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RESEARCH ARTICLE

GENETIC VARIABILITY, CORRELATION AND PATH ANALYSIS IN RICE (*Oryza Sativa* L.)

***P. Satheeshkumar and K. Saravanan**

Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, Annamalai Nagar – 608 002. Tamilnadu, India

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ABSTRACT

Estimates of variability, heritability, genetic advance, correlation and path analysis were carried out in rice for fifteen characters. The highest genotypic and phenotypic coefficient of variation for number of productive tillers per plant, grain L/B ratio and grain yield per plant. High heritability were observed for all the characters, except kernel breadth. High genetic advance as percent of mean were observed for all the characters except spikelet fertility and kernel breadth. Grain yield per plant exhibited high significant and positive genotypic correlation with number of productive tillers per plant, filled grains per panicle and total number of grains. Path analysis showed maximum positive direct effects for kernel L/B ratio, kernel length, filled grains per panicle, total number of grains and number of productive tillers per plant. Hence, the selection based on these traits could be more effective in rice.

INTRODUCTION

The presence and magnitude of genetic variability in a gene pool is the pre-requisite of a breeding programme. Heritability estimates provide the information on the proportion of variation that is transmissible to the progenies in subsequent generations. Genetic advance provides information on expected genetic gain resulting from selection of superior individuals. The grain yield is a complex character, quantitative in nature and an integrated function of a number of component traits. Therefore, selection for yield *per se* may not be much rewarding unless other yield attributing traits are taken into consideration. Correlation study provides a measure of association between characters and helps to identify important characters to be considered while making elucidates selection. The present study implication in deciding desirable traits for development of high yielding variability.

MATERIALS AND METHODS

The experimental material comprised of 53 genotypes (Table 1) were evaluated during samba season (September-January) 2010 and 2011 at the Plant Breeding Farm ($11^0$24' N latitude and 79^0 44' E longitude, $\pm$ 5.79m MSL), Annamalai University, Annamalai Nagar, Tamilnadu, South India. Seeds of the 53 genotypes were sown in raised nursery bed. The seedlings were transplanted to the mainfield at the rate of one seedling per hill, after 25 days, with a spacing of 20cm x 15cm. The experiement was arranged in a randomized complete block design with three replications, in four – row plots of 3m length. The recommended agronomical practices and plant protection measures were followed to ensure a normal crop. Observations were recorded on five randomly selected plants in each replication from the two centre rows. Fifteen traits *viz.* days to first flowering, plant height (cm), number of productive tillers per plant, panicle length (cm), filled grains per panicle, total number of grains per panicle, spikelet fertility, 100 grain weight (g), grain length (mm), grain breadth (mm), grain L/B ratio, kernel length (mm), kernel breadth (mm), kernel L/B ratio and grain yield per plant (g) were recorded. Correlation coefficient at the genotypes and phenotypic levels was computed from the variance and Co-variance components as suggested by panse and Sukhatme (1967). Path analysis was done as suggested by Dewy and Lu (1959).

Corresponding author: psnsathishkumar@gmail.com

RESULTS AND DISCUSSION

The analysis of variance showed highly significant differences among the various genotypes for the characters under study. This indicated that the genotypes were possessing inherent genetic variances among themselves with respect to the characters studied. A close examination of experimental results (Table 2) revealed a high estimate of phenotypic and genotypic coefficients of variation for grain L/B ratio, number of productive tillers per plant and grain yield per plant. These results indicated high degree of genetic variability (Sharma and Sharma 2007). A moderate value of phenotypic and Genotypic coefficients of variation was observed for days to first flower, plant height, panicle length, filled grains per panicle, total number of grains, hundred grain weight, grain length, grain breadth, kernel length and kernel L/B ratio. Similar results were reported by Awasthi and Borthakur (1986). However, Ganeshan *et al.,* (1995) differed with these observations and reported high genotypic coefficients of variation for these characters. A narrow magnitude of

Table 1. List of genotypes selected

Genotype code	Varieties / Cultures	Origin
G_1	ADT 36	Tamil Nadu Rice Research Institute (TRRI), Aduturai, Tamil Nadu, India.
G_2	ADT 37	
G_3	ADT 38	
G_4	ADT 39	
G_5	ADT 40	
G_6	ADT 41	
G_7	ADT 42	
G_8	ADT 43	
G_9	ADT 44	
G_{10}	ADT 45	
G_{11}	ADT 46	
G_{12}	ADT 47	
G_{13}	ADT 48	
G_{14}	ADT 49	
G_{15}	CR 1009	Central Rice Research Institute (CRRI), Cuttack, Orissa, India.
G_{16}	BPT 5204	Agricultural college, Bapatla, Andhra Pradesh, India.
G_{17}	IR 64	International Rice Research Institute (IRRI), Philippines.
G_{18}	IMPROVED WHITE PONNI	Paddy Breeding station, Coimbatore, Tamilnadu, India.
G_{19}	TRY-1	Agricultural College and Research Institute, Trichy, Tamilnadu, India.
G_{20}	TRY-2	
G_{21}	TRY-3	
G_{22}	CSR-30	Central Saline Soil Research Institute (CSSRI), Karnal, Haryana, India.
G_{23}	AURC39	Department of Genetics and plant Breeding Faculty of Agriculture, Annamalai University, Tamil Nadu, India
G_{24}	CO 49	Paddy Breeding station, Coimbatore, Tamilnadu, India.
G_{25}	AURC1	Department of Genetics and plant Breeding Faculty of Agriculture,
G_{26}	AURC3	Annamalai University, Tamil Nadu, India
G_{27}	AURC4	
G_{28}	AURC5	
G_{29}	AURC6	
G_{30}	AURC7	
G_{31}	AURC8	
G_{32}	AURC9	
G_{33}	AURC10	
G_{34}	AURC11	
G_{35}	AURC12	
G_{36}	AURC14	
G_{37}	AURC15	
G_{38}	AURC16	
G_{39}	AURC18	
G_{40}	AURC20	
G_{41}	AURC22	
G_{42}	AURC23	
G_{43}	AURC25	
G_{44}	AURC26	
G_{45}	AURC28	
G_{46}	AURC29	
G_{47}	AURC30	
G_{48}	AURC31	
G_{49}	AURC34	
G_{50}	AURC35	
G_{51}	AURC36	
G_{52}	AURC37	
G_{53}	AURC38	

Table 2. Mean, range, PCV, GCV, heritability and genetic advance for fifteen characters in Rice

Characters	Mean	Range	PCV (%)	GCV (%)	h^2 (%)	GA as % Mean
Days to first flower (days)	83.51±.0.46	66.00-105.00	12.28	12.24	99.38	25.14
Plant Height (cm)	101.03±1.61	69.85-151.70	16.21	15.97	97.06	32.41
Number of productive tillers per plant	13.84±0.66	9.50-27.30	26.05	24.69	89.82	48.20
Panicle Length (cm)	21.23±0.48	15.50-27.25	12.44	11.80	90.09	23.08
Filled grains per panicle	87.98±3.57	52.43-116.90	17.22	15.69	83.01	29.44
Total Number of grains	107.52±3.97	72.36-150.60	16.75	15.46	85.16	29.38
Spikelet Fertility	81.83±1.31	70.72-89.24	5.61	4.85	74.96	8.65
Hundred grain weight (g)	2.30±0.01	1.46-3.06	16.98	16.98	99.98	34.97
Grain Length (mm)	0.83±0.05	0.60-1.21	13.42	13.38	99.42	27.49
Grain Breadth (mm)	0.26±0.01	0.20-0.31	19.17	19.11	99.45	39.28
Grain L/B ratio	3.39±0.04	1.99-5.75	27.74	27.64	99.31	56.75
Kernel Length (mm)	0.61±0.04	0.41-0.90	13.60	13.56	99.39	27.85
Kernel Breadth (mm)	0.20±0.03	0.20-0.22	2.94	1.52	26.78	1.62
Kernel L/B ratio	3.00±0.05	1.96-4.54	13.77	13.45	95.54	27.09
Grain yield per Plant (g)	17.96±0.50	14.49-23.25	22.56	21.94	86.92	22.15

Table 3. Phenotypic and Genotypic correlation for fifteen quantitative characters in rice

		DF (days)	PH (cm)	NPT	PL (cm)	FGP	TNG	SF	HGW (g)	GL (mm)	GB (mm)	GLBR	KL (mm)	KB (mm)	KLBR	GYD (g)
DF (days)	P	1.0000	.4653**	-.2732*	.3276*	.3511*	.3364*	.1229	.1401	-.2916*	.1826	-.2897*	-.1855	.0612	-.2010	-.1392
	G	1.0000	.4723**	-.2927*	.3436*	.3839**	.3627**	.1426	.1406	-.2936*	.1844	-.2921*	-.1857	.0997	-.2029	-.1606
PH (cm)	P		1.0000	-.1341	.4281**	.3851**	.3491*	.1400	.1927	-.2745*	.3659**	-.4056**	-.2840*	-.0801	-.2662	-.0998
	G		1.0000	-.1495	.4379**	.4269**	.3819**	.1611	.1955	-.2796*	.3718**	-.4131**	-.2902*	-.1448	-.2791*	-.1455
NPT	P			1.0000	.0375	-.1421	-.1253	-.1237	-.2469	.3374*	-.1940	.3205*	.2942*	-.0421	.3029*	.2511
	G			1.0000	.0326	-.1769	-.1575	-.1439	-.2604	.3586**	-.2098	.3440*	.3163*	-.0998	.3352*	.3029*
PL (cm)	P				1.0000	.3613**	.3395*	.1051	.1773	.0971	.1200	-.0494	.0149	.0200	.0079	.1216
	G				1.0000	.3911**	.3636**	.1243	.1866	.1056	.1205	-.0459	.0134	.0227	.0087	.1490
FGP	P					1.0000	.9423**	.3186*	.0965	-.1945	.1298	-.2084	-.1403	-.0523	-.1288	.3700**
	G					1.0000	.9484**	.2940*	.1058	-.2128	.1396	-.2267	-.1574	-.2400	-.1333	.4440**
TNG	P						1.0000	-.0091	.0184	-.2246	.0925	-.1902	-.2115	-.1069	-.1886	.3477*
	G						1.0000	-.0174	.0199	-.2421	.0970	-.2038	-.2328	-.3206*	-.2006	.3971**
SF	P							1.0000	.2706	.0729	.1421	-.0849	.1907	.1653	.1559	.1494
	G							1.0000	.3125*	.0837	.1636	-.0976	.2203	.2718	.1917	.2308
HGW	P								1.0000	.2148	.5183**	-.2505	.2551	.1965	.2123	.0720
(g)	G								1.0000	.2155	.5197**	-.2513	.2559	.3795**	.2173	.0820
GL	P									1.0000	-.3198*	.7393**	.8988**	.0510	.8816**	.0643
(mm)	G									1.0000	-.3200*	.7404**	.9041**	.1143	.9027**	.0625
GB	P										1.0000	-.8700**	-.3255*	-.0523	-.3338*	.0989
(mm)	G										1.0000	-.8698**	-.3272*	.1041	-.3425*	.1098
GLBR	P											1.0000	.6911**	-.0165	.6896**	-.0416
	G											1.0000	.6952**	-.0257	.7068**	-.0510
KL	P												1.0000	.0671	.9782**	.0236
(mm)	G												1.0000	.1676	.9941**	.0242
KB	P													1.0000	-.1397	-.0083
(mm)	G													1.0000	.0606	.0155
KLBR	P														1.0000	.0254
	G														1.0000	.0243

* Significant 5% Level ** Significant 1% Level

Table 4. Genotypic Path Coefficient for fifteen components in rice

	DF (days)	PH (cm)	NPT	PL (cm)	FGP	TNG	SF	HGW (g)	GL (mm)	GB (mm)	GLBR	KL (mm)	KB (mm)	KLBR	GYD (g)
DF (days)	.2356	-.1113	-.0554	-.0809	-.0904	-.0854	-.0336	-.0331	.0692	-.0435	.0688	.0437	-.0235	-.0208	-.1606
PH (cm)	-.1886	-.3994	.0597	-.1749	-.1805	-.1525	-.0644	.1781	.1117	.1485	.1716	.1159	.1178	.1115	-.1455
NPT	-.1522	-.1778	1.5202	.0169	-.0920	-.0873	-.0748	-.1355	-.3114	-.1691	.1789	.1645	-.0519	-.3256	.3029*
PL (cm)	.0180	.0229	.0017	.0524	.0205	.0190	.0065	.0028	.0055	.0063	-.0090	.0007	.0012	.0005	.1490
FGP	-.8004	-.8601	.3688	-.8154	2.0851	-1.8574	-.6131	-.2110	1.4436	-.2911	1.4728	1.3282	-2.1063	1.3003	.4440**
TNG	.9618	1.0126	-.4178	.9642	2.5149	1.8554	-.9461	.6273	-2.6420	.6544	-.5873	-1.2182	-1.8501	-.5320	.3971**
SF	.1484	.1677	-1.1497	.1293	.3059	-1.0181	.4405	.3252	1.0879	.1703	-1.0882	.2293	.2829	.1994	.2308
HGW (g)	.0201	.0279	-.0372	.0267	.0151	.0028	.0446	-.1428	.0308	-.0001	-.0359	.0366	.0542	.0392	.0820
GL (mm)	-.0425	-.0434	.0019	.0153	-.1308	-.1350	.0121	.0312	.1400	-.1463	.1021	.1108	.0165	.1306	.0625
GB (mm)	.0188	.0378	-.0213	.0123	.0142	.0099	.0166	.0529	-.0325	.1017	-.0471	-.0333	.0146	-.0348	.1098
GLBR	.0013	.0019	-.0716	.0002	.0019	.0009	.0034	.0011	-.0033	.0239	-.0045	-.0031	.0001	-.0032	-.0510
KL (mm)	-.4181	-.6536	-.7122	.0303	-.3544	-.5243	.4962	-.5763	2.0171	-.7367	1.5656	2.2519	.1773	-2.5386	.0242
KB (mm)	-.0202	.0293	.0402	-.0057	.0485	.0648	.0549	.0767	-.1231	-.1210	.0052	-.1339	.2121	-.1123	.0155
KLBR	.5287	.7270	-.8732	-.2227	.3472	.5226	-.4993	-.5660	-2.4318	.8922	1.8422	-2.5896	-.2580	2.6050	.0243
GYD (g)	.2356	-.1113	-.0554	-.0809	-.0904	-.0854	-.0336	-.0331	.0692	-.0435	.0688	.0437	-.0235	-.0208	-.1606

Residual effect 0.1926 * Significant 5% Level ** Significant 1% Level

difference between phenotypic and Genotypic coefficients of variation for characters, namely days to first flower, plant height, panicle length, total number of grains per panicle, spikelet fertility, hundred grain weight, grain length, grain breadth, grain L/B ratio, kernel length, kernel L/B ratio and grain yield per plant. Suggested a limited role of environmental variation in the expression of these characters. Thus selection based on genotypic performance of the characters would be effective to bring about considerable improvement in these characters. The estimates of heritability were observed to be high in magnitude for all the characters, except kernel breadth. The percentage of heritability is ranged from 26.78 per cent (kernel breadth) and 99.98 per cent (hundred grain weight) (Table 2). Similar results were reported by Panwar and Gupta (1967) for days to first flower, panicle length and hundred grain weight. High estimates of heritability coupled with high genetic advances were observed for the characters *viz*., days to first flower, plant height, number of productive tillers per plant, panicle length, filled grains per panicle, total number of grains, hundred grain weight, grain length, grain breadth, grain L/B ratio, kernel length, kernel L/B ratio and grain yield per plant. Low genetic advances were observed for spikelet fertility and kernel breadth (Table 2).

In the present investigation, the genotypic correlation coefficients were generally higher than their respective phenotypic correlation coefficients (Table 3). At phenotypic level, grain yield per plant exhibited highly significant and positive correlation with filled grains per panicle and total number of grains. In genotypic level grain yield per plant exhibited highly significant and positive correlation with number of productive tillers per plant, filled grains per panicle and total number of grains. Similar results were reported by Lalitha and Shreedhar (1996). A perusal of the correlation coefficients at genotypic level revealed that days to first flower, plant height, number of productive tillers per plant and grain length were highly and positive correlated with each other indicating that these characters are interdependent. Selection of any easily observable traits among these will ultimately enhance the mean performance of all the concerned interdependent characters. Genotypic path analysis studies revealed that the all the characters were showed positive direct effects except for plant height, hundred grain weight and grain L/B ratio (Table 4). The maximum positive direct effects were observed for kernel L/B ratio, kernel length, filled grains per panicle, total number of grains, and number of productive tillers per plant. Positive direct effect as well as correlation coefficients indicated that selection may be exercised for these traits for yield improvement. Similar results were reported by Janardhanm *et al* (2001), Makwana *et al* (2010) and Yolanda and Das (1995). The result revealed high estimates of genotypic and phenotypic coefficient of variation for number of productive tillers per plant, grain L/B ratio and grain yield per plant. Estimates of heritability in broad sense coupled with high genetic advance as per cent of mean were observed for all the traits except spikelet fertility and kernel breadth. grain yield per plant exhibited high significant and positive genotypic correlation with number of productive tillers per plant, filled grains per panicle and total number of grains. Hence, the selection based on these traits could be more effective in rice.

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