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Full Length Research Paper

Study of correlation among yield related traits and path coefficient analysis in rice (*Oryza sativa* L.)

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In order to determine the associations among yield components and their direct and indirect influence on grain yield of rice, an experiment was conducted. For this purpose, 30 genotypes collected from different sources were tested in a randomized complete block design. The phenotypic correlations among the yield traits and their path coefficient were estimated. Grain yield was significantly correlated with its component characters; number of productive tillers per plant, number of grains per panicle and flag leaf area. Path analysis revealed that days to maturity had the highest direct effect (0.751) on grain yield per plant. In addition, the yield components had positive direct effect on grain yield except the days to heading (-0.834). The order of yield components was the number of productive tillers per plant, flag leaf area and 1000 grain weight. The improvement in grain yield will be efficient if the selection is based on biological yield components, number of productive tillers per plant and flag leaf area. These traits may also be utilized in pure line selection.

Key words: Rice (*Oryza sativa*), path coefficient, phenotypic correlation, yield components.

INTRODUCTION

Among the cereals, rice share equal importance as leading food sources for mankind. Rice is a staple food for nearly half of the world's population. In Pakistan, it is the second staple food after wheat and contributes more than two million tones to our food requirements annually. Being an exportable commodity, it has an immense economic value which greatly strengthens our national economy. Our local basmati rice is very famous in the international market for its aroma and quality of kernel. Rice in Pakistan's agrarian economy plays multifarious roles. Firstly, it is the second staple food; secondly, rice industry is an important source of employment and income for rural masses and thirdly, it contributes in the foreign exchange exchequer. The need and importance of rice is increasing day by day due to the increase in human population pressure on the earth. Therefore, improving the productivity of rice would contribute to hunger eradication, poverty alleviation, national food security and economic development.

Being a complex trait, grain yield is influenced by various genetic factors and environmental fluctuations. In plant breeding, path analysis has been used by plant breeders to assist in identifying the traits that are useful in selection criteria to improve the crop yield (Dewy and Lu, 1959: Milligan et al., 1990). A successful selection depends on information about the genetic variability and association of agronomic traits with grain yield. The advantage of path analysis is that it permits the partitioning of correlation coefficient into its components, one component being the path coefficient that measures the direct effect of a predictor variable on a response variable. The second component being the indirect effect of a predictor variable on the response variable through another predictor variable (Dewey and Lu, 1959).

The correlation of economic yield components with yield and partitioning of correlation coefficient into its

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Table 1. Genotypic correlation among the traits of 30 rice genotypes.

Variable	DTH	DTM	PH	NTP	NSP	NGP	TGW	FLA	YPP
DTH	1								
DTM	0.848**	1							
PH	0.444*	0.403*	1						
NTP	0.376*	0.434*	0.622**	1					
NSP	-0.066	0.078	-0.07	0.241	1				
NGP	-0.032	0.207	-0.015	0.223	0.501**	1			
TGW	-0.031	0.091	0.163	0.042	-0.108	0.152	1		
FLA	0.116	-0.089	0.567**	0.345	-0.032	-0.137	0.042	1	
YPP	-0.017	0.165	0.514**	0.299	0.041	0.138**	0.046	0.531**	1

*, ** Significant at $p \leq 0.01$ and 0.05, respectively; DTH, days to heading; DTM, days to maturity; PH, plant height; NTP, number of tillers /plant; NSP, number of spikelets/panicle; NGP, number of grains /panicle; TGW, 1000-grain weight; FLA, flag leaf area; YPP, yield/plant. The results without (*) are non significant.

components of direct and indirect effects have been extensively studied (Ganapathy et al., 1994). Highly significant associations of grain yield were observed with number of productive tillers per plant, flag leaf area (Subramanian and Rathinam, 1984; Sharma and choubey, 1985; Surek et al., 1998; Rasheed et al., 2002a) and the number of grains per panicle (Deosarkar et al., 1998; Ram, 1992; Rasheed et al., 2002b).

Grain yield has been reported to be influenced by high direct effects of number of tillers per plant and flag leaf area, the number of grains per panicle and 1000 grain weight (Yang, 1986), the number of filled grains per panicle and plant height (Ruben and Katuli, 1989), number of spikelets per panicle, number of grains per panicle (Ram, 1992) and plant height and tiller number (Kumar, 1992).

In this study, an attempt was made to study the direct and indirect influences of some important yield components on grain yield among the genotypes by adopting correlation and path coefficient analysis.

MATERIALS AND METHODS

Thirty rice genotypes collected from different sources were evaluated in a randomized complete block design with three replications at the experimental area of department of Plant Breeding and Genetics, University of Agriculture, Faisalabad. The distance between line to line and plant to plant was nine inches. Recommended agronomic practices were followed. Ten plants were selected from each replication. Data were collected on days to heading, days to maturity, plant height, number of productive tillers per plant, number of grains per panicle, number of spikelets per panicle, flag leaf area, 1000 grain weight and yield per plant. The flag leaf area was determined by multiplying the leaf length by its breadth and then multiplying the product by a constant factor (k). The value of constant factor was found to be 0.74 (Muller, 1991). The averages of replications were used after recording of data. The ANOVA for each trait was constructed (Steel et al., 1997). The path and correlation analysis were conducted following the methods of Dewy and Lu (1959). The detail of materials used in the experiment is given in Table 4.

RESULTS AND DISCUSSION

The analysis of variance revealed highly significant differences among the genotypes for all the characters. The yield related traits like number of tillers per plant, number of spikelets per panicle, number of grains per panicle, 1000 grain weight, plant height and flag leaf area had significant to highly significant positive genotypic association with grain yield per plant, while days to maturity had positive but non significant association with grain yield per plant. Days to heading had negative and non significant association with grain yield per plant. A positive correlation was observed between days to heading, days to maturity, plant height, number of tillers per plant and flag leaf area. Days to maturity also revealed positive correlation with plant height, number of tillers per plant, number of spikelets per panicle and number of grains per panicle. Plant height exhibited positive correlation with number of tillers per plant and flag leaf area, while negatively correlated with number of spikelets per panicle and number of grains per panicle. A positive correlation was exhibited between number of tillers per plant and number of spikelets per panicle, number of grains per panicle, one thousand grain weight and flag leaf area. Number of spikelets per panicle showed positive correlation with number of grains per panicle and flag leaf area, and exhibited a negative correlation with one thousand grain weight. Number of grains per panicle and thousand grain weight showed positive correlation with each other and with grain yield per plant indicating their importance as yield components (Table 1).

Path coefficient analysis revealed that days to maturity had the highest positive direct effect on grain yield per plant; flag leaf area also had positive direct effect on grain yield per plant. However, three yield components, number of tillers per plant, number of grains per panicle and number of spikelets per panicle also had direct positive effect on grain yield per plant. The effect of days to maturity was higher than others. Days to heading had

Table 2. The results of path analysis among 30 rice genotypes.

Variable	DTH	DTM	PH	NTP	NSP	NGP	TGW	FLA	r^g
DTH	-0.834	0.637	0.164	-0.052	0.004	-0.004	0.003	0.064	-0.018
DTM	-0.707	0.751	0.148	-0.060	-0.005	0.024	0.064	-0.05	0.165
PH	-0.370	0.302	0.368	-0.086	0.005	-0.001	-0.017	0.313	0.514
NTP	-0.314	0.046	0.229	0.139	-0.015	0.026	-0.004	0.191	0.299
NSP	-0.075	0.058	-0.027	-0.033	0.063	0.058	0.014	-0.017	0.041
NGP	0.027	0.156	-0.005	-0.030	-0.032	0.115	-0.016	-0.076	0.138
TGW	0.026	-0.187	0.06	-0.005	0.007	0.017	0.105	0.023	0.046
FLA	-0.097	-0.072	0.209	-0.047	0.020	-0.016	-0.004	0.553	0.532

Table 3. Phenotypic correlation among 30 rice genotypes.

Variable	DTH	DTM	PH	NTP	NSP	NGP	TGW	FLA	YPP
DTH	1								
DTM	0.842**	1							
PH	0.424*	0.377*	1						
NTP	0.3492	0.406*	0.552**	1					
NSP	-0.624	0.074	-0.074	0.261	1				
NGP	-0.034	0.199	-0.011	0.196	0.438	1			
TGW	-0.031	-0.092	0.115	0.040	-0.062	0.119	1		
YPP	0.115	-0.088	0.532**	0.315**	-0.04**	-0.12**	0.046**	1	
FLA	-0.025	0.077	0.398*	0.213*	0.057*	0.123*	0.044*	0.444*	1

a negative direct effect on grain yield per plant. The indirect effects of number of tillers per plant and number of grains per panicle via days to heading were negative, while indirect effects of plant height, number of spikelets per panicle, 1000 grain weight and flag leaf area were positive. The indirect effects of days to heading, number of tillers per plant, numbers of spikelets per panicle and flag leaf area via days to maturity were negative, while indirect effects of plant height, number of grains per panicle and 1000 grain weight were positive. The indirect effects of days to heading, number of tillers per plant, number of grains per panicle and 1000 grain weight via plant height were negative, while days to maturity, number of spikelets per panicle and flag leaf area had positive indirect effect via plant height on grain yield per plant. The indirect effects of days to heading, number of spikelets per panicle and 1000 grain weight via number of tillers per plant were negative, while days to maturity, plant height, number of grains per panicle and flag leaf area had indirect positive effect via number of tillers per plant. The indirect effects of plant height, number of tillers per plant and flag leaf area via number of spikelets per panicle were negative, while days to heading, days to maturity, number of grains per panicle and 1000 grain weight had indirect positive effects via number of spikelets per panicle (Table 2). Path analysis showed direct and indirect effect of traits on grain yield.

The indirect effects of plant height, number of tillers per plant, number of spikelets per panicle, 1000 grain weight and flag leaf area via number of grains per panicle were negative, while days to heading and days to maturity had indirect positive effect via number of grains per panicle. The indirect effects of days to maturity and number of tillers per plant via 1000 grain weight were negative. The characters like days to heading, plant height, number of spikelets per panicle, number of grains per panicle and flag leaf area had indirect positive effect on grain yield per plant via 1000 grain weight. The indirect effects of days to heading, days to maturity, number of tillers per plant, number of grains per panicle and 1000 grain weight were negative, while plant height and number of spikelets per panicle had indirect positive effect on grain yield via flag leaf area (Table 3).

Conclusions

The characters like number of tillers per plant, days to maturity, plant height and flag leaf area had significant and positive correlation with grain yield. Thus, selection for the improvement of grain yield can be efficient if it is based on number of productive tillers per plant, days to maturity and flag leaf area. The selection on the basis of these characters can be helpful for improvement in rice grain yield and quality. The study will help in the improvement of rice through selection of parents for hybridization programme. The results obtained in the present study have great importance to future breeding programme.

Table 4. Materials used in the experiment.

Genotype	Source	Genotype	Source	Genotype	Source
SRI-62	Saline research institute	BASMATI-370	RRI, kala Shah Kaku	DM-25	NIAB faisalbad
Shaheen-Basmati	Saline research institute	BASMATI-PAK	RRI, kala Shah Kaku	EF-1-25-30-2002	NIAB faisalbad
EF-1-30-54-2002	NIAB faisalbad	SRI-57	Saline research institute	DM-1-25-4-2002	NIAB faisalbad
SRI-57	Saline research institute	EF-1-20-50-2002	NIAB faisalbad	SRS-506	Saline Research Institute
SRI-53	Saline research institute	SS-SHAHEEN	Saline research institute	IRRI-26	IRRI
SRI-8	Saline research institute	DM-1-25-34-2002	NIAB faisalbad	IR-74101-3R-2-1	IRRI
DM-1-53-2002	NIAB faisalbad	SRI-66	Saline research institute	IR-74102-3R-9-1	IRRI
SRI-55	Saline research institute	SRS-502	Saline research institute	IR-74105-2-2	IRRI
SRI-51	Saline research institute	IR-74101-3R-1-1	IRRI	IR-29-3R-9-1	IRRI
SRI- 13	Saline research institute	IR-74101-3R-1-2	IRRI	Liangyoupeijiu	China

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