Electronic Journal of Plant Breeding, 8(2): 609-614 (June 2017)
ISSN 0975-928X
DOI: 10.5958/0975-928X.2017.00092.8

Research Note

Studies on genetic variability for floral and grain quality traits in rice (*Oryza sativa* L.)

R. Mohana Priyanka, K. Thiyagarajan, S. Pechiappan Bharathi and R. Rajendran
Vanavarayar Institute of Agriculture, Manakadavu, Pollachi – 642 103.
E-mail: pri.suthan22@gmail.com

(Received: 31 Jan 2016; Revised: 18 June 2017; Accepted: 24 June 2017)

Abstract
Genetic variability, heritability and genetic advance were estimated for various floral and grain quality traits in 22 genotypes of rice. The experiment was conducted in randomized block design with two replications during at Vanavarayar Institute of Agriculture, Pollachi during 2014-15. Analysis of variance showed significant differences among the genotypes studied for all the floral and grain quality traits. The phenotypic coefficients of variations were higher than those of genotypic coefficients of variations, which indicate the influence of environment for expression of the characters. The genotypic and phenotypic coefficient of variations (PCV and GCV) was maximum for stigma exsertion and minimum for hulling per cent. Floral traits anther length, anther breadth, number of pollen grains per anther, panicle exsertion, stigma length, stigma breadth, stigma exsertion and style length and grain quality traits like kernel length, kernel breadth, kernel length/ breadth ratio, kernel length after cooking, kernel breadth after cooking and volume expansion ratio exhibited higher magnitude of broad sense heritability accompanied with high genetic advance as per cent of mean, indicating the predominance of additive gene action governing these traits and genetic improvement for these traits is possible by using simple selection techniques.

Key words
Genotypic coefficient of variation, phenotypic coefficient of variation, heritability and genetic advance

Variation is the basis of plant breeding. As success of any crop improvement programme largely depends on the magnitude and range of variability on the available genetic stock, a critical estimate of genetic variability is a prerequisite for initiating appropriate breeding procedures in crop improvement programmes. Hence, it becomes necessary to spilt over-all variability into its heritable and non-heritable components with the help of certain genetic parameters, which may enable the breeders to plan a proper breeding programme. Therefore, the present investigation was taken up to study the variability for floral and grain quality traits in rice genotypes.

The experimental material consists of two CGMS lines *viz.*, COMS 24A and TNAU CMS 2A and 20 testers. They were raised in randomized block design (RBD) with two replications at Vanavarayar Institute of Agriculture, Pollachi. Observations were recorded on five florets of three randomly selected plants in each replication for the floral traits, namely, anther length, anther breadth, number of pollen grains per anther, stigma length, stigma breadth, style length, panicle exsertion, stigma exsertion and angle of glume opening. Observations were also recorded on grain quality traits *viz.*,hulling per cent, milling per cent, kernel length, kernel breadth, kernel length/ breadth ratio, kernel length after cooking, kernel breadth after cooking, linear elongation ratio, breadthwise expansion ratio and volume expansion ratio as per the Standard Evaluation System (SES, 1996) descriptors suggested by IRRI. The mean data for each character were subjected to statistical analysis. Genetic parameters like variability, GCV, PCV, heritability and genetic advance were calculated as per the formulae suggested by Johnson *et al.* (1955).

Analysis of variance showed significant differences among the genotypes studied for all the floral and grain quality traits (Table.1). The mean performance of parental lines for various floral traits and grain quality traits are presented in table 2 and 3.

Genetic variability in floral traits: The genotypic and phenotypic coefficients of variation indicate the extent of variability for different traits. The results of the study indicate that, the phenotypic coefficient of variation were higher than genotypic coefficient of variation for all the traits studied. All the characters showed narrow differences between phenotypic and genotypic coefficient of variation, indicating very low effect of environment and greater role of genetic factors in the expression of these traits (Table 4)

High PCV and GCV were recorded for number of pollen grains per anther, stigma breadth, style length and stigma exsertion. High PCV and GCV as recorded in the present study was observed by many earlier researchers namely, Ushakumari *et al.* (2002) and Kamalahar (2003) for stigma breadth; Maavimani and Saraswathi (2014) for number of pollen grains per anther and style length. The traits, anther length, anther breadth, stigma length and angle of glume opening exhibited moderate PCV and GCV. Low PCV and

DOI: 10.5958/0975-928X.2017.00092.8

GCV was observed in panicle exsertion. This is in accordance with the findings of Mahalingam *et al.* (2013).

Heritability is the proportion of observed variability, which is due to heredity alone, excluding the environmental influence. Heritability gives information only on the magnitude of inheritance, but genetic advance guide in evaluating the progress under a selection scheme. Higher the value of genetic advance, better and surer progress will be on the mean in the succeeding generation under directional selection. In the present study, the heritability and genetic advance as per cent of mean were high for anther length, anther breadth, number of pollen grains per anther, stigma length, stigma breadth, style length, panicle exsertion and stigma exsertion. Similar findings were reported by Mahalingam *et al.* (2013) for anther length, stigma length and stigma exsertion; Majumder *et al.* (2014) for anther length, anther breadth and stigma length; Maavimani and Saraswathi (2014) for anther length, anther breadth, number of pollen grains per anther, stigma length, stigma breadth and style length.

Genetic variability in grain quality traits: High PCV and GCV was observed for kernel length/ breadth ratio. The traits kernel length, kernel breadth, kernel length after cooking, kernel breadth after cooking and volume expansion ratio recorded moderate PCV and GCV values. These results are in agreement with the findings of Vanaja and Babu (2006) for kernel breadth and volume expansion ratio; Umadevi *et al.* (2010) for kernel length after cooking and kernel breadth after cooking; Dhanwani *et al.* (2013) for kernel length, kernel length after cooking and kernel breadth after cooking.Low PCV and GCV values were recorded for hulling per cent, milling per cent, linear elongation ratio and breadthwise expansion ratio. This is in accordance with the findings of Vanaja and Babu (2006), Umadevi *et al.* (2010) and Manonmani *et al.* (2010).

High heritability coupled with high genetic advance as per cent of mean was observed in kernel length, kernel breadth, kernel length/breadth ratio, kernel length after cooking, kernel breadth after cooking and volume expansion ratio. These results are in agreement with the findings of Umadevi *et al.* (2010) for kernel length/ breadth ratio, kernel breadth after cooking and volume expansion ratio; Dhanwani *et al.* (2013) for kernel length, kernel length/ breadth ratio and kernel breadth after cooking; The traits, hulling per cent, milling per cent, linear elongation ratio and breadthwise expansion ratio recorded high heritability coupled with moderate genetic advance as per cent of mean. Similar results were observed by Manonmani *et al.* (2010), Umadevi *et al.* (2010) and Dhanwani *et al.* (2013).

The results of the study revealed that, floral traits *viz.*, anther length, anther breadth, number of pollen grains per anther, panicle exsertion, stigma length, stigma breadth, stigma exsertion and style length and grain quality traits like kernel length, kernel breadth, kernel length/ breadth ratio, kernel length after cooking, kernel breadth after cooking and volume expansion ratio exhibited higher magnitude of broad sense heritability accompanied with high genetic advance as per cent of mean indicating the predominance of additive gene action governing these traits and genetic improvement for these traits is possible by using simple selection techniques.

References

Dhanwani, R.K., Sarawgi, A.K., Akash Solanki and Jitendra Kumar Tiwari. 2013. Genetic variability analysis for various yield attributing and quality traits in rice (*O. sativa* L.). *The Bioscan*, **8**(4): 1403-1407.

Johnson, H.W., Robinson, H.F. and Comstock, R.E. 1955. Estimation of genetic and environmental variability in soyabean (*Glycine max* (L.) Merril.). *Agron. J.*, **47**(4): 314-318.

Kamalahar, R. 2003. Genetic divergence among CGMS lines and maintainer lines in rice (*Oryza sativa* L.). *M.Sc. (Ag.) Thesis*, Tamil Nadu Agricultural University, Coimbatore.

Maavimani, M. and Saraswathi, R. 2014. Anther characteristics and spikelet fertility in rice (*Oryza sativa* L.) under high temperature stress at anthesis. *Indian J. Genet.*, **74**(3): 300-308.

Mahalingam, A., Saraswathi, R., Ramalingam, J. and Jayaraj, T. 2013. Genetics of floral traits in cytoplasmic male sterile (CMS) and restorer lines of hybrid rice (*Oryza sativa* L.). *Pak. J. Bot.*, **45**(6): 1897-1904.

Majumder, R.R., Roy, R.K., Khatun, M., Hore, T.K., Nahar, K. and Majumder, U.K. 2014. Study on outcrossing traits of some aromatic restorer lines of hybrid rice. *Eco-friendly Agril. J.*, **7**(10): 110-114.

Manonmani, S., Malarvizhi, D., Robin, S., Umadevi, M., Ameenal, M., Pushpam, R., Mohana Sundaram, K. and Thiyagarajan, K. 2010. Breeding three line rice hybrids with good grain quality. *Electron. J. Pl. Breed.*, **1**(4): 1265- 1269.

SES of IRRI. 1996. Standard Evaluation System for Rice. IRRI, Philippines, pp. 37-38.

Umadevi, M., Veerabadhiran, P., Manonmani, S. and Shanmugasundaram, P. 2010. Physico- chemical and cooking characteristics of rice genotypes. *Elect. J. Pl. Breed.*, **1**(2): 114-123.

Ushakumari, R., Rangaswamy, P. and Michael Gomez. 2002. Variability in floral characters in wild species of (*Oryza sativa* L.) paddy. *Int. J. Mendel (Genetics)*, **19**: 51.

Vanaja, T. and Luckins C. Babu. 2006. Variability in grain quality attributes of high yielding rice varieties (*Oryza sativa* L.) of diverse origin. *J. Trop. Agr.*, **44**(1-2): 61-63.

Electronic Journal of Plant Breeding, 8(2): 609-614 (June 2017)
ISSN 0975-928X
DOI: 10.5958/0975-928X.2017.00092.8

Table 1. Analysis of variance for floral traits and grain quality traits

S.No.	Characters	Mean Sum of Squares
1.	Anther length	0.140**
2.	Anther breadth	0.00350**
3.	Number of pollen grains per anther	243301.404**
4.	Stigma length	0.0647**
5.	Stigma breadth	0.00713**
6.	Style length	0.0298**
7.	Panicle exsertion	70.047**
8.	Angle of glume opening	32.985**
9.	Stigma exsertion	698.530**
10.	Hulling per cent	21.5981**
11.	Milling per cent	28.0035**
12.	Kernel length	0.6241**
13.	Kernel breadth	0.1470**
14.	Kernel length/ breadth ratio	0.4392**
15.	Kernel length after cooking	1.4911**
16.	Kernel breadth after cooking	0.1978**
17.	Volume expansion ratio	0.2596**
18.	Linear elongation ratio	0.1756**
19.	Breadthwise expansion ratio	0.0073**

** Significant at 1% level

Electronic Journal of Plant Breeding, 8(2): 609-614 (June 2017)
ISSN 0975-928X
DOI: 10.5958/0975-928X.2017.00092.8

Table 2. Mean performance of parental lines for various floral traits

S. No.	Genotypes	Anther length (mm)	Anther breadth (mm)	Number of pollen grains per anther	Stigma length (mm)	Stigma breadth (mm)	Style length (mm)	Panicle exsertion (%)	Angle of glume opening (°)	Stigma exsertion (%)
1.	ADT 36	2.51e	0.41bc	2030.71e	1.08 de	0.51 a	0.49 de	104.70 kl	32.75 ij	34.25 fg
2.	ADT 37	1.83q	0.40bcde	1163.63 p	0.75 i	0.39 hi	0.36 hi	108.13 hij	41.38 abc	14.81 ij
3.	ADT 43	2.44 hj	0.40bcde	1940.05 hi	0.95 fg	0.40 gh	0.34 i	111.81 efg	37.25 defg	49.38 cde
4.	ADT 45(R)	2.67 b	0.36fghi	2238.23 b	0.95 fg	0.41 dfg	0.42 fg	110.43 fgh	36.88 defgh	26.89 gh
5.	ADT 47(R)	2.47fgh	0.34i	1977.71 fgh	1.12 cd	0.43 cd	0.51 d	114.04 de	37.63 cdef	25.81 gh
6.	ADT 48(R)(	2.56d	0.39cdef	2099.67 d	1.41 a	0.47 b	0.49 de	107.41 ijk	41.75 ab	55.27 cd
7.	ASD 16	2.15m	0.42b	1578.66 l	0.84 ghi	0.39 hi	0.49 de	109.01 ghij	42.75 ab	21.72 hi
8.	ASD 18	2.30 l	0.38cdefg	1764.45 k	0.77 hi	0.37 ij	0.48 de	106.39 jk	40.63 abcd	23.30 hi
9.	AS10036	2.03n	0.38defg	1419.03 m	1.16 bcd	0.38 hi	0.41 fg	116.17 cd	34.38 fghi	48.85 de
10.	AS10062	2.30l	0.34i	1764.46 k	1.13 cd	0.35 k	0.43 fg	110.58 fgh	33.00 hij	35.73 fg
11.	AS10070	2.42jk	0.36fghi	1924.08 ij	1.15 cd	0.35 jk	0.50 d	106.27 jk	36.75 defgh	27.79 gh
12.	CB09538	1.99o	0.35hi	1371.15 n	0.87 fgh	0.26 n	0.69 b	102.74 l	34.13 fghij	40.04 ef
13.	IET 1308	2.60c	0.36ghi	2152.67 c	0.93 fg	0.30 m	0.51 d	106.41 jk	37.75 cdef	20.71 hij
14.	CO 47	2.50ef	0.37fgh	2014.76 ef	0.98 ef	0.38 hi	0.48 de	113.19 ef	30.38 j	20.40 hij
15.	CO 51	2.47fg	0.42b	1983.32 fg	0.92 fg	0.43 cd	0.58 c	118.29 bc	39.13 bcde	59.35 bc
16.	PMK 3(R)	2.94a	0.42b	2690.28 a	1.27 b	0.42 cdef	0.42 fg	109.20 ghij	42.75 ab	10.94 j
17.	Anna(R)4	2.13m	0.50a	1546.09 l	0.77 hi	0.33 l	0.53 d	109.5 ghi	33.25 hij	20.16 hij
18.	MDU 5	2.27l	0.29j	1732.54 k	1.20 bc	0.44 c	0.45 ef	127.39 a	36.13 efghi	57.99 cd
19.	TPS 5	1.92p	0.40bcd	1275.36 o	0.93 fg	0.37 ij	0.39 gh	106.36 jk	37.75 cdef	30.11 fgh
20.	TKM 9	2.44ghij	0.36fghi	1945.80 ghi	0.77 hi	0.28 n	0.40 fgh	119.96 b	44.25 a	14.34 ij
21.	TNAU CMS 2B	2.47fgh	0.37efgh	1977.71 fgh	1.12 cd	0.42 cdef	0.72 b	102.56 l	30.25 j	76.19 a
22.	COMS 24B	2.40k	0.38defg	1897.27 j	1.15 cd	0.44 c	0.85 a	109.65 ghi	33.38 ghij	68.12 ab
	Mean	**2.36**	**0.38**	**1840.35**	**1.01**	**0.39**	**0.49**	**110.46**	**37.02**	**35.55**

Values with same letter(s) are statistically identical at 1% level of probability.

Electronic Journal of Plant Breeding, 8(2): 609-614 (June 2017)
ISSN 0975-928X
DOI: 10.5958/0975-928X.2017.00092.8

Table 3. Mean performance of parental lines for various grain quality traits

S.No.	Genotypes	H %	M%	KL (mm)	KB (mm)	KL/B	KLAC (mm)	KBAC (mm)	VER	LER	BER	ASV
1.	ADT 36	77.11 m	66.50 n	6.15 c	1.95 fg	3.15 bc	9.65 c	2.80 e	3.23 de	1.57 fg	1.43 abc	5.5
2.	ADT 37	81.49 e	71.25 e	5.00 j	2.65 a	1.88 i	8.75 g	3.40 a	3.25 de	1.76 ab	1.28 fg	4.67
3.	ADT 43	80.23 i	72.75 d	5.80 d	1.90 gh	3.05 c	9.35 d	2.55 g	3.45 cde	1.61 ef	1.35 defg	4.33
4.	ADT 45	72.45 o	62.24 q	5.75 d	2.00 efg	2.88 d	9.20 e	2.85 de	3.66 bcd	1.61 ef	1.42 abcd	5.00
5.	ADT 47	71.99 p	60.49 r	5.20 hi	1.90 gh	2.73 def	8.85 g	2.85 de	4.60 a	1.70 c	1.50 a	4.50
6.	ADT 48	79.49 j	69.75 i	5.25 gh	1.90 gh	2.76 de	9.40 d	2.60 g	3.46 cde	1.79 a	1.37 bcde	4.00
7.	ASD 16	85.49 a	73.25 c	5.25 gh	2.55 ab	2.06 hi	7.80 l	3.45 a	3.37 cde	1.49 ijk	1.36 cdefg	4.83
8.	ASD 18	81.49 e	70.75 f	5.25 gh	2.65 a	1.98 i	7.65 m	3.45 a	3.33 de	1.46 jk	1.30 efg	4.67
9.	AS 10036	81.74 d	74.50 b	5.05 j	1.90 gh	2.65 ef	8.05 k	2.55 g	3.73 bcd	1.60 ef	1.35 defg	4.67
10.	AS 10062	80.48 h	69.50 j	5.10 ij	2.00 efg	2.55 fg	8.15 jk	2.60 g	4.14 ab	1.60 ef	1.30 efg	4.50
11.	AS 10070	79.21 k	70.75 f	5.25 gh	2.00 efg	2.63 ef	8.20 j	2.75 ef	3.63 bcd	1.57 fg	1.38 bcde	4.50
12.	CB 09538	83.14 c	70.25 h	5.45 f	2.00 efg	2.72 def	8.45 i	2.60 g	3.40 cde	1.55 fgh	1.30 efg	4.83
13.	IET 1308	81.23 f	69.45 k	5.60 e	2.10 de	2.67 ef	9.65 c	3.00 c	3.71 bcd	1.72 bc	1.43 abc	5.16
14.	CO 47	79.49 j	67.00 m	5.25 gh	2.15 d	2.44 g	8.60 h	2.75 ef	3.80 bcd	1.63 de	1.27 g	4.67
15.	CO 51 check	81.07 g	70.50 g	6.75 a	2.05 def	3.30 b	10.15 ab	2.80 e	3.57 bcd	1.50 ij	1.37 bcdef	6.83
16.	PMK 3	77.47 l	68.03 l	6.15 c	2.35 c	2.62 efg	10.05 b	3.20 b	3.96 bc	1.63 de	1.36 bcdef	6.50
17.	Anna(R) check	79.49 j	66.50 n	6.55 b	2.05 def	3.19 bc	10.25 a	2.95 cd	3.23 de	1.56 fg	1.44 ab	6.00
18.	MDU 5	79.22 k	65.75 o	5.35 fg	1.95 fg	2.74 de	8.05 k	2.65 fg	3.45 cde	1.50 hij	1.36 bcdef	5.00
19.	TPS 5	80.22 i	69.75 i	5.60 e	2.55 ab	2.19 h	9.00 f	3.40 a	3.66 bcd	1.61 ef	1.34 efg	5.00
20.	TKM 9	75.46 n	64.01 p	5.35 fg	2.45 bc	2.18 h	8.20 j	3.25 b	3.31 de	1.53 ghi	1.33 efg	7.00
21.	TNAU CMS 2B	81.38 e	70.50 g	6.15 c	1.95 fg	3.15 bc	10.25 a	2.80 e	3.38 cde	1.67 cd	1.43 abc	6.50
22.	COMS 24B	84.24 b	75.50 a	6.85 a	1.80 h	3.81 a	10.15 ab	2.60 g	2.88 e	1.44 k	1.44 ab	6.00
	Mean	**79.71**	**69.04**	**5.39**	**2.13**	**2.70**	**8.99**	**2.90**	**3.56**	**1.60**	**1.37**	**5.22**

Values with same letter(s) are statistically identical at 1% level of probability

H% - Hulling per cent, M% - Milling per cent, KL - Kernel length, KB - Kernel breadth, KL/B - Kernel length/ breadth ratio, KLAC - Kernel length after cooking, KBAC - Kernel breadth after cooking, VER - Volume expansion ratio, LER - Linear elongation ratio, BER - Breadthwise expansion ratio, ASV - Alkali spreading value.

Electronic Journal of Plant Breeding, 8(2): 609-614 (June 2017)
ISSN 0975-928X
DOI: 10.5958/0975-928X.2017.00092.8

Table 4. Range, mean, coefficient of variation, heritability and genetic advance for floral and grain quality traits

S. No.	Characters	Range	Mean	GV	PV	GCV (%)	PCV (%)	h^2	GA (%)
Floral traits									
1.	Anther length	1.83 - 2.95	2.35	0.069	0.070	11.23	11.24	99.74	23.10
2.	Anther breadth	0.29 - 0.50	0.38	0.003	0.003	15.37	15.68	96.12	31.04
3.	Number of pollen grains per anther	1163.63 - 2690.28	1840.35	243150.5	243452.3	26.79	26.81	99.88	55.16
4.	Stigma length	0.75 - 1.41	1.01	0.032	0.033	17.48	18.13	96.40	34.71
5.	Stigma breadth	0.26 - 0.51	0.39	0.007	0.007	21.71	21.84	98.81	44.45
6.	Style length	0.34 - 0.85	0.49	0.029	0.030	34.59	34.87	98.44	70.71
7.	Panicle exsertion	102.56 - 127.39	110.46	69.26	70.82	7.53	7.62	97.80	15.35
8.	Angle of glume opening	30.25 - 44.25	37.02	31.59	34.37	15.19	15.84	91.93	30.00
9.	Stigma exsertion	10.94 - 76.19	35.55	688.49	708.56	73.80	74.87	97.17	149.87
Grain quality traits									
10.	Hulling per cent	71.99 – 85.49	79.71	21.59	21.60	5.8303	5.8308	99.98	12.01
11.	Milling per cent	60.49 – 75.49	69.04	28.0033	28.0036	7.6647	7.6448	99.99	15.79
12.	Kernel length	5.00 – 6.85	5.39	0.622	0.625	14.6401	14.6802	99.45	30.08
13.	Kernel breadth	1.80 – 2.65	2.13	0.145	0.148	17.9416	18.1062	98.19	36.62
14.	Kernel length/breadth ratio	1.88 – 3.80	2.70	0.43	0.44	24.4751	24.6628	98.48	50.03
15.	Kernel length after cooking	7.65 – 10.25	8.99	1.48	1.49	13.5711	13.5850	99.79	27.92
16.	Kernel breadth after cooking	2.55 – 3.45	2.90	0.196	0.199	15.2753	15.3763	98.69	31.26
17.	Linear elongation ratio	1.44 – 1.79	1.60	0.0172	0.0178	8.2377	8.3732	96.78	16.69
18.	Breadthwise expansion ratio	1.27 – 1.50	1.37	0.006	0.007	5.9949	6.5080	84.85	11.37
19.	Volume expansion ratio	2.88 – 4.60	3.56	0.22	0.29	13.3890	15.2234	77.35	24.25