IRRI, 2002).The statistical analysis, including estimation of descriptive statistics and coefficient of correlation performed using path analysis and SPSS version 16 statistical package.

RESULT AND DISCUSSION

Diversity and genetic relationships are essential information in crop improvement programs and success of plant breeding programs relies heavily on the existence of genetic variability for particular trait (Kiani, 2012).The results of the descriptive statistics were shown in Table 1.According to the results of this table,maximum standard deviation belonged to total grain number (52.93) followed by filled grain per panicle (34.66) and grain yield (9.66). Among agronomic traits, filled grains per panicle, grain yield, total grain and panicles per plant with the CVs of 38.07, 32.77, 32.72 and 32.66 percent had more phenotypic variations, respectively. While grain length and plant height had less variation.

In the present investigation we intend to reveals the possibility of effective selection for improvement of yield and its important components in subsequent segregating populations. Knowledge on interrelationship between yield and its component may facilitate breeder to decide upon the intensity and direction of selection pressure to be given on related traits for the simultaneous improvement of yield contributing traits (Rajamadhan, 2011). Effective improvement in yield may be brought about through selection of yield component characters. Hence, association analysis was undertaken to determine the direction of selection and number of characteristics to be considered in improving grain yield.

Table 1. Descriptive statistics in fifty-three F3 rice lines for some agronomic traits.

Variable	Range	Mean	Standard deviation	Coefficient of variation(%)
PH	159-101	114.71	9.46	8.24
Pl	36-24.1	28.99	2.46	8.48
PP	25-4	15.43	5.04	32.66
TGN	302-84	161.75	52.93	32.72
FGP	168-35	91.03	34.66	38.07
GL	11.78-8.84	10.27	.63	6.13
GW	2.74-1.15	2.38	.26	10.92
TGW	27.2-11.5	21.58	4.11	19.04
GY	48.6-15	29.47	9.66	32.77

PH= plant height (cm), PL= panicle length (cm), PP= panicles per plant, TGN= Total grain number, FGP= filled grains per panicle, GL= grain length, GW= grain width, TGW= 1000-grains weight (g), GY= Grain yield/plant (g).

Correlation coefficients of studied traits (Table 2) showed that there was a highly significant correlation between grain yield with panicles length, panicles per plant and total grain number at the 0.01 level and filled grain per panicle at the 0.05 level indicating that simultaneous selection for these characters would result in improvement of yield.Similar findings were earlier reported by Basavaraja *et al.* (2011) and Shanthi *et al.* (2011) for panicles per plant and Kole *et al.* (2008) for panicle length and Gulzar *et al.* (2012) for total grain number. Panicle length as a criterion for evaluating the performance of a plant is deemed correlated significantly with the total grain number (1.239) considering the relatively high direct effect of this attribute on grain yield it can be used to enhance the yield of the genotypes.

Table 2. Correlation coefficients among grain yield and its components in fifty-three F3 rice lines

Characters	PH	PL	PP	TGN	FGP	GL	GW	TGW	GY
PH	1								
PL	.582**	1							
PP	-.410**	-.207	1						
TGN	.534**	.740**	-.354*	1					
FGP	.089	.334	-.303	.767**	1				
GL	-.068	-.252	.072	-.266	-.245	1			
GW	.232	.147	.064	.133	.151	-.075	1		
TGW	-.094	-.298	.275*	-.391*	.061	.309*	.410**	1	
GY	-.016	.636**	.400**	.641**	.475*	-.249	.072	.073	1

** and *, significant at 1 and 5% level of probability, respectively.PH= plant height (cm), PL= panicle length (cm), PP= panicles per plant, TGN= Total grain number, FGP= filled grains per panicle, GL= grain length, GW= grain width, TGW= 1000-grains weight (g), GY= Grain yield/plant (g).

The correlation coefficient alone is inadequate to interpret the cause and effect relationships among the traits and ultimately with yield (Bhadru, 2011). Path coefficient analysis (Table 3) revealed that filled grains per panicle (4.202), has highest direct effect on yield followed by panicle length (1.675), plant height (1.622), and panicle per plant (1.486).This characters have positive direct effect and significant positive association with grain yield indicating that these traits were more contribute towards grain yield in these rice lines,therefore selection for these characters is likely to bring about an overall improvement in single plant yield directly. Panicle per plant had highest indirect effect on grain yield that is also noted in another report (Bagheri et al, 2011; Madhavilatha et al, 2005). It seems that increasing in panicle per plant,led to increasing leaf area or photosynthesis source which will ultimately increase yield. The direct effect of total grain number was negative (-4.888) but it indicated high indirect effect via 1000-grains weight (1.91). Similarly the1000-grains weight has negative direct effect on grain yield (-2.158) but it showed high indirect positive effect on it through the panicle length (0.643).The combined results of both correlation and path analysis revealed that selection based on filled grains per panicle, panicle length and panicle per plant will be highly effective for yield improvement in rice breeding programs.

Table 3. Genotypic direct (diagonal) and indirect effects of different quantitative traits in fifty-three F3 rice lines.

Characters	PH	PL	PP	TGN	FGP	GL	GW	TGW	r ' with yield
PH	1.622	0.944	-0.666	0.866	.144	-.111	.376	-.153	-.016
PL	0.975	1.675	-0.347	1.239	.559	-.423	.246	-.5	.636**
PP	-0.61	-0.308	1.486	-.527	-.451	.107	.095	.408	.400**
TGN	-2.61	-3.617	1.73	-4.888	-3.749	1.3	-.651	1.91	.641**
FGP	.374	1.403	-1.274	3.223	4.202	-1.03	.634	.256	.475*
GL	-.041	-.15	.042	-.159	-.146	0.595	-.045	.183	-.249
GW	.069	-.043	.019	.039	.045	-.023	.298	.122	.072
TGW	.202	.643	-.594	.843	-.132	-.667	-.885	-2.158	.073

** and *, significant at 1 and 5% level of probability, respectively.

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