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Interrelationships for yield and component traits in rainfed upland rice

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ABSTRACT

A field experiment, with one hundred twelve diverse genotypes of rice, was conducted during wet season, 2007 at G.P.B. Research Farm of NDAU&T, Kumarganj, Faizabad to estimate the interrelationships under severe drought condition. The observations were recorded on eleven characters of yield and its attributes. The grain yield plant^{-1} reflected strong positive association with harvest index and spikelet fertility at phenotypic and genotypic levels. Path analysis indicated that harvest index and biological yield plant^{-1} contributed directly to grain yield plant^{-1}, while spikelet fertility, spikelets panicle^{-1}, panicle bearing tillers plant^{-1}, panicle length and days to 50% flowering were found to be important indirect contributors to grain yield. Besides, certain traits were found to be inter-correlated with each other. On the basis of overall mean performance associated with yield and its attributes the genotypes viz., NDR 509, IR 72049-B-R-22-3-1-1-B. IR 71695-3R-60-3-1 and IR 47547-3B-26-2B-1 were found promising.

Key words: *rice, correlation, path analysis, rainfed upland and drought condition*

Developing drought tolerant rice cultivars is considered to be one of the most effective and economic approaches to ensuring food security (Verma and Srivastava, 2004). A large portion about 70% of area under rice in India is drought prone rain fed, but it has not been exploited to full potential due to lack of suitable drought tolerant or resistant varieties. Grain yield in rice is a complex quantitative trait, dependent on several other component characters. The selection aimed at developing superior genotypes based on yield components, is likely to be more efficient. An attempt was made to identify important grain yield components in rainfed upland rice under severe drought condition. The objective of the present study, was to analyze the interrelationships, direct and indirect influences contributing traits for grain yield.

One hundred twelve genotypes of rice showing wide spectrum of variation for various characters, were evaluated under rainfed upland condition at G.P.B. Research Farm of NDAU&T, Kumarganj, Faizabad following Randomized Complete Block Design with three replications. Each plot consisted of single row of 3 m length, following between rows and within rows spacing of 20 cm and 15 cm, respectively. The low precipitation of irregular rainfall during the crop growth period 690.0 mm resulted into drought at both vegetative as well as reproductive phases while the average rainfall is about 1000 mm in this zone. The observations were recorded on 5 randomly selected competitive plants in each plot for days to 50% flowering, size of flag leaf, panicle bearing tillers plant^{-1}, plant height, panicle length, spikelets panicle^{-1}, spikelet fertility, test weight, biological yield plant^{-1}, harvest index and grain yield plant^{-1}. Correlation coefficients were worked out as per Panse and Sukhatme (1967) and Falconer (1981), while path coefficient was studied following Dewey and Lu (1959).

Analysis of variance revealed highly significant differences among entries for all the 11 characters. In general, genotypic correlations were higher than the corresponding phenotypic correlations indicating the existence of strong inherent associations, which might be due to masking or modifying effects of environment (Table 1). The genotypic and phenotypic correlations followed similar trend in direction and magnitude suggesting that reliance could be placed on both phenotypic as well as genotypic levels. Grain yield plant^{-}

Table 1. Estimates of phenotypic (upper) and genotypic (lower) correlation coefficients between different characters in rice germplasm lines under rainfed condition

Character	Size of flag leaf (cm^2)	Panicle bearing tillers $plant^{-1}$	Plant height (cm)	Panicle length (cm)	Spikelets $panicle^{-1}$ (%)	Spikelet fertility (g)	Test weight (g)	Biological yield $plant^{-1}$	Harvest index (%)	Grain yield $plant^{-1}$ (g)
Days to 50% flowering	-0.220	0.145	-0.392**	-0.369**	0.199	-0.122	-0.182	0.071	0.111	0.091
	-0.238	0.172	-0.417	-0.407	0.271	-0.139	-0.186	0.077	0.116	0.097
Size of flag leaf (cm^2)		-0.079	0.217	0.386**	0.204	-0.075	-0.210	0.059	-0.008	0.057
		-0.106	0.248	0.448	0.236	-0.095	-0.227	0.061	-0.014	0.066
Panicle bearing tillers $plant^{-1}$			-0.038	0.045	0.168	-0.043	-0.154	0.342**	0.101	0.222
			-0.093	0.044	0.273	-0.069	-0.243	0.375	0.156	0.279
Plant height (cm)				0.556**	-0.020	0.151	0.207	0.210	-0.015	0.067
				0.585	-0.058	0.187	0.225	0.206	-0.019	0.058
Panicle length (cm)					0.186	0.064	0.177	0.171	0.123	0.224
					0.248	0.046	0.209	0.166	0.150	0.253
Spikelets $panicle^{-1}$						0.025	-0.242	0.389**	0.105	0.234
						0.007	-0.304	0.436	0.125	0.253
Spikelet fertility (%)							0.022	0.307*	0.313*	0.351**
							0.024	0.310	0.345	0.383
Test weight (g)								-0.109	-0.113	-0.106
								-0.134	-0.114	-0.114
Biological yield $plant^{-1}$ (g)									-0.083	0.225
									-0.099	0.227
Harvest index (%)										0.904**
										0.920

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

$^{-1}$ displayed strong positive association with harvest index and spikelet fertility at phenotypic and genotypic levels indicating that yield increased whenever there was increase in the estimates of these characters. These characters can be considered as criteria for selection of higher yield under drought condition. Rao and Srivastava (1999) and Verma and Srivastava (2004) reported the similar results. However, test weight has negative association with grain yield $plant^{-1}$, days to 50% flowering, size of flag leaf, panicle bearing tillers $plant^{-1}$ and spikelets $panicle^{-1}$ suggesting the antagonistic association of test weight with these traits. The findings were in conformity with the results of Verma and Srivastava (2004) for days to 50% flowering. The remaining characters registered positive but non-significant association with grain yield indicating that these were not important yields contributing traits. Besides, these negative associations between different traits were observed which could arise primarily from developmentally induced relationships. Biological yield $plant^{-1}$ was positively correlated with panicle bearing tillers $plant^{-1}$, spikelets $panicle^{-1}$ and spikelet fertility while panicle length showed positive association with size of flag leaf and plant height at phenotypic as well as genotypic levels.

Path coefficient analysis (Table 2) indicated that harvest index and biological yield $plant^{-1}$ contributed directly to grain yield $plant^{-1}$, while spikelet fertility, spikelets $panicle^{-1}$, panicle bearing $plant^{-1}$, panicle length and days to 50% flowering exerted important indirect influences on grain yield through associated traits. This is inconformity with the findings of Verma and Srivastava (2004), Ashwani Panwar *et al.,* (2007) and Panwar and Ali (2007). The low residual effect indicated that most of the casual factors were accounted in determining the end product. Therefore, as indicated

Table 2. Direct and indirect effects of different characters on grain yield plant $^{-1}$ at phenotypic (upper) and genotypic (lower) levels in rice germplasm lines under rainfed condition

Character	Days to 50% flowering	Size of flag leaf (cm^2)	Panicle bearing tillers plant^{-1}	Plant height (cm)	Panicle length (cm)	Spikelets panicle^{-1} (%)	Spikelet fertility (g)	Test weight plant^{-1} (g)	Biological yield (%)	Harvest index yield	Correlation with grain
Days to 50% flowering	-0.037	0.004	-0.001	0.011	-0.020-	0.002	0.007	-0.005	0.024	0.106	0.091
	-0.029	0.006	-0.001	0.016	0.032	-0.003	0.007	-0.003	0.025	0.111	0.097
Size of flag leaf (cm2)	0.008	0.019	0.001	-0.006	0.021	0.002	0.005	-0.006	0.020	-0.007	0.057
	0.007	0.027	0.001	-0.010	0.036	-0.003	0.005	-0.004	0.020	-0.014	0.066
Panicle bearing tillers plant^{-1}	-0.005	0.001	0.009	0.001	0.002	0.022	0.003	-0.004	0.117	0.097	0.222
	-0.005	0.003	0.005	0.004	0.004	-0.003	0.004	-0.004	0.123	0.150	0.279
Plant height (cm)	0.014	-0.004	0.000	-0.028	0.030	0.000	-0.009	0.006	0.072	-0.015	0.067
	0.012	-0.007	0.000	-0.039	0.047	0.001	-0.010	0.004	0.068	-0.018	0.058
Panicle length (cm)	0.014	-0.007	0.000	-0.015	0.055	0.002	-0.004	0.005	0.059	0.118	0.224
	0.012	-0.012	0.000	-0.023	0.080	-0.003	-0.002	0.003	0.054	0.144	0.253
Spikelets panicle^{-1}	-0.007	-0.004	-0.002	0.001	0.010	0.010	-0.002	-0.007	0.134	0.101	0.234
	-0.008	-0.006	-0.001	0.002	0.020	-0.011	0.000	-0.005	0.143	0.120	0.253
Spikelet fertility (%)	0.004	0.001	0.000	-0.004	0.004	0.000	-0.060	0.001	0.105	0.299	0.351**
	0.004	0.003	0.000	-0.007	0.004	0.000	-0.053	0.000	0.102	0.331	0.383
Test weight (g)	0.007	0.004	0.001	-0.006	0.010	-0.003	-0.001	0.027	-0.037	-0.108	-0.106
	0.005	0.006	0.001	-0.009	0.017	0.003	-0.001	0.016	-0.044	-0.110	-0.114
Biological yield plant^{-1} (g)	-0.003	-0.001	-0.003	-0.006	0.009	0.004	-0.019	-0.003	0.343	-0.095	0.227
	-0.002	-0.002	-0.002	-0.008	0.013	-0.005	-0.016	-0.002	0.328	-0.080	0.225
Harvest index (%)	-0.004	0.000	-0.001	0.000	0.007	0.001	-0.019	-0.003	-0.034	0.956	0.904**
	-0.003	0.000	-0.001	0.001	0.012	-0.001	-0.018	-0.002	-0.027	0.960	0.920

by correlation and path coefficient analysis, due emphasis should be given to select biological yield and harvest index for yield enhancement in rainfed upland rice eco-system in order to sustain the yield potential in this risk-prone target drought environment. The genotypes exhibiting high mean performance for grain yield along with higher performance for some other yield components were NDR 509, IR 72049-B-R-22-3-1-1-B. IR 71695-3R-60-3-1 and IR 47547-3B-26-2B-1 under rainfed upland rice growing ecosystem, which may be utilized in hybridization programme to select desirable recombinants.

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