GENETIC VARIABILITY FOR QUALITY, YIELD AND YIELD RELATED PARAMETERS IN BASMATI RICE (*Oryza sativa* L.)

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ABSTRACT

Twenty five Basmati rice (Oryza sativa L.) germplasm, representing diversity in yield and quality traits were sown on 17th June, and 25 days old seedlings were used for transplanting in the field in a Randomized Block Design with two replications. Each plot consisted of three rows of 1.5m length with spacing (15 × 20 cm) provided by, AICRIP, Department of Genetics and Plant Breeding, Banaras Hindu University, Varanasi, U.P. Observations were recorded for fifteen traits viz., days to 50 per cent flowering, days to maturity, plant height, panicle length, effective panicle per plant, grain yield per plant, seeds per panicle, 100 seed weight, test weight (gm), kernel length, kernel breadth, Kernel L/B Ratio, kernel length after cooking (KLAC), kernel breadth after cooking (KBAC) and alkali spread value. Analysis of variance recorded highly significant mean sum of squares for all yield characters and for some quality characters. Seeds per panicle (62 to 305) showed highest range of variation and highest values for GCV and PCV was observed for seeds per panicle (38.28% and 38.88% respectively) followed by days to maturity, days to 50 per cent flowering, plant height, grain yield per plant and number of effective panicle among yield traits. High heritability (more than 85%) along with moderate genetic advance for the characters viz., days to 50 per cent flowering (47.15%), days to maturity (47.7%) and plant height (45.9%) suggests that the careful and restricted selection will be effective for the improvement of these characters. Seeds per panicle expressed high heritability (96.9%) coupled with high genetic advance (121.7%).

KEY WORDS: Basmati rice, GCV, genetic advance, heritability, PCV, transplanting

INTRODUCTION

Rice is believed to have arisen from a single domestication event (8200-13500 years ago) in wild *O. rufipogon* in the region of Yangtze river valley of china. The genus *Oryza* includes 24 species, (2n=24) representing 10 genomic type (AA, BB, CC, BBCC, CCDD, EE, FF, GG, HHJJ and HHKK) of which 22 are wild and only two, namely *Oryza sativa* and *Oryza glaberrima* are cultivated (Watanabe, 1997). Scented rice occupies a prime position in

Indian culture, not only because of their high quality, but that they have been considered auspicious. Scented rice is nature's gift exclusive to Indian subcontinent, in which Basmati rice is a special type of aromatic rice known the world over for its extra - long grains, and the pleasant and distinct, 'popcorn' like aroma component (2-acetyle-l-pyrroline), has been reported as an important flavour component of several aromatic varieties. Traditional basmati rice is not only in demand in the domestic markets, but is also seen in the menu of connoisseurs, worldwide creating a billion-dollar export market.

Variability refers to the presence of difference among the individuals of plant population. Variability results due to difference either in the genetic constitution of the individuals of a population or in the environment in which they are grown. Selection is also effective when there is genetic variability among the individuals in a population. Hence, insight into the magnitude of genetic variability present in a population is of paramount importance to a plant breeder for stating a judicious breeding programme (Vivek *et al.,* 2005).

Knowledge of heritability and genetic advance of the character indicates the scope for the improvement through selection. Heritability estimates along with genetic advance are normally more helpful in predicting the gain under selection. However, it is not necessary that a character showing high heritability will also exhibit high genetic advance (Johnson *et al.,* 1955).

MATERIALS AND METHODS

In the present investigation, the experimental material comprised of 25 scented rice germplasm (*Oryza sativa* L.), (Table 1) representing diversity in yield and quality traits were sown on 17th June and 25 days old seedlings were used for transplanting in the field in a Randomized Block Design with two replications. Each plot consisted of three rows of 1.5m length with spacing (15 × 20) cm provided by, AICRIP, Department of Genetics and Plant Breeding, Banaras Hindu University, Varanasi, U.P. Observations were recorded for fifteen traits *viz.,* days to 50 per cent flowering, days to maturity, plant height, panicle length, effective panicle per plant, grain yield per plant, seeds per panicle, 100 seed weight, test weight (g), kernel length, kernel breadth, Kernel L/B Ratio, kernel length after cooking (KLAC), kernel breadth after cooking (KBAC) and alkali spread value. Estimation of Alkali Digestion was done as per Standard Evaluation System for Rice given in Table 2. Analysis of variance was done as per Randomized Block Design method given by Panes and Sukhatme (1985), GCV and PCV by Burton and DeVane (1953), Heritability (h^2) and genetic advance Allard (1960).

RESULTS AND DISCUSSION

Analysis of variance recorded highly significant mean sum of squares for all yield characters and quality characters studied (Table 3) indicating the presence of substantial variation among the genotypes with respect to the traits studied.

Range and variances

Seeds per panicle (62.00 to 305.00) showed the highest range of variation followed by plant height (111.90 to 213.00), days to maturity (90.50 to 166.00), days to 50 per cent flowering (63.80 to 137.00), panicle length (20.30 to 29.50) and number of effective panicle (6.00 to 18.00) among yield attributing traits and among quality traits, kernel length after cooking (6.10 to 13.57) showed the highest range of variation followed by

kernel length (4.00 to 8.15), alkali spread value (2.50 to 6.70), L/B ratio (1.91 to 5.01), kernel breadth (1.44 to 3.21) and lowest for elongation ratio (1.12 to 2.03) inferring maximum scope for selection of these traits (Table 4). It was observed that the range of variation for quality traits is less compared to yield traits indicating the difficulty in selection for quality traits.

The genotypic variance for seeds per panicle was very high followed days to maturity, days to flowering, days to 50 per cent flowering and plant height for yield traits. For quality traits, the highest genotypic variance was noted for kernel length after cooking followed by kernel length, alkali spread value, L/B ratio, kernel breadth after cooking and kernel breadth. Variance is a statistical parameter which measures variation within a particular trait. But it does not provide a real measure for comparison of variation between different traits.

Coefficient of variation

The highest values for genotypic coefficients of variation (GCV) and phenotypic coefficients of variation (PCV) was observed for seeds per panicle panicle (38.28% and 38.88%, respectively) followed by days to maturity, days to 50 per cent flowering, plant height, yield per plant and number of effective panicle among yield traits (Table 5). For quality traits, the highest values for genotypic and phenotypic coefficients of variation were observed for kernel length after cooking (22.99 % and 23.10 %, respectively) followed by kernel length, alkali spread value, L/B ratio, kernel breadth after cooking and kernel breadth among quality traits. The findings of Singh (2005) are in agreement with those of the present study, where he observed higher genotypic and phenotypic coefficients of variation for test weight (31.56 % and 31.85%, respectively) indicating important role of additive gene action for the expression of this trait and may be considered as a selection parameter. Higher magnitude of PCV for all the traits are higher than GCV, suggested that appreciable portion of variability has been accounted by environmental effects.

Only the GVC is not sufficient for the find out the amount of heritable variation. Burton (1952) suggested that, GCV together with the heritability estimates would give the best picture of the extent of advance to be expected by selection.

Heritability and genetic advance

In the present study (Table 5), very high heritability (broad sense) was noted for days to 50 per cent flowering (99.5%) and days to maturity (99.0%) and moderate for main number of effective panicles (95.2%) and number of seeds per panicle (96.9%). For quality traits, all characters studied showed high heritability estimates. Similar findings were reported by Singh (2005) and Panwar (2005) in his studies on heritability in basmati rice. Higher magnitude of heritability in broad sense indicated that though the character is least influenced by environmental effects. Selection for improvement of such traits may not be useful, because it include both additive and non-additive variance.

High heritability coupled with moderate genetic advance was observed with low GCV for days to 50 per cent flowering (23.8%), days to maturity (18.61%) among yield traits and in quality traits, kernel length (20.21%) and kernel length after cooking (22.99%). In the present study, moderate heritability (79%) and low genetic advance (4.06%) was

exhibited by panicle length indicating the predominant role of non-additive gene action and environment plays major role in governing these characters, improvement of these characters is complicated and it might be possible through heterosis breeding. High heritability (more than 85%) along with moderate genetic advance for the characters *viz.*, days to 50 per cent flowering (47.15%), days to maturity (47.7%) and plant height (45.9%) suggests that the careful and restricted selection will be effective for the improvement of these characters. Seeds per panicle expressed high heritability (96.9%) coupled with high genetic advance (121.7%).

CONCLUSION

High heritability (more than 85%) along with moderate to high genetic advance for the characters *viz.*, seeds per panicle, days to 50 per cent flowering, days to maturity and plant height suggests that the careful and restricted selection may followed for the improvement of these characters and ultimately the yield.

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Table 1: List of scented variety of rice used in the investigation

Sr. No.	Germplasms	Origin
1.	Begum	Jammu & Kashmir
2.	Quadir	Jammu & Kashmir
3.	Mehvan	Jammu & Kashmir
4.	Mushkbudgi	Jammu & Kashmir
5.	Mazhat	Jammu & Kashmir
6.	Kamad	Jammu & Kashmir
7.	Majheradehradoon basmati-1	Uttarakhand
8.	Majheradehradoon basmati-2	Uttarakhand
9.	Majheradehradoon basmati-3	Uttarakhand
10.	Juhibengal 24-1	Bihar
11.	Kala namak 12-1	Uttar Pradesh
12.	Type-3	Uttarakhand
13.	Sarjoo -52	Uttar Pradesh
14.	NDR-359	Uttar Pradesh
15.	Tarori basmati	Haryana
16.	Basmati-370	Punjab
17.	Adam chini	Uttar Pradesh
18.	Badshahbhog	Uttar Pradesh
19.	Jeerabatti	Uttar Pradesh
20.	Tulsimangri	Madhya Pradesh
21.	Dubraj	Madhya Pradesh
22.	Jaya	Punjab
23.	Sonachur	West Bengal
24.	Laungchur	Uttar Pradesh
25.	Hariram 48	Uttar Pradesh

Table 2: Scale for alkali digestion value and GT for milled rice

Scale	Features	Alkali Digestion	Rating	GT (°C)
1	Not effected but chalky	Low	High	75-79
2	Kernel swollen	Low	High	75-79
3	Swollen with color incomplete and narrow	Low or Intermediate	High or Intermediate	70-74
4	Swollen with color incomplete and wide	Intermediate	Intermediate	70-74
5	Split or segmented with collar Complete and wide	Intermediate	Intermediate	70-74
6	Dispersed, merging with color	High	Low	65-69
7	Completely dispersed and Intermingled	High	Low	65-69

Table 3: Analysis of variance for 15 yield and yield traits characters in 25 genotypes of scented rice in *kharif* 2013

Sr. No.	Characters	Replication	Treatment	Error
1.	Days to 50 per cent Flowering	0.744	1055.62**	2.7017
2.	Days to Maturity	1.843	1088.36**	5.2915
3.	Days to Maturity	1.729	1008.95**	8.397
4.	Effective Panicle (Nos.)	2.000	19.872**	0.490
5.	Panicle Length(cm)	0.129	11.178**	1.314
6.	Seeds per Panicle (Nos.)	22.444	7324.20**	114.830
7.	Test weight (g)	0.006	0.752**	0.007
8.	Yield per Plant (g)	3.135 **	39.572**	0.346
9.	Kernel Length (mm)	0.014	3.032**	0.034
10.	Kernel Breadth (mm)	0.008	0.429**	0.005
11.	Kernel L/B Ratio	0006	1.929**	0.016
12.	KLAC (mm)	0.076	9.605**	0.045
13.	KBAC (mm)	0.00007	0.721**	0.018
14.	Elongation Ratio	0.003	0.071**	0.002
15.	Alkali Spread Value (ALKD)	0.010	2.992**	0.098

***Significance p=0.01,*

Table 4: Summary table of the general mean, range of variation, C.D values and genotypic, phenotypic and error variance of different characters contributing to yield in scented rice (*Oryza sativa* L.) in *kharif* 2013

Character	General Mean	Range		Critical Difference		Phenotypic Variance	Genotypic Variance	Error/ Environm-ental Variance
		Lowest	Highest	5%	1%			
Days to 50 per cent Flowering	96.37	63.80	137.00	3.39	4.59	529.16	526.46	2.70
Days to Maturity	124.98	90.5	166.00	4.74	6.43	546.82	541.53	5.29
Days to Maturity	142.86	111.90	213.00	5.98	8.10	508.67	500.27	8.39
Effective Panicle (Nos.)	9.97	6.00	18.00	1.44	1.95	10.18	9.69	0.49
Panicle Length(cm)	24.56	20.30	29.50	2.36	3.20	6.24	4.93	1.31
Seeds per Panicle (Nos.)	156.82	62.00	305.00	22.11	29.97	3719.51	3604.68	114.83
Test weight (g)	1.93	0.83	3.39	0.17	0.23	0.379	0.372	0.007
Yield per Plant (g)	11.85	5.48	24.79	1.21	1.64	19.95	19.61	0.34
Kernel Length (mm)	6.05	4.00	8.15	0.38	0.52	1.53	1.49	0.03
Kernel Breadth (mm)	1.98	1.44	3.21	0.15	0.20	0.21	0.21	0.005
Kernel L/B Ratio	3.18	1.91	5.01	0.26	0.35	0.97	0.95	0.01
KLAC (mm)	9.50	6.10	13.57	0.44	0.59	4.82	4.78	0.04
KBAC (mm)	2.90	2.06	4.66	0.28	0.38	0.36	0.35	0.01
Elongation Ratio	1.56	1.12	2.03	0.09	0.12	0.036	0.034	0.002
Alkali Spread Value (ALKD)	4.50	2.50	6.70	0.64	0.87	1.54	1.44	0.09

Table 5: Estimates of genotypic and phenotypic coefficient of variation, heritability and genetic advance for 15 characters in scented rice *(Oryza sativa* L.*)* in *kharif* 2013

Character	PCV %	GCV %	CV %	Heritability %	Genetic Advance		GA % of Mean	
					At 5% SI	At 1% SI	At 5% SI	At 1% SI
Days to 50 per cent Flowering	23.86	23.80	1.70	99.5	47.145	60.419	48.917	62.69
Days to Maturity	18.70	18.61	1.84	99.0	47.706	61.137	38.169	48.91
Days to Maturity	15.78	15.65	2.02	98.3	45.964	58.559	31.984	40.989
Effective Panicle (Nos.)	31.98	31.20	7.01	95.2	6.257	8.018	62.717	80.375
Panicle Length(cm)	10.17	9.04	4.66	79.0	4.065	5.210	16.553	21.213
Seeds per Panicle (Nos.)	38.88	38.28	6.83	96.9	121.756	156.037	77.64	99.50
Test weight (g)	31.85	31.56	4.31	98.2	1.246	1.596	64.417	82.55
Yield per Plant (g)	37.68	37.35	4.96	98.3	9.043	11.59	76.274	97.75
Kernel Length (mm)	20.44	20.21	3.08	97.7	2.493	3.195	41.16	52.75
Kernel Breadth (mm)	23.53	23.23	3.70	97.5	0.937	1.20	47.27	60.58
Kernel L/B Ratio	30.97	30.71	4.01	98.3	1.998	2.56	62.73	80.40
KLAC (mm)	23.10	22.99	2.24	99.1	4.482	5.74	47.14	60.41
KBAC (mm)	20.97	20.43	4.70	95.0	1.190	1.52	41.02	52.57
Elongation Ratio	12.18	11.82	2.94	94.2	0.370	0.47	23.63	30.29
Alkali Spread Value (ALKD)	27.58	26.68	6.97	93.6	2.397	3.072	53.19	68.16

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