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Genetic Variability in Aromatic Rice

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ABSTRACT

Grain quality characters is important parameters to access consumer's preference of rice. Aromatic rices are highly preferred due to their pleasant aroma and palatability. Twenty One diverse aromatic rice varieties including Pusa Basmati-1 used as a check were evaluated in randomized block design with three replications for various physico – chemical and cooking quality characters. The statistical analysis revealed highly significant differences among the varieties under study for various quality characters. The highest kernel length was recorded in Khao Dawk Mali 105 (8.33mm) followed by KCN 80152 (7.89 mm) and Hawn Kikwai (7.72mm), which may be utilized as donor for developing long grains varieties. Overall five varieties, namely Khao Dawk Mali – 105, Pakistani Basmati, Khao Hawn, Basmati Sathi and Basmati Champaran were identified superior among of them for most of the characters, and also superior over Pusa Basmati -1 which can be used as donor for quality improvement as well as for consumption and export purposes. High GCV, PCV, genetic advance coupled with high heritability were recorded for the gel consistency, gelatinization temperature, water uptake, head rice recovery and grain yield, indicating the genetic variance for these characters are probably due to their high additive gene effects and phenotypic selection for these traits will be highly rewarding.

Keywords: Physico-chemical & cooking quality characters, Genetic variability, Aromatic rice.

INTRODUCTION

Rice is important staple food more than 50% of world's population. India is the second largest producer of rice in the world with the 20% contribution in total rice production and occupies an area of 44m. ha with the production of 121 mt during 2020-21. Among the rices, Aromatic rices have most demand in domestic as well in International market due to its superfine grains, pleasant aroma, soft texture, extra- elongation of kernels, flaky, and fluffiness of cooked rice. Due to premium price of quality rices, India got huge amount of foreign currency 26415 crores during 2021-22. However, contribution of basmati rices in total rice export is less than 50% hence there is an urgent need to improve the grain quality characters of rice. Genetic variability is pre-requisite for improvement of any target trait. The information regarding the extent of variation for quality characters in lacking. In view of above consideration, the present study was undertaken to assess the extent of variation for physico-chemical and cooking quality characters in aromatic rices.

MATERIALS AND METHODS

The experimental material comprises 21 aromatic rice varieties includes Pusa Basmati- 1 as a check, which was evaluated at Agricultural Research farm of Amar Singh (P.G.) College, Lakhaoti (Bulandshahr) in randomized block design with three replications during Kharif 2020. One month old seedlings of each varieties were transplanted in a single row of 3m length with the spacing of 20X15 cm. The crop was raised under good management condition and all the recommended package of practices were followed. The data ware recorded on grain quality characters, like head rice recovery (HRR), kernel length (KL), kernel breadth (KB), length and breadth ratio (L/B), kernel elongation (KE), chalkines of endosperm

(Clk), alkali spreading value (ASV), water uptake number (WUP), volume expansion (VE), gel consistency (GC), amylose content (AC), aroma and grain yield. (GYP). The head rice recovery was recorded as per standard methods of Gosh et al. (1971). The kernel length and breadth were measured from milled kernels by using dial micrometer (Mitutoya), and L/B ratio derived from individual kernel length and breadth. Kernel elongation was measured from cooked kernels with the help of photographic enlarger and calculated as ratio of average length of cooked kernels to average length of raw kernels. Aroma was detected in leaves as wall as in kernels by using methods of Nagaraju et al. (1991). The alkali spreading value, water uptake number, volume expansion, gel consistency and amylose content were measured as per standard procedure of Little et al. (1958), Beachell & Stansel (1963), Cagampang et al. (1973) and Sadasivam & Manikkam (1992), respectively. Grain yield was observed from ten randomly selected plants per replication.

STATISTICAL ANALYSIS

The date were subjected to analysis of variance, estimation of genotypic and phenotypic coefficient Analyses variation GCV, PCV, heritability and genetic advance. The characters men for each replication were subjected to analysis of variance for randomized block design (Panse & Sukhamte, 1967), phenotypic (PCV) and genotypic (GCV) coefficient of variation wear computed (Burton, 1952). Heritability in broad sense (h^2b) was calculated (Hanson W.D., 1963) and expected genetic advance (Gs) at 5% selection intensity was also estimated Johnson et al. (1955).

RESULTS

Mean values of rice varieties for various physico-chemical and cooking quality characters are presented in Table 1. Varieties showing greater variation for different quality characters as well for yield. The head rice recovery of rice karnel is important character judging the market value of rice. In the present study, the head rice recovery was ranged from 27.45-66.45% The highest head rice recovery was recorded in Niaev Ping (66.65%) followed by AC-25419 (60.76%), Gopal Bhog (59.99%) and Khao Hawn (58.72%). The varieties having highest head rice recovery can be used as donor in quality improvement programme and also useful for export purposes. Grain size and shape is important quality characters inhance the market value of rice in national and international market. Superfine grains are much preferred by consumers as wall as traders. The varieties, Khao Dawk Male-105 and KCN-80152 have long slender grains and also found to be superior over Pusa Basmati-1 for kernel length. These varieties can be used as donor for breeding long grains varieties.

Table 1: Mean values of various physico-chemical and cooking quality characteristics of 21 Aromatic rice varieties.

Genotype	HRR (%)	KL (mm)	KB (mm)	L/B ratio	KE ratio	CLK (0-9)	ASV (1-7)	Wup (ml)	VE	GC (mm)	AC (%)	Set (1-3)	GYP (g)
Pusa Basmati-1	50.37	7.71	1.7	4.53	1.99	1	7	373.33	3.54	41	24.26	3	14.55
Daev Leuana	51.66	6.67	2.14	3.11	1.65	2	6.94	151	2.5	29	23.73	2	17.91
Khao Hawn	58.72	7.27	2.37	3.21	1.87	2	4	302.67	4.8	33	22.67	2	21.34
Niaev Ping	66.65	5.51	2.24	2.45	1.48	4	3.2	180.33	2.6	40	24.25	2	13.76
Sadri	54.14	6.39	2.21	2.89	1.63	6	3.33	256.67	4.4	38	23.2	2	12.27
Seeta Sail	40.57	7.29	1.95	3.76	1.88	1	3	205.67	3.2	30	22.7	3	14.78
Basmati-134	39.6	7.51	1.94	3.87	1.87	4	3	378.33	5.4	38	22.33	3	14.31
Basmati-397	27.45	7.56	1.96	3.8	1.89	6	4	203.67	4.2	33	21.22	3	11.44
Khao Dawk Mali-105	41.1	8.3	1.97	4.21	1.88	2	5.81	189.67	4.6	41.33	21.34	2	19.89
Hawn Kikwai	34.75	7.72	1.78	4.33	1.82	4	2.77	244	4.3	44	22.62	3	14.42
Patloon Tahni	28.14	6.55	2.27	2.88	1.89	8	3	428	6.2	37	22.66	3	17.05
KCN-80152	35.84	7.89	1.88	4.19	1.88	4	2.83	409.33	6.03	35	23.2	2	15.46
Pakistani Basmati	53.2	7.67	1.9	4.03	1.87	1	2.83	367.67	4.41	35.67	24.78	3	18.42
AC 25419	60.76	6.18	2.17	2.84	1.85	4	4	150.67	2.41	44	21.62	2	10.65
Basmati Sathi	42.49	6.62	2.11	3.13	1.87	2	3.5	206	3.2	32	22.68	2	10.61
Gopal Bhog	59.99	6.49	2.05	3.16	1.88	6	4.27	354.67	5.2	33	23.2	3	19.1
RD-15	43.88	6.43	1.95	3.29	1.7	6	2.72	388.33	6.2	36	21.62	2	11.02
Domsiah	35.35	7.6	2.83	3.68	1.85	2	2.5	178	2.9	96	18.25	2	18.71
Basmati Champaran	56.21	7.35	2.05	3.58	1.87	6	3.81	296	3	52	23.73	2	15.26

Prasad Bhog	54.2	6.48	2.07	3.15	1.72	4	2.53	175.67	3	36	19.21	3	12.39
Tulsi Manjari	57.79	5.53	2.19	2.52	1.66	4	4	318.33	4	30	21.09	2	10.93

HRR = Head Ries Recovery, KL = Karnel Length, KB = Kernal Breadth, L/B Ratio = Kernal Length and breadth ratio, KE = Kernal Elongation ratio, Clk = Chalkiness of endosperm, ASV = Alkali spreading value, Wup = Water Uptake number, VE = Volume expansion, GC = Gel consistency, AC = Amylose content, Sct = Scent, GYP = Grain yield per plant

Table 2 :- ANOVA and variability for physico-chemical and cooking quality traits in 21 aromatic rice varieties

Item	HRR	KL	KB	L/B	KE	Clk	ASV	Wup	VE	GC	AC	Sct	GYP
Mean Squares	547.33**	1.79**	0.158**	1.01**	0.002**	11.16**	4.98**	24793.21**	4.23**	549.46**	7.07**	2.81**	72.93**
Mean	47.78	6.94	2.07	3.43	1.81	3.77	3.72	279.43	4.03	39.22	22.41	2.31	15.07
Range	35.84-66.65	5.51-8.30	1.70-2.83	2.45-4.53	1.81-1.99	1.00-8.00	2.5-7.0	150.67-4.28	2.40-6.20	28.99-96.00	18.25-24.28	3-Jan	10.61-21.34
CD (5%)	4.74	0.29	0.08	0.25	0.015	0.91	0.459	3.94	0.4	0.225	0.561	0.917	2.76
6^2 p	188.014	0.62	0.054	0.356	0.001	3.92	1.713	8649.225	1.452	108.502	2.438	1.145	26.2
6^2 g	179.66	0.587	0.051	0.332	0.001	3.62	1.635	8071.96	1.39	180.483	2.32	0.832	23.36
6^2 e	8.353	0.032	0.002	0.024	0	0.307	0.078	577.261	0.061	8.019	0.117	0.313	2.838
CV (%)	6.38	2.57	2.51	4.45	0.53	19.94	7.43	8.59	6.12	7.22	1.52	29.9	10.44
PCV (%)	30.27	11.19	11.26	17.1	2	71.22	34.72	33.28	29.89	35	6.95	57.23	31.72
GCV (%)	29.59	10.89	10.97	16.51	1.92	68.38	33.92	32.15	29.25	34.25	6.78	48.8	29.95
h^2 (bs)	95.5	94.7	95	93.2	92.8	92.1	95.4	93.3	95.8	95.7	95.1	72.7	89.1
GA	26.99	1.53	0.45	1.14	0.75	3.76	2.57	178.79	2.37	22.07	3.06	1.6	9.4
GA (%)	59.58	21.84	22.04	32.85	3.82	135.23	68.25	63.98	58.99	69.05	13.63	85.73	58.27

PCV = Phenotypic coefficient, GCV = Genotypic coefficient of variation, h^2 = Heritability, GA = Genetic advancement at 5% selection intensity, 6^2 p = Phenotypic variance, 6^2g = Genotypic variance, 6^2e = Environmental Variance

Kernel elongation after cooking is also important cooking quality character. In case of kernel elongation length wise expansion without increases in girth is considered a highly desirable which gives finer appearance and much preferred by consumers. Maximum kernel elongation was observed in Pusa Basmati-1 (1.99) followed by Basmati-397(1.89), Khao Dawk Mali-105, KCN-80152, Gopal Bhog and Seeta Sail (1.88). These varieties can be used as donor for quality improvement programme. Aroma is important economic trait of quality rices mostly preferred by consumers and traders in domestic as well as international market. Out of 20, Nine Varieties exhibited strong aroma which included Pusa Basmati-1, Seeta Sail, Basmati-134, Basmati-397, Hawn Kikwai, Patloon Tahni, Pakistani Basmati, Gopal Bhog and Prasad Bhog. There varieties can be used as donor in basmati improvement programme. Grain Appearance is determined by endosperm opacity, amount of chalkiness in grains. Less area of chalkiness makes more market acceptability of rice. Two varieties, Seeta Sail and Pakistani Basmati showing chalkiness at par with Pusa Basmati -1 (1.0). Alkali spreading value, amylose content, gel consistency are the important cooking and eating quality characters depends on the properties of starch in rice grains, (Singh et al. 2000). Intermediate scores of alkali spreading value (3.5-5.4), and anylose content (20-25%) are desirable to quality point of view. Out of 21, four varieties, viz., Khao Hawn, Basmati-397, AC-25419, Gopal Bhog and Tulsi Manjari exhibited intermediate values of alkali digestion and anylose content. These varieties can be used as donor in quality improvement as well as for export purposes. Water uptake, volume expansion and gel consistency are also important cooking quality characters, their higher values desirable to quality point of view. Domsiah variety showing soft gel ; and Patloon Tahni, KCN-80152 and RD-15 exhibited higher water uptake number and volume expansion. In respect to grain yield per plant, varieties, viz., Khao Dawk Mali-105, Gopal Bhog, Domsiah and Pakistani Basmati are found superior over Pusa Basmati -1. Out of which, Khao Dawk Mali-105 and Pakistani Basmati also exhibited excellent grain quality characters.

DISCUSSION

In the present study, High heritability along with high

genetic advance were recorded for gel consistency, alkali spreading value, water uptake number, head rice recovery, chalkiness of endosperm and grain yield per plant. Hence, selection could be effective for these traits. The statistical analysis revealed highly significant differences among the varieties under study for physico-chemical and cooking quality characters. Overall five varieties viz., Khao Dawk Mali 105, Pakistani Basmati, Khao Hawn, Basmati Sathi and Basmati Champaran were identified superior among of them for most of the quality characters. These varieties were also found superior over Pusa Basmati for various characters, which can be used as donor for quality improvement programme or included in export rices.

The mean, range, variances, coefficient of variation, heritability and genetic advance are presented in Table 2. Varieties under studies shown wide range of variation for water uptake number, gel consistency, head rice recovery, kernel length, chalkiness, amylose content and L/B ratio. The highest genotypic ($6g^2$) and phenotypic variances ($6g^2$) were recorded for water uptake, gel consistency and head rice recovery, indicating negligible environmental influence for these characters. Similar findings were also reported by Sahu et al. (2017). The high GCV and PCV were observed in this study for gel consistency, alkali spreading value, water uptake number, chalkiness and aroma. These results are in conformity with the earlier workers Vanaja & Babu (2006), and Sahu et al. (2017). The closeness between GCV and PCV for grain quality characters indicated minimum influence of the environment on expression of these characters. Apart from high to moderate GCV and PCV, the high heritability was recorded in volume expansion (95.8%) followed by head rice recovery (95.5%), alkali spreading value (95.4%), kernel breadth (95%) and kernel length (94.7%). The high heritability indicating higher gains through selection. High heritability for above characters were also reported by Sahu et al. (2017). Heritability alongwith genetic advance will be more helpful in predicting the gain under selection. The high heritability coupled with high genetic advance were recorded for gel consistency, alkali spreading value, water uptake number, head rice recovery, chalkiness of endosperm, grain yield & aroma. These findings are in conformity with earlier workers Vanaja & Babu (2006) and Nanda et at. (2021). These results suggested that the preponderance of additive gene action with low environmental influence on these characters and selection could be effective for above characters.

CONCLUSION

Varital differences for different physico-chemical and cooking quality characters was significant under this study. Out of 21 aromatic varieties, five varieties viz., Khao Dawk Mali-105, Pakistani Basmati, Khao Hawn, Basmati Sathi, and Basmati Champaran were found superior over Pusa Basmati-1 for most of the grain quality characters. In respect to grain yield per plant, these varieties also exhibited higher yield than Pusa Basmati-1, which can be used as donor for Basmati improvement programme or used as export purposes. On the basis of genetic parameters, characters like gel consistency, alkali spreading value, water uptake number, head rice recovery, chalkiness of endosperm, grain yield and aroma exhibitied high GCV & PCV, high heritability couple with high genetic advance, resulted little influence of environment on expression of these characters, which indicated that selection respond would be better in case of these traits.

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Declaration: *We also declare that all ethical guidelines have been followed during this work and there is no conflict of interest among authors.*

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