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Character Association and Path Coefficient Analysis for Yield Component Traits in Rice (*Oryza sativa L.*) Under Moisture Stress Condition at Vegetative Stage

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Abstract

Present study was attempted with forty six F_3 families to trace the associations among twelve yield component characters under moisture stress condition at vegetative growth stage in rice during 2013. Grain yield per plant showed significant positive association with productive tillers per plant, filled spikelet per panicle and harvest index and significant negative association with days to flowering and days to maturity at both genotypic (r_g) and phenotypic (r_p) levels. Path coefficient analysis exhibited the positive direct effect on grain yield per plant via days to flowering, productive tillers per plant, spikelet fertility and 100 grain weight. In total, four characters viz., productive tillers per plant, filled spikelets per panicle, spikelet fertility and harvest index showed highly significant positive correlation coefficients along with high direct effects on grain yield per plant indicating selection based on these characters could be very effective in selecting high yielding genotypes under moisture stress condition at vegetative stage stress in rice.

Keywords: Correlation; Moisture stress; Vegetative stage; Grain yield; Rices

Introduction

In grass family, Rice (*Oryza sativa L.*) is the most important staple food crop for more than half of the world's population [1]. In India, rice is cultivated on 44.00 million hectares of area with a production of 103.00 million tons and productivity of 2.34 t/ha [2-4]. Rice is cultivated in diverse agro-ecosystems viz., rainfed lowland, and flood prone, upland, irrigated and aerobic conditions. Dynamics in climatic factors brought water scarcity to rice cultivation which led to reduction in the production.

Grain yield is the ultimate criterion which a plant breeder always keep in mind, while developing new variety with high yield potential. However, while carrying out selection for a highly variable character like grain yield, straight selection may not always be efficient since it is a polygenic character largely influenced by environment? In any yield improvement program, knowledge of associations between yield and its component characters is very essential. Hence, the investigation was carried out with the objective to study associations between yield and yield component characters which will be useful in formulating selection criteria for high yielding genotypes in rice crop improvement programmer.

Materials and Method

Experimental location and material used

Current study was conducted at K block, Department of Genetics and Plant Breeding, University of Agricultural Sciences, GKVK, Bengaluru-560 065, Karnataka, India (12° 58' North latitude, 77° 35' East longitude and 930 meter above mean sea level) during 2013. Experimental plant material considered in the study includes 46 F_3 families of rice derived from the cross RB6×QRT25. The parental line RB6 (sensitive to moisture stress), a recombinant inbred line derived from RpBio×BL122 and QRT25 (tolerant to moisture stress), a near isogonics line derived from IR64×Azucena were used to develop F_3 families.

Experimental layout and Statistical analysis

Plant material was planted with a spacing of 20cmx20 cm in a randomized complete block design with two replications and evaluated for grain yield and yield component characters under moisture stress condition at peak vegetative growth stage. Moisture stress was imposed at vegetative stage of crop growth for a period of 15 days (from 61 to 75 days after sowing)

by withholding irrigation and preventing rain water using a rainout-shelter.

Observations were recorded on 10 randomly selected plants per family in both the replications on 12 yield component characters *viz*., PHT-plant height (cm), DF-days to flowering, DM-days to maturity, PT-productive tillers per plant, PL-panicle length (cm), PE-panicle exsertion (cm), FS-filled spikelet per panicle, SF-spikelet fertility (%), 100GW-100 grain weight (g), BM-biomass per plant (g) and HI-harvest index (%) along with GYLD-grain yield per plant (g) by following IRRI standard evaluation system. The recommended package of practice (UAS, Bangalore, India) was followed to raise a good crop of rice under moisture stress condition at peak vegetative growth stage.

Data analysis of each character was carried out using mean values of 10 randomly selected plants from each family in each replication. Correlation coefficients between all pairs of characters were determined using the method suggested by Webber & Moorthy [5], and then were compared with 'r' values given by Snedecor [6] at (n-2) degrees of freedom at the probability levels of 0.05 and 0.01 to test their significance. Path coefficient analysis was carried out as suggested by Wright [7] and illustrated by Dewey and Lu [8], which unveils the direct and indirect effects of different component characters on grain yield per plant.

Results and Discussion

Correlation coefficient analysis among yield and yield component characters

Table 1: Genotypic correlation (r_g) coefficients of yield component characters on grain yield, evaluated under moisture stress condition at peak vegetative growth stage in rice.

Characters	LA	DF	DM	PT	PL	PE	FS	SF	100GW	BM	HI	GYLD
PHT	0.67**	-0.37**	-0.40**	0.18	0.22*	0.62**	0.31*	0.04	0.17	0.74**	-0.29	0.27
LA	1	0.24	0.20	-0.13	0.36*	0.28	0.07	0.02	0.18	0.61**	0.01	0.18
DF		1	0.99**	-0.82**	-0.15	-0.94**	-0.20	-0.001	-0.4**	0.53**	-0.75**	-0.67**
DM			1	-0.29*	-0.22	-0.43**	-0.28	-0.05	-0.36*	0.50**	-0.86**	-0.88**
PT				1	0.48**	0.29*	0.29*	0.17	0.33*	-0.06	0.22	0.35*
PL					1	0.35*	0.14	-0.15	0.18	0.90**	-0.15	0.47**
PE						1	0.47**	0.49**	0.55**	-0.71**	0.88**	0.74**
FS							1	0.77**	-0.22	0.3**	0.26	0.64**
SF								1	-0.30*	0.11	0.26	0.53**
100GW									1	-0.47**	0.26	-0.8**
BM										1	-0.68**	-0.43**
HI											1	0.97**

* and ** = Significant at 5 % and 1 % respectively.

Table 2: Phenotypic correlation (r_p) coefficients of yield component characters on grain yield, evaluated under moisture stress condition at peak vegetative growth stage in rice.

Characters	LA	DF	DM	PT	PL	PE	FS	SF	100GW	BM	HI	GYLD
PHT	0.1	-0.27	-0.29	0.11	0.46**	0.33*	0.27	0.04	0.03	0.31*	-0.14	0.17
LA	1	0.13	0.1	-0.06	0.21	0.07	0.07	0.02	0.1	0.05	-0.02	0.06
DF		1	0.97	-0.32*	-0.24	-0.44**	-0.16	-0.01	-0.2	0.04	-0.30*	-0.29*
DM			1	-0.32*	-0.25	-0.42**	-0.2	-0.05	-0.14	0.05	-0.34*	-0.32*
PT				1	0.1	0.08	0.15	0.09	0.1	0.17	0.24	0.46**
PL					1	0.35*	0.06	-0.06	0.14	0.35*	-0.13	0.23
PE						1	0.13	0.15	0.09	0.19	-0.01	0.21
FS							1	0.78**	-0.15	0.13	0.19	0.32*
SF								1	-0.2	0.07	0.17	0.27
100GW									1	0.03	0.03	0.09
BM										1	-0.52**	0.37**
HI											1	0.57**

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* and ** = Significant at 5 % and 1 % respectively.

Genotypic and phenotypic correlation coefficients between different pairs of yield and yield component characters are presented in Table 1 & 2 respectively. Grain yield per plant showed significant positive association with productive tillers per plant (r_g=0.35, r_p=0.46), filled spikelet per panicle (0.64, 0.32) and harvest index (0.97, 0.57) at both genotypic (r_g) and phenotypic (r_p) levels. However, grain yield per plant exhibited significant negative association with days to flowering (r_g= -0.67, r_p= -0.29) and days to maturity (-0.88, -0.32) at both genotypic and phenotypic levels. In most of the cases, estimates of genotypic correlation coefficients were higher than the corresponding phenotypic correlation coefficients indicating suppression of environment effect on the characters and could be used as surrogates for selection of genotypes with high grain yield. Earlier studies by Saimuraliraj [9], Gireesha [10] and Haider, et al. [11] were reported similar findings of significant positive association of productive tillers per plant and harvest index on grain yield, both at phenotypic and genotypic levels under moisture stress conditions. While, Pantuwan et al. [12] in a study observed a significant negative association of grain yield with days to flowering both at genotypic and phenotypic levels.

Path coefficients analysis of yield component characters on grain yield

Table 3: Estimates of direct and indirect effects of yield attributing characters on grain yield, evaluated under moisture stress condition at peak vegetative growth stage in rice.

Characters	PHT	DF	DM	PT	PL	PE	SF	FS	100GW	HI	'r$_g$'	'r$_p$'
PHT	**-0.044**	-0.039	0.035	0.017	-0.004	-0.023	0.001	-0.035	0.007	0.052	**0.274**	**0.169**
DF	0.016	**0.107**	-0.088	-0.1	0.001	0.018	0.001	0.037	-0.015	0.132	**-0.677****	**-0.288**
DM	0.018	0.107	**-0.087**	-0.115	0.001	0.021	-0.001	0.044	-0.014	0.151	**-0.882****	**-0.324***
PT	-0.008	-0.12	0.114	**0.089**	-0.002	-0.038	0.002	-0.043	0.013	-0.039	**0.354***	**0.463****
PL	-0.055	-0.016	0.02	0.043	**-0.003**	-0.007	-0.002	-0.018	0.007	0.028	**0.472****	**0.23**
PE	-0.054	-0.101	0.099	0.181	-0.001	**-0.019**	0.006	-0.072	0.021	-0.155	**0.74****	**0.211**
SF	-0.002	0.001	0.005	0.015	0.001	-0.009	**0.012**	-0.083	-0.012	-0.046	**0.533****	**0.271**
FS	-0.013	-0.032	0.032	0.031	-0.001	-0.011	0.008	**-0.123**	0.006	-0.057	**0.628****	**0.33***
100GW	-0.008	-0.043	0.032	0.029	-0.001	-0.011	-0.004	-0.02	**0.038**	-0.046	**-0.018**	**0.086****
HI	0.013	-0.08	0.076	0.02	0.001	-0.017	0.003	-0.04	0.01	**-0.174**	**0.975****	**0.567****

Residual effect: 0.09, Where, 'rg' - Genotypic correlation coefficient, 'rp'- Phenotypic correlation coefficient.

Path coefficient analysis (Table 3) revealed that the positive direct effect on grain yield per plant was exhibited by days to flowering (0.107), productive tillers per plant (0.089), spikelet fertility (0.012) and 100 grain weight (0.038). The findings are in agreement with the earlier studies in rice by Manickavelu et al. [13] & Basavaraj et al. [14]. Among the yield component characters, four characters *viz*., productive tillers per plant, filled spikelets per panicle, spikelet fertility and harvest index showed highly significant positive correlation coefficients along with high direct effects on grain yield per plant indicating selection based on these characters could be very effective for the improvement of grain yield under moisture stress condition at vegetative stage stress in rice [15].

Conclusion

Present study isolated four characters *viz*., productive tillers per plant, filled spikelets per panicle, spikelet fertility and harvest index out of twelve yield component characters studied which are ideal to consider in a selection strategy for selection of genotypes with high grain yield under moisture stress situation at vegetative stage in rice.

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