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Research Note

Genetic analysis and correlations in mid early genotypes of rice (*Oryza sativa* L.) under irrigated condition

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Abstract
Sixty four mid early rice genotypes of diverse origin, with three check varieties *viz*., IR 64 (National), MTU 1010 (Southern Regional) and Jyothi (Local), were evaluated under irrigated wet land conditions. Analysis of variance indicated highly significant variation for all the traits indicating the presence of genetic diversity among these genotypes. Genotypic and phenotypic coefficients of variation (GCV and PCV), heritability and genetic advance (% of mean) were high for all the characters. The highest heritability was observed for plant height (96.71) followed by panicle length (90.57). However, grain yield exhibited the lowest heritability (54.74) among all the traits. Positive association existed among all the traits. Grain yield was highly associated with plant height and panicle length. The top yielding genotypes identified in the study were MTU 1155, UPRI 2012-18, HKR 08-62 and RNR 10294.

Keywords
Rice, genetic variability, heritability, correlation

Rice (*Oryza sativa* L.) is an important staple food that provides 66-70 % of calorie requirement of the consumers. To ensure food security in rice consuming countries of the world, rice production must be enhanced to an extent of 50 per cent by 2025. In Indian agriculture, rice plays a pivotal role, being the livelihood for 150 million rural households and accounting for 43% of national food grain production (DRR, 2005).

However, yield level of this crop has reached a plateau and improving its productivity and quality traits has become crucial (Vanaja and Babu, 2006). To accomplish this, crop improvement programmes should aim at broadening the genetic base of breeding stock. Success in crop improvement generally depends on the magnitude of genetic variability and the extent to which the desirable characters are heritable. Estimation of genetic variability present in the germplasm of a crop is a pre-requisite for making any effective breeding program. However, variability studies and association grain quality characters of high yielding rice varieties of specific eco-geographical origin are limited. Hence, the present study was undertaken to evaluate the extent of variability, genetic parameters and correlations in high yielding diverse genotypes for important yield parameters.

Sixty four mid early rice genotypes of diverse origin were evaluated during *Kharif 2012* under irrigated wet land conditions at Regional Agricultural Research Station, Pattambi. Three genotypes *viz*., IR 64 (National), MTU 1010 (Southern Regional) and Jyothi (Local) were included as check varieties. The experiment was laid out in a completely randomised block design with two replications. Each plot had eleven rows with sixteen hills per row having a spacing of 20 cm between rows and 15 cm between hills. Cultural and Management practices were followed as per KAU Package of Practices Recommendations. At maturity, five plants were randomly selected from each genotype in each replication for recording observations on seven biometric traits *viz*., days to 50% flowering, plant height, tillers/plant, panicles/hill, panicles/m^2, panicle length (cm), and grain yield (t/ha). In addition, grain type of each genotype was also recorded.

ANOVA was performed for all the biometric traits. Genetic parameters *viz*., genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability (broad sense), genetic advance (% of mean) and correlation coefficients among the characters were estimated (Singh and Choudhary, 1985).

Genetic variability: *Per se* performance of 64 rice genotypes for traits evaluated are furnished in Table 1. The results revealed wide variation for days to 50% flowering (71-113.5), plant height (83.8-137 cm), tillers/plant (3.7-11.5), panicles/hill (3.7-11.1), panicles/m^2 (123-370), panicle length (19.1 to 28.3 cm) and grain yield/ha (2.1-7.3 tons). ANOVA indicated highly significant variation for all the traits studied thereby indicating the presence of genetic diversity among these genotypes (Table 2). These results are in agreement with previous studies by Anbanandan *et al*. (2009) and

Karthikeyan *et al*. (2010). On the basis of overall mean, 28 genotypes exhibited 5% yield superiority over the best check, MTU 1010, which had a grain yield of 4.13 t/ha. The top yielders among the 64 genotypes under study were MTU 1155 (7.3 t/ha), UPRI 2012-18 (6.47 t/ha), HKR 08-62 (6.2 t/ha) and RNR 10294 (6.06t/ha). These superior genotypes can be utilized in further breeding programmes.

*Genetic parameters:*Results of genetic parameters of the characters are furnished in Table 2. The estimates of genotypic and phenotypic coefficients of variation (GCV and PCV) were high for all the characters. High PCV and GCV values for all traits except days to 50 % flowering and panicle length were also reported by Shet *et al*. (2012). Yield is controlled by polygenes and highly influenced by the environment. The higher PCV observed when compared to respective GCV for all the traits in the present study indicated the influence of environment in the expression of the traits, which is in consonance with the results obtained by earlier researchers (Anbanandan *et al*., 2009 and Karthikeyan *et al*., 2010).

High heritability (broad sense) was recorded for all the characters. The highest heritability observed was for plant height (96.71) followed by panicle length (90.57). However, grain yield exhibited the lowest heritability (54.74) among all the traits, indicating the influence of environment in the character expression as well as its inheritance.

Among all the traits, panicles/m^2 exhibited the highest genetic advance (89.52%) followed by plant height (23.56%). High heritability accompanied with high genetic advance had been reported by Shet *et al*. (2012) for grain yield and component traits *viz*., days to 50 % flowering, panicle length, productive tillers, filled grains per panicle in F_2 segregating populations of two crosses of rice evaluated under aerobic conditions.

Correlations: Genotypic correlation coefficients among the characters under study are presented in Table 3. Grain yield was highly associated with plant height (0.59) and panicle length (0.48). It had positive correlation with all other traits. Significant positive association of grain yield with plant height (Shashidhar *et al*., 2005) and panicle length (Rajeshwari and Nadarajan, 2004 and Reddy *et al*., 2008) were reported. Krishna *et al*., (2008) and Bhadru *et al*. (2011) observed significant positive association for grain yield with days to 50 % flowering and plant height. Such associations of yield with component traits can be well utilised as an indicator of grain yield in designing selection strategies.

Positive association of component traits would offer the scope for selection and simultaneous improvement in all these traits in addition to improving the yield. Association analysis among yield components revealed that days to 50 per cent flowering had positive significant association with plant height and panicle length. Similar positive association of days to 50% flowering with other traits such as plant height (Panwar and Ali, 2007; Anbumalarmathi and Nadarajan, 2008) and panicle length were reported earlier. Panicle length and panicles/hill showed significant positive association with plant height. According to Shet *et al*. (2012), grain yield per plant had highly significant positive association with productive tillers but significant negative association with days to 50 % flowering.

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Table 1. Mean performance of sixty four Mid Early rice genotypes evaluated during Kharif 2012

Sl. No.	IET No.	Genotype	Days to 50% flowering	Plant height (cm)	Tillers/ plant	Panicles/ hill	Panicles/ m^2	Panicle length (cm)	Grain type	Grain yield (t/ha)	Straw yield (t/ha)
1	23272	MTU 1155	102.5	137	9.7	9.6	320	25.9	MS	7.30	21.63
2	23273	MGD-1201	97	112.2	10.1	9.8	326.7	24.8	MS	4.27	6.47
3	23274	NDR 2106-9-1	95	114.1	6.1	5.5	183.3	26.0	SB	5.51	13.91
4	23275	HKR 08-62	97	108.9	6.9	6.9	230	23.2	LB	6.20	9.37
5	23276	KAUM 164-1	98.5	113.3	10.6	10.6	353.3	22.5	SB	5.79	9.78
6	23277	NPD-4006	97.5	110	7	7	233.3	26.1	LS	5.10	5.79
7	23278	UPR 3626-1-2-1	91.5	107	10.7	10.7	356.7	26.3	LB	3.86	5.65
8	23279	CN 1757-5-3-7-MLD 18	88	104.5	7	7	233.3	21.8	MS	4.27	6.61
9	23280	CB 09 537	90.5	103	8.5	8.5	283.3	23.1	MS	4.68	8.40
10	23281	OR 2406-17	98	112.8	6.2	6.2	206.7	25.6	MS	5.65	14.19
11	23282	PABG 426	103	109.3	8	8	266.7	27.5	LS	4.96	16.80
12	23283	UPRI 2012-18	93.5	112	8.3	8.3	276.7	23.8	LS	6.47	12.81
13	23284	R 1677-1375-1-157-1	82	97.7	8.3	8.3	276.7	23.7	MS	3.58	3.72
14	23285	ARRV-612	98	111.8	10.2	10.2	340	25.6	LB	4.96	10.33
15	23286	JGL-20168	84	100.32	8.3	8	266.7	24.5	MS	4.41	6.75
16	23287	MSN 97	89	102.3	7	7	233.3	23.2	MS	4.27	6.61
17	23288	WGL 625	92	101.3	7.8	7.5	250	22.8	MS	4.41	9.92
18	23289	CR 2710-7-3	87.5	99.2	7	7	233.3	22.8	LB	3.44	4.68
19	22765	NLR 40058	95	96	7.5	7.5	250	25.3	MS	4.13	6.34
20	NC	IR 64	91	88.8	7.3	7.3	243.3	23.6	LS	3.99	8.95
21	23290	CR 2708-15-2	94	91.8	6.6	6.6	220	24.8	LS	2.62	3.17
22	23291	ACK 09009	98	99.5	7.7	7.7	256.7	24.6	MS	3.99	9.50
23	23292	TRC 2012-1	86.5	110.7	8.5	8.5	283.3	24.1	LB	4.41	7.44
24	22766	PAU 3832-196-4-1-2	113.5	108.5	6.4	6.4	213.3	25.5	LS	3.99	12.67
25	23293	NP 9351	94.5	109.1	6.6	6.6	220	28.3	LS	7.16	11.29
26	22825	CR 2992-1-3	84.5	118.1	6.6	6.6	220	22.3	MB	2.75	5.51
27	23086	JGL 17196	92.5	102.8	6.5	6.5	216.7	23.5	MS	5.37	5.65
28	23294	NP 9307	88.5	95.3	7.8	7.8	260	22.2	LB	4.55	11.43
29	23295	RP 5218-49-13-9-2-1-1-B	90	107.5	9.2	8.9	296.7	25	LS	4.82	7.58
30	23296	OR 1929-4	90.5	116.3	10.7	10.7	356.7	22.5	SB	3.31	4.41
31	23297	RP 5212-41-4-3-1-1-1-B	87.5	132.1	10.3	9.9	330	25.1	MS	3.99	9.78
32	23298	NSG-412	97	110.5	8.5	8.5	283.3	23.3	MS	5.10	15.15
33	23299	HKR08-83	89	108.3	7.5	7.5	250	26.3	LS	5.65	7.71
34	23300	MTU1156	91	111.8	11.5	11.1	370	24.7	MS	5.51	8.82
35	RC	MTU 1010	85.5	104.9	10.4	9.9	330	24.0	LS	4.13	7.99
36	23301	RNR 10294	95	106.3	8	8	266.7	24.2	MS	6.06	12.53
37	23302	UPR 3657-8-1-2	86	119.7	5.9	5.9	196.7	24.2	SB	5.92	7.44
38	23303	GNV-11-01	91	92.3	6.3	6.3	210	23.6	LS	4.41	6.61

39	23304	MGD-1202	98.5	102.5	7.2	7.2	240	22.3	MS	4.13	7.30
40	23305	CRR 612-4-1	71	87.8	3.7	3.7	123.3	22.6	LS	2.07	3.03
41	23306	KAUM 112-10-6-5	92	93	5.9	5.9	196.7	21.3	MS	3.44	5.23
42	23307	NVSR-304	86	99.1	6.2	6.2	206.7	20.5	SB	3.58	8.95
43	23308	HKR 08-92	96	96.5	7.5	7.5	250	22.5	LB	3.03	7.71
44	23309	CB 09 526	93	90.3	6.8	6.8	226.7	22.8	MS	2.20	2.75
45	23310	R 1630-1249-1-649-1	93	85.8	5.8	5.8	193.3	21.8	SB	3.58	6.06
46	23311	RP 5339	92.5	99.5	6.3	6.3	210	22.5	SB	4.41	8.54
47	23312	CRR 574-16-1-3	85.5	88	5.6	5.6	186.7	20.3	LS	2.34	3.31
48	LC	Jyothi	82.5	86.6	5.5	5.5	183.3	22	LB	2.75	4.55
49	23313	CN 1944-8	76	93.3	5.5	5.5	183.3	22.8	LS	2.07	3.17
50	23314	OR 1974-4	93.5	88.3	6.7	6.7	223.3	22.6	MS	3.03	5.51
51	23315	CR 3564-1-1-1-1	97	106.8	5.5	5.5	183.3	23.1	SB	3.72	6.47
52	23316	RP 5338-0M616	91.5	88	5.7	5.7	190	23.1	LB	2.89	3.17
53	23317	KAUM 174-6	93.5	96	6	6	200	21.3	SB	3.72	4.82
54	23318	CR 3516-10-14-10	96	94	6.8	6.8	226.7	21.8	MS	3.72	4.96
55	23319	PAU 3832-194-3-1-3	94	90.1	6.2	6.2	206.7	21.6	LB	3.31	5.51
56	23320	R 1677-1891-3-1435-1	87.5	86.3	6.2	6.2	206.7	21.8	LB	4.82	4.68
57	23321	KAUM 173-4	96.5	96.5	5.5	5.5	183.3	19.1	SB	4.13	5.23
58	23322	OR 2324-28	88	99.3	5.6	5.6	186.7	22.3	MS	4.41	8.95
59	23323	MSN 97-1	80.5	94.1	7.6	7.6	253.3	20	LB	4.13	6.47
60	23324	CN 1752-18-1-9-MLD 19	81	83.8	5.3	5.3	176.7	21	MS	4.27	6.61
61	23325	CR 3624-4	93.5	133.5	5.8	5.8	193.3	26.1	LS	5.23	17.36
62	23326	UPR 3668-5-1-1	94.5	83.9	6.4	6.4	213.3	21.2	MS	4.27	8.54
63	23327	CR 3691-1-1	82	110.4	11.4	11	366.7	24.6	LB	4.27	9.50
64	23328	RP 4631-27-8-3-2-2-B	86.5	105.7	6.6	6.6	220	22.1	LS	5.51	8.40
		Mean	**91.4**	**102.6**	**7.4**	**7.3**	**243.3**	**23.4**	**...**	**4.3**	**8.0**
		CV	7.7	11.5	24.5	23.8	24.11	8.07	…	30.4	49.5
		CD	7.5	5.1	2.0	2.0	71.9	1.4	…	2.11	4.2

SB-Short bold, MS-Medium slender, LS-Long slender, LB-Long bold

Table 2. Genetic parameters for sixty four irrigated mid early rice genotypes

Sl. No.	Character	Range	Mean	GCV	PCV	H^2	GA (% of mean)
1	50% Days to flower	71-113.5	91.35	6.90	7.70	80.259	11.64
2	Tillers/plant	3.7 - 11.5	7.36	21.76	24.59	78.308	2.92
3	Panicles/hill	3.7 - 11.1	7.3	21.10	23.91	77.872	2.80
4	Panicles/m^2	123-370	243.33	20.78	24.18	73.84	89.52
5	Panicle length (cm)	19.1 - 28.3	23.43	7.71	8.10	90.573	3.54
6	Plant height (cm)	83.8 - 137	102.60	11.33	11.52	96.708	23.56
7	Grain yield (kg/plot)	0.75 - 2.65	1.57	22.39	30.31	54.562	0.53
8	Grain yield (t/ha)	2.07 - 7.3	4.31	22.55	30.48	54.744	1.48

Table 3. Correlation coefficients for biometric characters in irrigated mid early rice genotypes

Characters	50% DF	Plant height (cm)	Tillers/plant	Panicles/hill	Panicle length (cm)
Plant height (cm)	0.29				
Tillers/plant	0.15	0.51**			
Panicles/hill	0.16	0.50**	1.00**		
Panicle length (cm)	0.35**	0.58**	0.38**	0.37**	
Grain yield (t/ha)	0.38**	0.59**	0.30**	0.30**	0.48**

**- Significant at 1% level