Oryza Vol. 44. No.4, 2007 (351-353)

Variability and association studies in indigenous aromatic rice (*Oryza sativa* L.)

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ABSTRACT

The variability, correlation and path analysis for yield and quality traits in twenty-five indigenous aromatic rice genotypes were estimated. Highest genetic coefficient of variation was recorded for grain yield plant^{-1} and number of panicle bearing tillers among yield traits and length/breadth ratio for quality traits. High heritability (broad sense) coupled with high genetic advance was observed for yield plant^{-1}, number of panicle bearing tillers and number of grains panicle^{-1}. Number of panicle bearing tillers and days to 50% flowering exhibited highest positive direct effect along with positive association with yield plant^{-1}. Kernel length after cooking quality showed highest positive direct effect on kernel length.

Key words: *Aromatic rice, genetic variability, path analysis*

India is bestowed with a rich diversity of aromatic rice. Uttar Pradesh, Madhya Pradesh, Bihar, Orissa, West Bengal and Assam have a wealth of genetic diversity of indigenous aromatic short grain types, many of which compare equally with basmati rice for aroma and cooking qualities. Short grain aromatic rice enjoys a high preference among local consumers within the country. Singh *et al*. (2002) have emphasized the importance of conservation of indigenous aromatic rice and worked extensively on their characterization and maintenance. At present only a small fraction of available diversity of rice of this region has been utilized in varietal development due to lack of information about nature and degree of association of yield and quality traits.

Therefore, an experiment was conducted during wet season 2004 and 2005 at the Agricultural Research Farm, Banaras Hindu University, Varanasi, using twenty-five genotypes of indigenous aromatic rice. The twenty-five genotypes consisted of Kalanamak (8 accessions), Juhi Bengal (4 accessions), Kanak Jeera (4 accessions), Hari Ram (2 accessions), Basmati Local (3 accessions), Dhania (1 accession), Katarni (1 accession) and Burmah (2 accessions) and were collected from four districts of eastern Uttar Pradesh. Twenty-one days old seedlings were planted singly at a spacing of 15x20 cm within and between rows. Each entry was transplanted in 3 rows, each 5 m in length in a randomized block design with two replications. All the recommended agronomic practices were followed.

Five randomly selected plants from each replication were used to record observations on yield traits viz. plant height (PH), main panicle length (MPL), grains panicle^{-1} (G/P), number of panicle bearing tillers (PBT), 1000 grain weight (TGW) and yield plant^{-1} (Y/P) and days to 50% flowering (DTF) and days to maturity (DTM) were recorded on plot basis. Observations on quality traits viz. kernel length (KL), kernel breadth (KB), length/breadth ratio (L/B), kernel length after cooking (KLAC), elongation ratio (ER) and alkali digestion value (AlkD) were also recorded. AlkD was estimated following Little *et al.* (1958). The data of two years was pooled and means were used for estimating phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability (H) in broad sense, correlation coefficient, and genetic advance (GS). Path coefficient analysis was done based on phenotypic correlation as suggested by Dewey and Lu (1959).

Highly significant differences were observed among the twenty-five genotypes for all the yield and

quality characters except AlkD indicating presence of considerable variability (Tables 1a and 1b). Among yield traits, highest range of variability was recorded in case of G/P and lowest for MPL. The lines Juhi Bengal-21 and Kalanamak-6 recorded higher number of G/P (185.0 and 170.7, respectively). For quality traits the range of variability was highest for KLAC and lowest for ER. The lines Kalanamak-2 and Kanak Jeera-26 recorded higher ER of 1.74 and 1.66, respectively. PCV varied from 9.39% (DTM) to 86.76% (Y/P) for yield traits and from 8.01% (ER) to 20.56% (L/B) for quality traits. PCV was higher than GCV for all the traits. The H (broad sense) ranged from 82% (G/P) to 99% (DTF and DTM) for yield traits and from 27% (AlkD) to 98% (KL, KB and L/B) for grain quality traits. GS (as % of mean) ranged from 19.24% (DTM) to 88.53% (Y/P) for yield traits and from 5.02% (AlkD) to 41.41% (L/B) for grain quality traits. Johnson *et al.* (1955) have suggested that high heritability with high genetic advance would be more reliable to arrive at a conclusion. In the present study high heritability coupled with high genetic advance is observed for Y/P, PBT and G/P indicating preponderance of additive genetic effect. Prasad *et al.* (2001) and Borbora *et al.* (2005) have reported similar findings. In case of quality traits KL, KB, L/B and KLAC showed high heritability and high genetic advance revealing predominantly additive genetic effect and hence phenotypic selection would be effective. AlkD showed low heritability with low genetic advance indicating the influence of environmental effects and selection would be ineffective.

The phenotypic correlations were partitioned into direct and indirect effect of the yield components on Y/P (Table 2a) and grain quality characters on KL (Table 2b). Among all the yield components, PBT and DTF exhibited highest positive direct effect along with positive association with Y/P. PH exerts positive effect on the Y/P via PBT. So, if the PBT is not reduced, a decrease in PH will not adversely affect the yield. Also, negative selection for DTM would reduce the crop duration without affecting yield. For quality traits, KLAC showed highest positive direct effect followed by LB

Table 1a. Estimates of variability and genetic parameters of eight yield traits in indigenous aromatic rice.

Characters	Range	Mean ± SE	Mean Sum of Square	GCV(%)	PCV(%)	H (bs)	GS	GS as % of mean
DTF	84.50 to 137.00	122.20 ± 0.65	585.38**	13.99	14.01	0.99	35.21	28.80
DTM	122.50 to 167.50	153.54 ± 1.05	414.74**	9.37	9.39	0.99	29.55	19.25
PH (cm)	78.50 to 170.40	129.45 ± 3.96	1266.92**	19.32	19.56	0.97	50.89	39.31
MPL (cm)	19.50 to 27.75	23.67 ± 0.87	12.62**	10.29	10.93	0.88	4.72	19.95
G/P	40.00 to 185.00	116.84 ± 16.32	2861.78**	30.83	33.85	0.82	67.58	57.84
PBT	3.10 to 14.00	5.78 ± 0.76	13.27**	43.59	45.54	0.91	4.97	85.98
TGW (g)	10.90 to 24.00	16.14 ± 0.40	24.44**	21.58	21.73	0.98	7.13	44.18
Y/P (g)	6.00 to 30.16	13.34 ± 1.77	74.74**	44.85	46.78	0.91	11.81	88.50

** Significant at P = 0.01

Table 2a. Direct (bold) and indirect effects of various yield components on yield plant^{-1} in indigenous aromatic rice.

Characters	DTF	DTM	PH (cm)	MPL (cm)	G/P	PBT	TGW (g)	r values
DTF	**0.540**	-0.517	0.225	0.024	0.118	0.410	-0.266	0.534**
DTM	0.531	**-0.525**	0.214	0.023	0.117	0.416	-0.247	0.528**
PH(cm)	0.458	-0.425	**0.265**	0.022	0.079	0.499	-0.219	0.679**
MPL(cm)	0.277	-0.249	0.120	**0.048**	0.158	0.041	-0.179	0.216
G/P	0.199	-0.193	0.066	0.024	**0.319**	-0.199	-0.276	-0.061
PBT	0.268	-0.264	0.160	0.002	-0.077	**0.827**	-0.050	0.866**
TGW(g)	-0.338	0.305	-0.136	-0.020	-0.207	-0.096	**0.426**	-0.067

Residual Effect = 0.131; * and ** Significant at P= 0.05 and 0.01, respectively.

Table 1b. Estimates of variability and genetic parameters of six quality traits in indigenous aromatic rice.

Characters	Range	Mean ± SE	Mean sum of Square	GCV(%)	PCV(%)	H (bs)	GS	GS as % of mean
KL (mm)	4.09 to 5.99	4.87 ± 0.08	0.74**	12.44	12.54	0.98	1.24	25.46
KB (mm)	1.54 to 2.68	2.14 ± 0.04	0.15**	12.75	12.84	0.98	0.56	26.17
L/B	1.63 to 3.34	2.32 ± 0.06	0.45**	20.35	20.54	0.98	0.96	41.38
KLAC(mm)	5.28 to 8.83	7.06 ± 0.12	1.33**	11.51	11.59	0.98	1.65	23.37
ER	1.26 to 1.74	1.45 ± 0.03	0.03**	7.71	8.01	0.92	0.22	15.17
AlkD	3.75 to 4.25	3.98 ± 0.29	0.15	4.70	8.52	0.30	0.20	5.02

** Significant at P = 0.01

Table 2b. Direct (bold) and indirect effects of grain quality components on kernel length in indigenous aromatic rice

Characters	KB (mm)	L/B	KLAC (mm)	ER	AlkD	r values
KB (mm)	**0.109**	-0.115	-0.139	-0.028	0.002	-0.170
LB	-0.084	**0.150**	0.520	0.159	0.000	0.745**
KLAC (mm)	-0.018	0.092	**0.844**	-0.122	0.001	0.797**
ER	0.005	-0.043	0.186	**-0.555**	-0.003	-0.410*
AlkD	0.016	-0.001	0.054	0.083	**0.017**	0.168

Residual effect = 0.003; * and ** Significant at P= 0.05 and 0.01, respectively.

and KB. These characters have higher heritability and genetic advance also. Hence, improvement by simultaneous selection of these characters would help in improving grain quality of these aromatic rice genotypes.

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