

Genetic Variability, Heritability and Genetic Advance for Quantitative Traits in Short Grain Aromatic Rice

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Received 7 December 2016; Accepted 9 January 2017; Published online 28 January 2017

Abstract Genetic variability, heritability and genetic advance for eleven yield attributing traits were estimated in fifty five indigenous aromatic rice cultivars. The experimental material possessed considerable amount of variation in respect of all the characters under study. Plot yield, number of fertile grains per panicle, plant height, fertility percentage, flag leaf area, and days to 50% flowering showed relatively higher magnitude of genetic variation. Selection on phenotypic value was effective for majority of traits as there was little difference between PCV and GCV, but the low values of GCV for days to 50% flowering, panicle length and fertility percentage indicated limited scope for improvement of these traits. A moderate to high degree of heritability with moderate to high genetic gain for fertile grain number per panicle, 100-grain weight and flag leaf area indicated the presence of additive gene effects, hence selection based on phenotypic value would be effective. The traits like days to 50% flowering, plant height, panicle length and plot yield showed high heritability value with low genetic gain indicated the presence of both additive and non-additive gene ef-

fects and low heritability estimates with low genetic gain for traits like panicle number, fertility percentage, grain yield per plant and harvest index suggested that dominance and epistatic gene effects might be operating in the inheritance of these traits.

Keywords Aromatic rice, Genetic variability, Heritability, Genetic advance.

Introduction

Aromatic or scented rices have occupied a prime position in Indian society. The Basmati types like Basmati 370, Kernal local, Pusa Basmati 1, Taroari Basmati, Type 3 ETC among them enjoy a unique place for three distinct quality features like pleasant aroma, extra long superfine grain and extreme grain elongation on cooking and soft texture of cooked rice. On the contrary the scented rices traditionally grown in the state have pleasant fragrance with small and round grains, white color and softness without much elongation on cooking [1]. The small and medium grain aromatic rices are regarded as a separate class of non-basmati aromatic rice [2].

These aromatic rice basmati types enjoy a unique position in the international trade and is the center of attraction of both the growers and consumers [3]. Similarly despite of tall stature and low yield the

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non-basmati indigenous aromatic rices possessing outstanding quality traits like aroma, medium kernel elongation after cooking, fluffiness and taste fetch highest premium price in the local market than any other fine grain rice.

The areas of cultivation of the traditional basmati types are limited due to non retention of their aroma when grown in relatively warmer parts of Odisha and the adjoining Eastern-Indian states. However, the scented rices indigenously grown in the state have very strong aroma under the prevailing warmer climate during grain maturity period in *kharif* season [1]. Almost every state has its own collection of aromatic rices that perform well in native areas [4–6], during collection of rice germplasm in the state indicated that the majority of these scented types are tall in stature, lodge at maturity but are highly adaptable to local conditions. The enhancement in yield in these indigenous types will help all categories of farmers to fetch more price and also the consumers to get quality scented rice at a reasonable cost. In the present investigation efforts were made to assess the availability and extent of variation in yield and yield attributing traits.

Materials and Methods

Fifty five local scented rice genotypes collected from different parts of Odisha were evaluated along with Pusa Basmati-1 and Suman as aromatic and ORS 199-5, Lalat and Sambamahsuri, as non-aromatic checks in a field trial, at instructional farm, OUAT, Bhubaneswar during 2012 *kharif* season. The experiment was laid out in a randomized complete block design with two replications. Observations were recorded on eleven yield and yield attributing traits and these traits were analyzed. The experimental materials were transplanted as four row plots of 4.5 m length with a row to row distance of 20 cm and plant to plant spacing of 15 cm in irrigated medium lands. Observations were recorded in nine metric characters on five randomly selected competitive plants from the middle row of each plot, whereas the characters like plot yield and days to 50% flowering were recorded on plot basis. The phenotypic and genotypic co-efficient of variability (PCV and GCV) were computed as per method suggested by Burton [7].

Table 1. Analysis of variance for various characters (mean sum of squares). ** Significant at 1% level of probability. Figures in parentheses indicate degrees of freedom (DF) for corresponding sources of variation.

Sl. No. Characters	Source of variation (df)		
	Repl-ication (1)	Geno-type (59)	Error (59)
1. Days to 50% flowering	0.625	64.11**	0.896
2. Plant height (cm)	3783.62	643.06**	74.44
3. Panicle length (cm)	10.62	13.37**	0.851
4. Panicle number	32.76	5.61**	1.99
5. No. of fertile grains/panicle	23.75	2149.23**	313.96
6. Fertility percentage	497.18	105.88**	41.31
7. 100-grain weight (g)	0.013	0.288**	0.0004
8. Flag leaf area (cm ²)	604.47	69.14**	9.29
9. Grain yield / plant (g)	0.496	4.42**	1.79
10. Harvest index	0.040	0.007**	0.002
11. Plot yield (kg/ha)	2688.0	329969.9**	30477.0

Heritability in broad sense by Lush [8] and Burton and De Vane [9] and genetic advance at 5% selection intensity as per Robinson and comstock [10].

Results and Discussion

The materials in the present investigation possess considerable amount of variations irrespective of all the characters [2, 11,12]. The magnitude of genetic variance was highest for plot yield followed by fertile grain number per panicle, plant height, fertility percentage, flag leaf area and days to 50% flowering as evidenced from the analysis of variance, mean and range of characters (Table 1 and Table 2). It is not surprising to note that there exists enormous amount of variability in all most all the characters, as the materials under study were mid-early to mid-late in maturity duration varieties, combining many quantitative and physiological traits, maintaining wider range of genetic diversity with respect to plant type, maturity duration, grain features and yielding ability were proved efficient in inducing variability for various traits.

The presence of considerable amount of genetic variability in the test materials provide enormous scope for selection. However out of eight different traits showing relatively higher magnitude of genetic variation the traits like plot yield, number of fertile

Table 2. Mean, range, co-efficient of variation, genotypic and phenotypic co-efficient of variation, heritability and genetic advance in percent of mean for eleven quantitative traits in short grain aromatic rice.

Sl. No.	Characters	Mean	Range	CV (%)	GCV (%)	PCV (%)	h ² (%)	GA (%)
1.	Days 50% flowering	110.28	100.0–122.0	0.86	5.10	5.17	97.2	10.35
2.	Plant height (cm)	130.48	72.33–159.93	6.61	12.92	14.52	79.3	23.69
3.	Panicle length (cm)	26.11	19.33–31.31	3.53	9.58	10.22	88.0	18.54
4.	Panicle number	9.28	6.10–14.30	15.22	14.49	21.01	47.5	20.58
5.	No. of fertile grains / panicle	132.94	65.40–195.90	13.33	22.79	26.40	74.5	40.51
6.	Fertility percentage	75.10	48.42–86.62	8.56	7.57	11.42	43.9	10.32
7.	100-grain weight (g)	1.51	1.01–2.47	4.13	24.97	25.31	97.3	50.99
8.	Flag leaf area (cm ²)	24.75	15.96–40.05	12.31	22.10	25.30	76.3	39.76
9.	Grain yield per plant (g)	5.86	3.00–9.03	22.87	19.58	30.10	42.3	26.28
10.	Harvest index	0.25	0.14–0.46	17.81	20.74	27.34	57.6	32.00
11.	Plot yield (kg/ha)	2521.0	1743.0–3583.0	6.92	15.35	16.84	83.1	28.82

grains per panicle, fertility percentage, days to 50% flowering and flag leaf area which have direct bearing on yield may be sorted out as important selection criteria for realization of higher productivity in rice. The study on genotypic co-efficient of variation (GCV) in different traits maintained correspondence with phenotypic co-efficient of variation (PCV) for most of the traits except for panicle number, grain yield per plant and harvest index. In general phenotypic co-efficient of variation was higher than the genotypic co-efficient of variation suggesting the influence of environmental factor. Particularly in panicle number, harvest index and grain yield per plant the difference between these two estimates was fairly wide enough indicating the greater influence of environment on expression of these traits.

Among the characters studied the GCV ranged from 5.10% for days to 50% flowering to 24.97% for 100-grain weight and for PCV the characters ranged from 5.17% for days 50% flowering to 30.10% for grain yield per plant. PCV was found to be low (less than 15%) for days to 50% flowering, plant height, panicle length and fertility percentage; moderate (15-20%) for plot yield and high (more than 20%) for panicle number, number of fertile grains per panicle, 100-grain weight, flag leaf area, grain yield per plant and harvest index. As majority of traits showed smaller difference between PCV and GCV indicating little influence of the environment, therefore selection on the basis of phenotypic values for most of the traits is expected to be effective.

. But low values of GCV for days to 50% flowering, panicle length and fertility percentage indicated the limited scope for the improvement of these traits. Both GCV and PCV were observed to be high for traits like panicle number, number of fertile grains per panicle, 100-grain weight, flag leaf area, grain yield per plant and harvest index suggesting that these traits are under the influence of genetic control. Hence, these traits can be relied upon and simple selection can be practiced for further improvement. A review of literature from published reports on genetic variability indicates very inconsistent and contrasting earlier [13–16]. However in the majority of cases these estimates were found to be low for panicle length, moderate to high for days to 50% flowering, plant height, panicle number, 100-grain weight, grain yield per plant and harvest index.

The heritability values estimated for different characters varied from 42.3% for grain yield per plant to 97.3% for 100 grain weight whereas the genetic advance expressed as percentage of mean varied 10.32% for fertility percentage to 50.99% for 100-grain weight. A moderate to high degree of heritability estimates were observed for majority of traits under study indicating low or negligible influence of the environment in the expression of these traits. Moderate to high heritability estimates associated with moderate to high genetic gain for number of fertile grains per panicle, 100-grain weight and flag leaf area indicate the presence of additive gene effects and hence selection for these traits

based on phenotypic performance would be effective leading to greater success in breeding program [17—19]. The characters like days to 50% flowering, plant height, panicle length and plot yield exhibited high heritability values in conjunction with low genetic gain suggested that these traits are under the control of both additive and non-additive gene effects [20—23]. Low heritability estimates with low genetic gain for traits like panicle number, fertility percentage, grain yield per plant and harvest suggested that dominance and epistatic effects may be operating in the inheritance of these traits [24].

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