

ANALYSIS OF COEFFICIENTS OF VARIATION FOR YIELD AND QUALITY CHARACTERS IN AROMATIC ADVANCED BREEDING LINES OF RICE (*ORYZA SATIVA* L.)

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Abstract: The experiment was conducted at Research Farm, Department of Genetics and Plant Breeding, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during kharif 2010 to assess the agromorphological characterization, genetic variability, association analysis and genetic divergence among the ninety eight aromatic advanced breeding lines of rice along with popular standard checks namely Indira Sugandhit Dhan-1, Pusa Basmati-1, Badsha bhog, Dubraj, Chinnor, Mahisugandha and Kalanamak. The high estimate of phenotypic and genotypic coefficient of variation was observed from Unfilled spikelets per panicle, Filled spikelets per panicle, Total spikelets per panicle, Spikelet sterility percentage, and Grain yield per plant and Brown rice breadth.

Keywords: Aromatic rice, Genotypic Coefficient of Variance (GCV), Phenotypic Coefficient of Variance (PCV)

INTRODUCTION

Rice is the most consumed cereal grain in the world, constituting the dietary staple food for more than half of the planet's human population. In world, rice has occupied an area of 160.6 million hectares, with a total production of 459.74 million metric tons in 2010 (Anonymous, 2011a). In Asian countries, rice is the main staple crop covering about ninety per cent of rice grown in the world, with two countries, China and India, growing more than half of the total crop. Rice provides about two-third of the calorie intake for more than two billion people in Asia, and a third of the calorie intake of nearly one billion people in Africa and Latin America (Shastri *et al.*, 2000).

India is the second largest producer of rice after China has an area of over 43.77 million hectares with the production of 89.05 million tons in 2010 (Anonymous, 2011b). Rice being the main source of livelihood for more than 120-150 million rural household is the backbone of the Indian Agriculture. It occupies about 23.3 per cent of the food grain production and 55 percent of cereal production. The rice plays a very vital role in the national food security. Even then rice self-sufficiency in India is precarious. The country's population of more than a billion is growing at 1.8% per year, outpacing the 1.4% annual growth rate of rice production.

Chhattisgarh popularly known as "Rice Bowl of India" occupies an area around 3.61 million hectares with the production of 5.22 MT (Anonymous, 2011c). The prime causes of low productivity of rice in Chhattisgarh are inappropriate adoption of agronomical practices, limited irrigation (28.0 %) and lack of improved varieties suitable to different ecosystems.

Aromatic rice varieties are very much popular for their quality and aroma. Aroma quality of scented rice is major character, which increases the value of

rice in the international market. In addition to long grain Basmati type which have high export potential, there are large number of indigenous short grained aromatic varieties cultivated in pockets of different states. Despite of low yield, they possess valuable genes for aroma, excellent cooking and eating quality traits and enjoy immense consumer preference in Chhattisgarh and in many other states. Grain quality in rice is a combination of many physico-chemical traits (Juliano, 1970). Physical quality is determined by the grain dimension, hulling, milling and head rice recovery. The quality of starch gelatinization temperature and protein content mainly constitute the chemical quality of rice. The cooking qualities are indexed by alkali spreading value, cooked kernel length, and elongation ratio. Scented varieties in general are tall, photoperiod sensitive with low yield potential. Therefore, presently much emphasis is given by the researchers on the development of high yielding varieties with good grain quality and aroma.

MATERIAL AND METHODS

The present research study on "Analysis of genetic variability for yield and quality characters in aromatic advanced breeding lines of rice (*Oryza sativa* L.)" was conducted at Research Farm, Department of Genetics and Plant Breeding, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India. Chhattisgarh state is located between 17° 14' and 24° 45' N latitude and 79° 16' and 84° 15' E longitudes whereas, Raipur lies at 21° 16' N and 81° 36' E with a height of 289.60 meters above the mean sea level.

The experiment was conducted during *kharif* 2010. The maximum temperature 35.7 °C and minimum temperatures 15 °C was recorded during the crop growth season. The total rainfall during crop growth season was 1104.2 mm. highest amount of rainfall during crop growth period was received in the month

of July (277.8 mm). The meteorological data depict a favorable season for crop growth but due to unevenly spread of rains, adversely affected the crop.

The experimental material was consisting of ninety eight aromatic advanced breeding lines of rice along with popular standard checks viz., Indira Sugandhit Dhan-1, Pusa Basmati-1, Badsha Bhog, Dubraj, Chinnor, Mahisugandha, and Kalanamak, These breeding lines were received from rice section of department of Genetics and Plant Breeding I.G.K.V Raipur (C.G.). The experiment was laid out in randomized block design with two replications. Each breeding line was grown in a plot comprising 7 rows of 5 meter long maintaining inter and intra row spacing of 20X15 cm. Transplanting of the material was done manually when the seedlings were 21 days old nursery. A fertilizer dose of 60N:40P:20K kg/ha was applied. The entire dose of phosphorus and potassium along with half dose of nitrogen was applied as basal at the time of field preparation and the remaining nitrogen dose was applied in two splits at 20 days interval on standing crop, starting from 30 days after transplanting.

Observations recorded on various agromorphological including qualitative and quantitative characters in each plot, on five random plants. By taking the average, the mean value for the treatment was computed. The characters studied viz., Qualitative characters : Early plant vigor (EPV), Basal leaf sheath color (BLSC), Leaf blade color (LBC), Leaf blade pubescence (LBP), Ligule color (LgC), Ligule shape (LgS), Collar color (CC), Auricle color (AC), Internode color (IC), Flag leaf angle (FLA), Panicle exertion (PE), Panicle type (PT), Stigma color (SgC), Apiculous color (ApC), Awning (An), Hull color (HC), Sterile lemma color (SLmC), Seed coat color (SCC). Quantitative characters: Days to 50 per cent flowering, Plant height, Panicle length, Total number of tillers per plant, Effective tillers per plant, Total number of spikelets per panicle, Number of filled spikelets per panicle, Number of unfilled spikelets per panicle,

Spikelet sterility percentage, 100-Seed weight (g), Grain yield per plant (g). Physico-chemical quality characters, Paddy length (mm), Paddy breadth (mm), Paddy length, breadth (L/B) ratio, Brown rice length (mm), Brown rice breadth (mm), Brown rice length, breadth (L/B) ratio, Kernel length (mm), Kernel breadth (mm), Kernel length, breadth (L/B) ratio, Kernel length after cooking (KLAC) (mm), Kernel breadth after cooking (KBAC) (mm), Cooked kernel L/B ratio (KLAC: KBAC), Elongation ratio (ER), Elongation index (EI), Hulling percentage, Milling percentage, Alkali spreading value (Gelatinization temperature), Aroma.

Statistical Analysis

Range: The lower and higher value of a character determines its range, which is expressed as follows:

Range = Highest value – Lowest value.

Mean: The mean is calculated by the following formula

$$\bar{X} = \sum Xi / N$$

Where,

$\sum Xi$ = Summation of all the observation

N = Total number of observation

Estimation of coefficients of variation

The coefficient of variation for different characters was estimated by formula as suggested by Burton and De Vane (1953).

$$GCV (\%) = (\sqrt{\sigma^2_g / \bar{X}}) \times 100$$

$$PCV (\%) = (\sqrt{\sigma^2_p / \bar{X}}) \times 100$$

Where,

PCV = Phenotypic coefficient of variation

GCV = Genotypic coefficient of variation

$\bar{X}$ = Mean of character

σ^2_g = Genotypic variance

σ^2_p = Phenotypic variance

The magnitude of coefficient of variation was categorized as high (> 20%), moderate (20% - 10%) and low (< 10%).

Table 1: Genotypic and phenotypic coefficient of variance (GCV and PCV), and range for different characters.

S.N.	Characters	Average mean	Range		GCV (%)	PCV (%)
			Min	Max		
1	Days to 50% flowering	98.05	77.5	122	10.92	11.01
2	Plant height (cm)	115.22	95	195	13.82	14.22
3	Panicle length (cm)	24.89	19.9	35.6	8.55	9.86
4	Total tillers per plant	7.93	5.9	9.6	8.62	10.84
5	Effective tillers per plant	6.55	3.1	8.9	13.96	18.37
6	Total number of spikelets per panicle	215.96	112.3	328.0	20.25	22.02
7	Filled spikelets per panicle	178.49	99.9	290.7	21.52	23.39
8	Unfilled spikelets per panicle	37.46	9.5	78.30	38.37	42.31
9	Spikelet sterility percentage	17.22	6.47	35.0	33.14	36.61
10	100 seed weight (g)	1.78	1.00	3.00	19.28	24.17
11	Grain yield per plant (g)	25.22	10.90	45.42	25.79	30.65
12	Paddy length(mm)	8.44	5.75	10.4	16.77	17.32

13	Paddy breadth(mm)	1.97	1.20	2.50	9.92	13.08
14	Paddy L/B ratio	4.35	2.66	6.61	19.40	21.61
15	Brown Rice Length (mm)	6.35	4.25	8.45	16.84	17.38
16	Brown Rice breadth (mm)	1.77	1.35	2.95	21.25	22.50
17	Brown Rice L/B ratio	3.74	2.10	5.89	23.52	26.01
18	Kernel length (mm)	5.44	3.50	7.15	16.57	16.96
19	Kernel breadth (cm)	1.66	1.35	1.95	7.67	10.57
20	Kernel L/B ratio	3.31	1.88	4.93	18.80	20.67
21	Kernel length after cooking (mm)	7.42	5.55	9.70	13.91	14.44
22	Kernel breadth after cooking (mm)	2.31	1.65	2.70	6.51	8.46
23	Cooked Kernel L/B ratio	3.23	2.21	4.60	15.70	17.29
24	Elongation ratio	1.38	0.87	1.95	17.73	18.68
25	Elongation Index	0.99	0.50	1.62	17.99	21.54
26	Hulling %	76.18	71.55	80.55	2.30	2.88
27	Milling %	63.31	54.75	70.40	5.01	6.40

Note: GCV: Genotypic coefficient of variation; PCV: Phenotypic coefficient of variation;

RESULT AND DISCUSSION

The coefficient of variation is an important tool for obtaining comparison of the variability present among different characters. A wide range of variation was observed for most of the characters in the genotypes studied; indicating that selection based on these characters is expected to be effective.

The estimates of phenotypic and genotypic coefficient of variation for different quantitative and quality characters of 98 genotypes in the present study are presented in table 1.

The high estimate of phenotypic and genotypic coefficient of variation was observed from number of unfilled spikelets per panicle (PCV% = 42.31, GCV% = 38.37).

The number of filled spikelets per panicle, total spikelet's per panicle, spikelet sterility percentage, grain yield per plant, brown rice breadth and brown rice length/breadth ratio showed high PCV% (23.39, 22.06, 36.31, 30.65, 22.50 and 26.01 respectively) in combination with high GCV% (21.52, 20.25, 33.14, 25.79, 21.25 and 23.52 respectively).

The 100- seed weight, paddy length/breadth ratio, kernel rice length/breadth ratio and elongation index showed high PCV% (24.17, 21.61, 20.67 and 21.54 respectively) in combination with moderate GCV% (19.28, 19.40, 18.80 and 17.99 respectively) for this traits.

The moderate estimates of PCV% and GCV% (10-20%) were observed for days to 50 percent flowering (PCV% =11.01, GCV%=10.92), plant height (PCV% =14.22, GCV% =13.82) total number of effective tillers per plant(PCV% =18.37, GCV%=13.96), paddy length (PCV% =17.32, GCV% =16.77), brown rice length (PCV% =17.38, GCV% =16.84), kernel length (PCV% =16.96, GCV% =16.57), kernel length after cooking (PCV% =14.44, GCV% =13.91), kernel length/breadth ratio after cooking (PCV% =17.29, GCV% =15.70) and elongation ratio (PCV% =18.68, GCV% =17.73)

The number of total tillers per plant, kernel breadth and paddy breadth showed moderate PCV% (10.84,

10.57 and 13.08) in combination with low GCV % (8.62, 7.67 and 9.92).

The low estimates of PCV% and GCV% (<10%) were observed for panicle length (PCV% =9.86, GCV% =8.55), hulling percentage (PCV% =2.88, GCV% =2.30), milling percentage (PCV% =6.40, GCV% =5.01) and kernel breadth after cooking (PCV% =8.46, GCV% =6.51).

The high magnitude of genotypic coefficient of variation reveals the high genetic variability present in the material studied. In the present investigation phenotypic coefficient of variation was recorded higher than genotypic coefficient of variation and was in accordance with the Sarawgi *et al.* (1994) and Ganesan *et al.* (1995). The high magnitude of genotypic coefficient of variation was noted for grain yield per plant. Similar findings were also obtain by Borbore and Hazarika (1998), and Kaw *et al.* (1999), Chaudhary and Motiramani (2003) and Sinha *et al.* (2004). For filled spikelets per panicle by Kaw *et al.* (1999) and Chaudhary and Motiramani (2003), spikelet sterility percentage by Kavitha and Ramareddy. (2002). The moderate estimates of genotypic coefficient of variation for brown rice length, kernel length after cooking, and kernel breadth after cooking is in accordance with the Sarkar *et al.* (2007).

CONCLUSION

The coefficient of variation is an important tool for obtaining comparison of the variability present among different characters. The number of Filled spikelets per panicle, Unfilled spikelets per panicle, Total spikelet's per panicle, Spikelet sterility percentage, Grain yield per plant, Brown rice width and Brown rice length/breadth ratio showed high PCV % in combination with high GCV %. The moderate estimates of PCV and GCV were observed for Days to 50 percent flowering, Plant height, Total number of effective tillers per plant, Paddy length, Brown rice length, Kernel length,

Kernel length after cooking, Kernel length/breadth ratio after cooking and Elongation ratio.

Suggestions for future works

Desirable breeding lines for yield and quality characters may be used in the improvement programme to develop superior high yielding aromatic rice varieties. For hybridization programme, the better genotypes should be taken from different clusters on the basis of yield and quality characters for hybridization programme. Morphological characterization criteria may be used for marker assisted selection.

ACKNOWLEDGEMENT

I take this opportunity to express my heartfelt and deepest sense of gratitude to the Chairman of my Advisory Committee, Dr. A.K. Sarawgi, Principal Scientist, Department of Genetics & Plant Breeding, IGKV, Raipur (C.G.) for his research insight, valuable guidance, constant encouragement, endless inspiration, constructive criticism, support and keen interest during course of study and preparation of this manuscript.

REFERENCES

- Anonymous** (2011a). World Agricultural Production. *United States Dept. of Agril. Service*. p. 7.
- Anonymous** (2011b). The Hindu Survey of Indian Agriculture. Agril. Statistics Division Directorate of Economics & Statistics Dept. of Agriculture and corporation, p. 125.
- Anonymous** (2011c). Credible Chhattisgarh, Raipur. p. 8.
- Shastry, S.V., Tran, D.V., Nguyen, V.N. and Nanda, J.S.** (2000). Sustainable integrated rice production. In: Nanda, J.S. (Ed) *Rice Breeding and Genetics: Research Priorities and Challenges*. Oxford and IBH Pub., New Delhi. pp. 53-72.
- Juliano, B.O.** (1970). Relation of physic-chemical properties to properties characteristics of rice. Proc. 5th Cental and Board Congress, 4: 21-27.
- Sarawgi, A.K., Soni, D.K. and Shrivastava, M.N.** (1994). Variability in correlation studies of physio-chemical traits in some selected cultivars / lines of rice (*Oryza sativa* L.). *Ad. Plant Sci.*, 7(2): 298-307.
- Ganesan, K., Wilfred Manuel, W. and Sundaram, T.** (1995). Correlation and path coefficient analysis of yield components in F2 and F3 generations of tall X dwarf rice crosses. *Oryza*, 35(4): 329-332.
- Borbora, T.K. and Hazarika, G.N.** (1998). Study of genetic variability, heritability and genetic advance for panicle character in rice. *Oryza*, 35(1): 19-20.
- Kaw, R.N., Aquino, R.C., Mom, H.P., Yae, J.D. and Haq, N.** (1999). Variability and interrelations in rice under cold stress environment. *Oryza*, 36(1): 1-4.
- Chaudhary, M. and Motiramani, N.K.** (2003). Variability and association among yield attributes and grain quality in traditional aromatic rice accessions. *Crop Imp.*, 30(1): 84-90.
- Sinha, S.K., Tripathi, A.K. and Bisen, U.K.** (2004). Study of genetic variability and correlation coefficient analysis in midland landraces of rice. *Ann. Agric. Res.*, 25(1): 1-3.
- Kavitha, S. and Reddi, N.S.R.** (2002). Variability and heritability and genetic advance of some important traits in rice (*Oryza sativa* L.). *Andhra Agric J.*, 49(3-4): 222-224.
- Burton, G.W. and Devane, E.H.** (1953). Estimating heritability in tall fescue (*Festuca arundinaceae*) from replicated coloal material. *Agron. J.*, 45: 478-481.
- Sarkar, K.K., Bhutia, K.S., Senapati, B.K. and Roy, S.K.** (2007). Genetic variability and character association of quality traits in rice (*Oryza sativa* L.). *Oryza*, 44(1): 64-67.