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Association Studies for Yield and Its Traits in Rice (*Oryza sativa* L.) Genotypes

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A B S T R A C T

Association studies among seven traits were studied in 40 genotypes during *kharif*, 2015 at Agricultural Research Station, Kunaram, Telangana State. In general, genotypic correlation coefficients were higher than the corresponding phenotypic correlation coefficients suggesting that strong genetic association among the yield and yield components of rice. Correlation coefficient analysis showed that number of productive tillers per m^2 and 1000-grain weight exhibited significant positive correlation with yield at both genotypic and phenotypic levels. Significant negative correlation was observed between number of filled grains per panicle and yield. Path coefficient analysis revealed that positive direct effect of number of productive tillers per m^2 and days to 50% flowering on grain yield at both genotypic and phenotypic levels.

Introduction

Rice is the world's most important food and second most widely cultivated cereal in the world and is a staple food for more than half of the world's population. Rice grain yield being a complex trait, depends upon the various yield contributing traits like test weight, number of grains per panicle, panicle length, effective bearing tiller number etc. Character association derived by correlation coefficient which is one of the important biometrical tools for formulating a selection index as it reveals the strength of relationship among the group of traits. The type and extent of correlation between the yield and other characters helps in estimating the relative effect of the individual traits on yield improvement thereby enable the breeders to identify desirable traits that play a key role in yield improvement. Knowledge about the relationship between a trait with yield and other yield components would be helpful in selecting proper rice genotypes as parents in breeding programmes. Path analysis furnishes the information of influence of each contributing trait to yield directly as well as indirectly and also enables the breeders to rank the genetic attributes according to their contribution. The present study is aimed at

estimating the association between yield and its components for further improvement to derive high yielding rice genotypes with desirable agronomic traits to attain self sufficiency and meet the future demand resulting from population growth.

Materials and Methods

In the present research work study, material consisted of 40 rice genotypes (37 genotypes involving 11 diverse parental lines from ARS, Kunaram and three released promising varieties from APRRI, Maurteru; RARS, Jagtial and ARS, Bapatla) developed through pedigree method of breeding (Table 1). The seed was raised on nursery beds and 25 days old seedlings of each entry was transplanted under irrigated system with two replications in a RBD design during *kharif*, 2015 at Agricultural Research Station, Kunaram, Telangana. All the recommended package of practices and need based plant protection measures were followed to ensure healthy crop growth. The data was recorded at maturity on 5 random plants for plant height (cm), panicle length (cm), number of productive tillers per m^2 and number of grains per panicle. However, days to 50 % flowering and grain yield (kg) were recorded on whole plot basis, whereas, random sample was taken to estimate 1000 grain weight (g) for each entry in each replication. Number of productive tillers per plant values were converted into the number of productive tillers per m^2 and grain yield values recorded from the net plot (kg per plot) were converted in to hectare (kg per ha). The mean data after computing for each trait was subjected to analysis of variance and estimates of correlations and path coefficients were determined to estimate the type and degree of association among the yield and its characters. Genotypic and Phenotypic correlation coefficients for all the possible comparisons were computed.

Results and Discussion

Analysis of variance revealed highly significant differences among the genotypes for all the traits studied indicating the presence of considerable amount of variability among the genotypes (Table 2). Calculation of correlation between yield and its traits, and among the traits plays an important role in selection of desirable genotypes. Genotypic and phenotypic correlations were in perfect agreement with each other and relatively higher magnitude of genotypic correlations indicated the masking effect of the environment. Similar results were reported by Ravindra babu *et al*., (2012), Mohan *et al*., (2015), Ratna *et al*., (2015) and Kalyan *et al*., (2017). The grain yield (kg per ha) showed significantly positive correlation with number of productive tillers per m^2 and 1000-grain weight at both genotypic and phenotypic levels. These results clearly indicated that genotypes with more number of productive tillers per m^2 and bold grains contribute for more grain yield (kg per ha). These results are in agreement with Akinwale *et al.*, (2011), Ravindra babu *et al*., (2012) and Ratna *et al*., (2015) for productive tillers per plant and, Mohan *et al.,* (2015) and Islam *et al*., (2016) for test weight. Days to 50% flowering exhibited significant positive association with number of grains per panicle and number of productive tillers per m^2, whereas, it manifested significant negative correlation with 1000-grain weight. The trait, number of grains per panicle showed significant negative correlation with grain yield (kg per ha) and 1000-grain weight indicating the practice of selecting bold grain genotypes would enhance the yield levels (Table 3). Akinwale *et al*., (2011), Ruth Elizabeth Ekka *et al.,* (2011), Ravindra babu *et al*., (2012), Gopikannan and Ganesh (2013) and Ratna *et al*., (2015) reported the positive association of grain yield (kg per ha) with filled grains per panicle which was contradictory with this study.

Table.1 List of genotypes studied along with the pedigree and grain type

s S.No.	Genotype	Pedigree	rain type
1	CNM 2108	MTU 1001 X JGL 11470	MS
2	CNM 2211	MTU 1001 X JGL 11727	LS
3	CNM 2230	BPT 5204 X JGL 3828	MS
4	CNM 2231	BPT 5204 X JGL 3828	MS
5	CNM 2237	JGL 3855 X JGL 11470	MS
6	CNM 2242	JGL 3855 X JGL 11470	MS
7	CNM 2246	JGL 3855 X JGL 11470	MS
8	CNM 2249	JGL 3855 X JGL 11470	MS
9	CNM 2250	JGL 3855 X JGL 11470	MS
10	CNM 2251	JGL 3855 X JGL 11470	MS
11	CNM 2254	JGL 3855 X JGL 11470	MS
12	CNM 2266	JGL 3828 X JGL 13595	MS
13	CNM 2275	JGL 13571 X JGL 11727	MS
14	CNM 2283	JGL 13571 X JGL 11727	MS
15	CNM 2285	JGL 13571 X JGL 11727	MS
16	CNM 2287	JGL 3828 X JGL 13595	MS
17	CNM 2289	JGL 11118 X Himalaya 741	MS
18	CNM 2300	JGL 11470 X Himalaya 741	MS
19	CNM 2301	JGL 11470 X Himalaya 741	MS
20	CNM 2302	JGL 11470 X Himalaya 741	MS
21	CNM 2303	JGL 11470 X Himalaya 741	LS
22	CNM 2311	JGL 11727 X JGL 17004	MS
23	CNM 2312	JGL 11727 X Himalaya 741	MS
24	CNM 2314	JGL 11470 X Himalaya 741	MS
25	JGL 3844	Released variety from RARS, Jagtial.	MS
26	BPT 5204	Released variety from ARS, Bapatla.	MS
27	CNM 2110	MTU 1001 X JGL 11727	LS
28	CNM 2112	MTU 1001 X JGL 11727	LS
29	CNM 2114	MTU 1001 X JGL 11727	LS
30	CNM 2118	MTU 1001 X JGL 11727	LS
31	CNM 2119	MTU 1001 X JGL 11727	LS
32	CNM 2207	MTU 1001 X JGL 11727	LS
33	CNM 2213	MTU 1001 X JGL 11727	LS
34	CNM 2290	JGL 11118 X Himalaya 741	LS
35	CNM 2305	JGL 11470 X Himalaya 741	LS
36	CNM 2307	JGL 11727 X JGL 17004	LS
37	CNM 2321	JGL 11470 X Himalaya 741	LS
38	CNM 2326	JGL 11118 X Himalaya 741	LS
39	CNM 2332	JGL 11118 X Himalaya 741	LS
40	MTU 1010	Released variety from APRRI, Maurteru.	LS

LS: Long slender; MS: Medium slender

Table.2 Mean squares corresponding to various sources of variation for seven traits in rice

Source of variation	Degrees of freedom	Days to 50% flowering	Plant height (cm)	Number of productive tillers per m^2	Panicle length (cm)	Number of grains per panicle	1000-grain weight (g)	Grain yield (kg/ ha)
Replications	1	0.01	0.92	1119.01	1.13	5126.40	0.02	1108263.00
Treatments	39	262.64**	211.16**	2082.54*	5.47**	7004.89**	47.61**	4718577.99**
Error	39	0.75	5.42	1208.36	0.72	1468.17	0.23	315815.28

*, ** significant at 5 and 1 per cent level

Table.3 Phenotypic (P) and genotypic (G) correlation coefficients among yield and other parameters in rice genotypes

Character		Days to 50% flowering	Plant height (cm)	Panicle length (cm)	Number of productive tillers per m^2	Number of grains per panicle	1000 grain weight (g)	Grain yield (kg/ ha)
Days to 50% flowering	**P**	1.0000	0.0565	-0.0077	0.1148	0.3638**	-0.3000**	0.0884
	G	1.0000	0.0639	0.0058	0.2252*	0.4544**	-0.3003**	0.0935
Plant height (cm)	**P**		1.0000	0.2843*	0.1961	0.0101	-0.1217	-0.0287
	G		1.0000	0.2940*	0.3687**	-0.0153	-0.1267	-0.0420
Panicle length (cm)	**P**			1.0000	0.1581	-0.1518	0.3297**	-0.0641
	G			1.0000	0.2162	-0.2452*	0.3744**	-0.1532
Number of productive tillers per m^2	**P**				1.0000	-0.2251*	0.1649	0.2422*
	G				1.0000	-0.0987	0.3318**	0.4432**
Number of grains per panicle	**P**					1.0000	-0.6287**	-0.2511*
	G					1.0000	-0.7840**	-0.3468**
1000 grain weight (g)	**P**						1.0000	0.2570*
	G						1.0000	0.2796*

P: Phenotypic correlation coefficients, G: Genotypic correlation coefficients
*, ** significant at 5 and 1 per cent level
Gen: R^2= 0.4855; Residual effect =0.7173
Phe: R^2= 0.1772; Residual effect =0.9071

Table.4 Phenotypic (P) and genotypic (G) path coefficients of yield and other parameters in rice genotypes

Character		Days to 50% flowering	Plant height (cm)	Panicle length (cm)	Number of productive tillers per m^2	Number of grains per panicle	1000 grain Weight (g)	Grain yield (kg/ ha)
Days to 50% flowering	**P**	**0.2002**	0.0113	-0.0015	0.0230	0.0728	-0.0601	0.0884
	G	**0.1977**	0.0126	0.0011	0.0445	0.0898	-0.0594	0.0935
Plant height (cm)	**P**	0.0010	**0.0183**	0.0052	0.0036	0.0002	-0.0022	-0.0287
	G	-0.0170	**-0.2668**	-0.0784	-0.0983	0.0041	0.0338	-0.0420
Panicle length (cm)	**P**	0.0016	-0.0581	**-0.2045**	-0.0323	0.0310	-0.0674	-0.0641
	G	-0.0014	-0.0718	**-0.2441**	-0.0528	0.0599	-0.0914	-0.1532
Number of productive tillers per m^2	**P**	0.0196	0.0334	0.0269	**0.1705**	-0.0384	0.0281	0.2422
	G	0.1364	0.2232	0.1309	**0.6055**	-0.0598	0.2009	0.4434
Number of grains per panicle	**P**	-0.0550	-0.0015	0.0229	0.0340	**-0.1511**	0.0950	-0.2511
	G	-0.3390	0.0114	0.1829	0.0736	**-0.7459**	0.5849	-0.3468
1000 grain weight (g)	**P**	-0.0791	-0.0321	0.0869	0.0435	-0.1657	**0.2636**	0.2570
	G	0.1169	0.0493	-0.1457	-0.1291	0.3052	**-0.3892**	0.2796

P: Phenotypic path coefficients, G: Genotypic path coefficients

The direct positive effect of number of productive tillers per m^2 on grain yield (kg per ha) and positive significant correlation between these two traits indicates that true relationship and direct selection through this trait would be more effective for the improvement. Positive direct effect of the trait, days to flowering on grain yield (kg per ha) was reported by Chandra *et al.*, (2009) and Bhadru *et al*., (2011). Rice workers *viz*., Madhavilatha (2002), Khedikar *et al*., (2004), Ruth Elizabeth Ekka *et al*., (2011), Ravindra babu *et al*., (2012), Gopikannan and Ganesh (2013) and Ratna *et al.*, (2015) found the positive direct effect and significant correlation between productive tillers per plant and grain yield (kg per ha) which supported the present finding. On the other hand, number of grains per panicle and panicle length exhibited negative direct effect on grain yield (kg per ha) suggesting the non reliability of these traits in selection process for improving the grain yield (kg per ha) using present experimental material. These results were in conformity with Ganesan *et al*., (1997), Nayak *et al*., (2001), Madhavilatha (2002), Nagaraju *et al*., (2013) and Rao *et al*., (2014) for number of filled grains per panicle; Basava raja *et al*., (2011), Padmaja *et al*., (2011) and Mohanty *et al*., (2012) for panicle length. Number of grains per panicle and 1000-grain weight had direct negative and positive effects at phenotypic level on grain yield (kg per ha), respectively (Table 4). Simultaneous improvement of these both traits is not possible as they are negatively correlated with each other. Therefore, appropriate balance should be attained between them to get high yield.

It is concluded that number of productive tillers per m^2 and 1000-grain weight had strong genetic association with grain yield, and the traits number of productive tillers per m^2 and days to 50% flowering registered positive direct effect on grain yield (kg per ha) in studied genotypes. Thus, these plant traits deserve greater attention in further breeding programmes for developing high yielding rice varieties.

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