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Genetic variability, heritability and genetic advance studies in aromatic short grain rice (*Oryza Sativa* l.) genotypes

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Abstract
Rice is the major cereal crop of India. Aromatic rice possesses immense diversified quality of size, shape and appearance of grain, milling quality and cooking properties (Dela Cruz and Khush, 2000). Most of the varieties are small and medium grained under aromatic rice, possessing excellent aroma and other quality traits like elongation after cooking, taste, flavour etc. In the present scenario, when govt. is focusing to double the farm income by 2020. Rice can be a turning point for income enhancement. In this backdrop, aromatic rice of short grain feature is a boon for farmers for profit making. It is grown in pockets of provinces like Bihar, Orrisa, Madhya Pradesh, Chhattisgarh, Uttar pradesh etc. (Singh *et al.*,). The present study was carried out on aromatic short grain rice genotypes tested under Advance Varietal Trial-Two (AVT-2) consisting of total 11 entries along with three checks {(Kalanamak (RC), Vishnubhog(LC) & Badshahbhog(NC)} to screen out the best genotypes compared to checks and to advance such entries for next level. Along with the screening a study on genetic parameter has been conducted to advance the genotype on the basis of sound genetic principles. The trial was conducted at Barrister Thakur Chhedilal College of Agriculture and Research Station, Sarkanda (IGKV Raipur), Bilaspur, Chhattisgarh during *kharif* 2013-14. Analysis of variance reflected significant differences among the genotypes for all the traits studied. The CD value of (5.99) confirms that genotypes numbered PNR 546 (48.22 q/ha) and CN 1646-6-11-9 (47.78 q/ha) out yielded all the three checks *viz.* Kalanamak (32.44 q/ha), Vishnubhog (28.67 q/ha) and Badshahbhog (20.00 q/ha). The phenotype variance was higher in magnitude than that of genotypic variance for all studied characters indicates the influence of environmental factors on these traits. The estimates of genotypic & phenotypic coefficients of variation (GCV & PCV) were high for all the characters (flowering, plant height, panicle length, flag leaf length, tillers pet plant,1000 grain weight and grain yield) except days to maturity. Heritability in broad sense was highest for all the characters. High heritability along with high genetic advance as percent of mean was registered for grain yield, 1000 grain weight, tillers per plant, flag leaf length, panicle length & plant height. Its indicates the involvement of additive type of gene action in controlling these character & selection will be effective for crop improvement.

Keywords: Aromatic rice, GCV, PCV, heritability, Genetic advance

Introduction
Rice (*Oryza sativa*) belongs to family Gramineae. It is the most important crop of Chhattisgarh and is also the staple food of Chhattisgarh. Morphologically, rice is an annual grass and one of the most important grain crops. Globally it is grown extensively in tropical and sub-tropical regions of the world. More than half of the people on the globe depend on rice as their basic diet and generally extensively consumed in the producing countries. The continuous increasing population of world can only be satisfied with rice. It is expected that the world population increase by about 2 billion in the next two decades and half of this increase will in Asia where rice is the staple food. The chief rice production countries are; China, India, Indonesia, Bangladesh, Vietnam, Thailand, Myanmar, Philippine, Brazil, Japan, U.S.A and Pakistan. China is the prime producer of rice. India is an important rice growing and exporting country. In 2011-12 status of rice in India confirms that it was grown on 44.00 mha area with the production of 105 MT with the average productivity of 24 q/ha. (Source: State of Indian Agriculture, 2012-13 report) In the state of Chhattisgarh the status of rice on Kharif 2012 it was grown on3.79mha area with the production of 7.34 MT with the average productivity of 20 q/ha. (Source:http://agridept.cg.gov.in/report). It clarifies the fact that being the tag of rice bowl state of Chhattisgarh, but its average productivity is lower than national average productivity. The present studies were undertaken to study the genetic parameters viz, genotypic coefficient of variation. phenotypic coefficient of variation, genetic advance, heritability of various yield-influencing traits.

Materials and Methods

The material consist of 11 entries along check was grown at the research farm of Barrister Thakur Chhedilal College of Agriculture and Research Station, Sarkanda (IGKV Raipur), Bilaspur, Chhattisgarh, India in a Randomized Block Design (RBD) with three replications during the year Kharif 2013-14. Each genotypes were grown in a plot size of 3x5 $m^2$with 20 cm plant to plant and row-to-row spacing. Thirty day old seedlings were transplanted by maintaining one seedling per hill. To get a good crop, standard agronomic practices were followed. Five plants per replication per entry were harvested randomly to collect the data on Plant Height, Panicle Length, Tillers Per Plant, Flag Leaf Length, 1000-Grain Weight, and Grain Yield Per Plant. The analysis of variance was done using MSTATC software. Genotypic and phenotypic coefficients of variation were estimated as per Singh and Chaudhary [14]. Genotypic and phenotypic coefficients of variation, genetic advance (GA), Heritability (h^2) were calculated using Windostat software ver. 9.1. Hyderabad.

Results and Discussion

Analysis of variance

The analysis of variance for different characters is presented in Table 1. The treatments *i.e.* mean sum of squares due to genotypes showed significant differences for all 08 characters under study at 5 % level of significance, suggesting that the genotypes were genetically divergent. This indicates that there is ample scope for selection of promising lines from the present gene pool for yield and its components. These findings are in accordance with the findings of (Vivek *et al*.,) [19] and (Singh *et al*.,) [15] who also observed significant variability for yield and its components in rice.

Phenotypic and genotypic variance

The phenotypic variance was higher in magnitude than that of genotypic variance for the yield and yield contributing characters *viz.* plant height, flag leaf length and grain yield indicates the influence of environmental factors on these traits. Similar findings were reported by (Ganapati *et al.*) [4] and (Shiva Prasad *et al.*). The results are given in Table 2.

PCV and GCV

Phenotypic coefficients of variation (PCV) and genotypic coefficients of variation (GCV) were categorized as low (0-10%), moderate (10-20%) and high (>20%) as indicated by (Sivasubramanian and Madhavamenon). High phenotypic and genotypic coefficient of variation was recorded for grain yield (q/ha) (38.37 and 38.35) similar results by (Bisne *et al.*,; Ketan and Sarkar; Shaikh *et al*.,) [2, 8, 12], flag leaf length (cm) (26.03 and 25.68) similar results for high PCV reported by (Abebe *et al*.,) [1], thousand grain weight (25.40 and 25.32) similar results by (Bisne *et al.*,; Ketan and Sarkar) [2, 8] and plant height (21.81 and 21.75) similar results by (Abebe *et al*.,) [1]. Moderate phenotypic and genotypic coefficient of variation were recorded for tillers per plant (19.54 and 18.19) similar results for moderare GCV reported by (Abebe *et al*.,; Bisne *et al.*,; Shaikh *et al*.,) [1, 2, 12] while moderate PCV reported by (Shaikh *et al*.,) [12], panicle length (cm) (12.45 and 11.83) similar results by (Abebe *et al*.; Ketan and Sarkar) [1, 8], days to 50 % flowering (10.51 and 10.23) similar results by (Abebe *et al*.,) [1]. Whereas low phenotypic and genotypic coefficient of variation was observed for only days to maturity (5.96 and 5.90) similar results by (Abebe *et al*.,; Shaikh *et al*.,) [1, 12] for low GCV, while (Abebe *et al*.,) [1] reported for low PCV. These results are presented in Table 2.

Heritability

Heritability was classified as low (below 30%), medium (30-60%) and high (above 60%) as suggested by (Johnson *et al.,)* [7] Heritability and genetic advance were determined to study the scope of improvement in various characters through selection. Heritability and genetic advance are important selection parameters. High heritability estimate along with high genetic advance are more helpful in prediction the grain under selection than heritability estimates alone. However, it is not necessary that a character showing high heritability will also exhibit high genetic advance (Johnson *et al.*,) [7]. Heritability in broad sense estimates were high for grain yield (q/ha) (99.99) similar results by (Shaikh *et al*.,; Ketan and Sarkar; Bisne *et al.*,; Thorat *et al*.,) [12, 8, 2, 18], thousand grain weight (99.40), plant height (cm) (99.40) similar results by (Abebe *et al*., Shaikh *et al*.,; Ketan and Sarkar; Bisne *et al.*,; Rajpoot *et al*.,; Padmaja *et al*.,; Govinthraj *et al*.,; Thorat *et al*.,) [1, 12, 8, 2, 11, 9, 5, 18], days to maturity (97.70), flag leaf length (97.30) similar results by (Rajpoot *et al*.,; Padmaja *et al*.,) [11, 9], days to 50% flowering (94.80) similar results by (Ketan and Sarkar; Bisne *et al.*,; Rajpoot *et al*.,; Padmaja *et al*.,) [8, 2, 11, 9], panicle length (90.30) similar results by (Abebe *et al*.,; Ketan and Sarkar; Bisne *et al.*,; Rajpoot *et al*.,; Thorat *et al*.,) [1, 8, 2, 11, 18], tillers per plant (86.60) similar results by (Shaikh *et al*.,; Bisne *et al.*,; Padmaja *et al*.,; Govinthraj *et al*.,) [12, 2, 9, 5]. According to (Panse and Sukhatme) such characters governed predominantly by additive gene action and could be improved through individual plant selection. These results are presented in Table 2.

Genetic advance

Heritability in conjunction with genetic advance would give a more reliable selection value. According to (Johnson *et al.,)* [7] genetic advance as percent of mean classified as low (<10%), moderate (10-20%) and high (>20%).Among all the characters studied high expected genetic advance were observed for characters *viz.*, grain yield (q/ha) (78.97) similar results by (Shaikh *et al*.,; Ketan and Sarkar; Rajpoot *et al*.,) [12, 8, 11], thousand grain weight (52.03) similar results by (Shaikh *et al*.,; Ketan and Sarkar; Bisne *et al.*,; Rajpoot *et al*.,; Govinthraj *et al*.,) [12, 8, 2, 11, 5], flag leaf length (cm) (52.19) similar results by (Rajpoot *et al*.,; Padmaja *et al*.,) [11, 9], plant height (cm) (44.68) similar results by (Abebe *et al*.,; Ketan and Sarkar; Bisne *et al.*,; Padmaja *et al*.,) [1, 8, 2, 9], tillers per plant (34.88) similar results by (Shaikh *et al*.,; Bisne *et al.*,; Padmaja *et al*.,; Govinthraj *et al*.) [12, 2, 9, 5], panicle length (cm) (23.17) similar results by (Ketan and Sarkar) [8] and days to 50% flowering (20.52) Whereas moderate genetic advance was observed for days to maturity (12.00) However, lowest genetic advance was not observed in the present study. High heritability along with high genetic advance as percent of mean was registered for grain yield (q/ha) (99.99 and 78.97), thousand grain weight (99.40 and 52.03), plant height (cm) (99.40 and 44.68), flag leaf length (97.30 and 52.19), days to 50% flowering (94.80 and 20.52), panicle length (90.30 and 23.17) and tillers per plant (86.60 and 34.88), suggesting preponderance of additive gene action in the expression of these characters. This type of characters could be improved by mass selection and other breeding methods based on progeny testing. However, high heritability associated with moderate genetic advance as percent of mean was observed for days to maturity suggesting greater role of non-additive gene action in their inheritance. These results are presented in Table 2.

Table 1: Yield and Ancillary data of Advance Variety Trial-2 Aromatic Short Grain of AVT-2 (ASG) trial sown on *Kharif* -2013

Sl no.	Entry No.	Designation	Days to 50% flowering	Days to maturity	Plant height (cm)	Panicle length (cm)	Flag leaf length (cm)	Tillers plant $^{-1}$	1000 Grain weight (Gm)	Yield (q/ha)
4	2504	PNR 546	070	107	114	27.93	74.33	12	23.36	48.22
7	2507	CN 1646-6-11-9	075	114	119	22.80	65.66	10	25.35	47.78
8	2508 RC)	(RC)Kalanamak	089	121	188	26.53	52.33	10	16.40	32.44
10	2510(LC)	(LC)Vishnubhog	094	126	165	29.06	33.33	16	16.70	28.67
11	2511	HUR-917	090	125	099	26.53	61.33	10	11.73	22.00
9	2509	R 1536-136-1-77-1	089	125	109	26.73	55.33	11	13.98	21.78
3	2503	CR 2713-11	089	125	119	28.86	51.33	16	12.58	21.56
6	2506	CN 1268-5-7	089	125	132	29.93	87.00	14	19.21	21.11
5	2505	R 1521-950-6-843-1	089	116	122	23.33	57.33	10	15.59	20.67
2	2502	NDR 6330	087	124	145	23.26	40.33	10	15.21	20.22
1	2501 NC)	(NC)Badshabhog	102	125	188	20.10	53.66	11	29.38	20.00
Coefficient of Variation (CV) %			2.40	0.90	1.65	3.88	4.28	7.15	1.90	1.24
Critical Difference (CD) at 5%			3.42	1.88	3.68	1.71	4.19	1.45	0.57	0.58

Table 2: Genetic parameters (Summary) of Advance Variety Trial-2 Aromatic Short Grain of AVT-2 (ASG) trial sown on *Kharif* -2013

Characters	Days to 50% flowering	Days to Maturity	Plant height(cm)	Panicle length (cm)	Flag leaf Length(cm)	Tillers plant $^{-1}$	1000 Grain Weight	Grain yield(q/ha)
Genotypical variance	73.20	51.77	810.14	9.41	217.76	4.70	19.74	112.64
Phenotypical variance	77.25	52.99	814.80	10.42	223.81	5.41	19.85	112.76
GCV	10.23	5.90	21.75	11.83	25.68	18.19	25.32	38.35
PCV	10.51	5.96	21.81	12.45	26.03	19.54	25.40	38.37
$h^{2\ (Broad\ sense)\ \%}$	94.80	97.70	99.40	90.30	97.30	86.60	99.40	99.99
Gen Adv as % of mean 5%	20.52	12.00	44.68	23.17	52.19	34.88	52.03	78.97
General Mean	83.60	122.09	130.85	25.91	57.45	11.91	17.54	27.67
Range Lowest	65.00	107.33	102.33	20.10	33.33	10.33	11.58	20.15
Range Highest	97.00	134.00	187.66	29.93	87.00	16.00	25.23	48.07

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