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VARIABILITY STUDIES FOR SOME YIELD AND QUALITY TRAITS IN RICE (*ORYZA SATIVA*)

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Abstract

The estimates of heritability, genetic advance, phenotypic and genotypic coefficient of variation among yield, quality and its component characters in twenty three genotypes of rice were worked out at Experimental Farm, Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, Annamalainagar (Tamil Nasu), India. A high degree of variation was observed for all characters studied. Panicle weight, number of grains per panicle, grain L/B ratio, plant height, 1000 grain weight and grain breadth were recorded moderate phenotypic and genotypic coefficients of variation. High heritability coupled with high genetic advance as percent of mean was observed for grain breadth, grain L/B ratio, plant height, number of grains per panicle and grain yield per plant indicating that the characters were controlled by additive gene action. Therefore, the selection based on phenotypic values will be instrumental for effective improvement in these characters.

Key words: Rice, yield, variability, heritability.

Introduction

Rice (*Oryza sativa* L. 2n: 2x: 24) is the most important cereal crop cultivated widely in many parts of the world. To initiate an effective improvement programme in any crop, the first and foremost step is to build a comprehensive germplasm. Information on the magnitude of variation in the available genetic material and the role played by the environment on the expression of plant characters are of prime importance for the appraisal of the rate and magnitude of possible improvement. Further, estimates of genetic advance and heritability would give the best picture of the extent of improvement expected from selection and reliability of selection based on phenotype. The present investigation is an attempt in that direction.

Though, during past two and half decades, a number of high yielding rice varieties have been released, rice productivity in the valley has reached a plateau in the recent years and chances of further yield enhancement are scanty due to low genetic variability in hill rice cultivars (Sanghera and Wani, 2008). Therefore, enhancing productivity of rice through novel genetic approaches like hybrid rice was felt necessary. Hybrid rice technology will offer an opportunity to boost the yield of rice under temperate valley conditions and to break through the yield ceilings of semi dwarf varieties, as hybrid rice varieties have a yield advantage of 15-20% over the conventional high yielding varieties (Virmani, 1996).

Materials and Methods

The investigations were conducted at the Experimental Farm, Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, Chidambaram, Tamil Nadu, India. The experimental material consisted of 23 diverge genotypes of rice (*Oryza sativa* L.) collected from International Rice Research Institute (IRRI), Tamil Nadu Rice Research Institute (TRRI) and different parts of Tamil Nadu and Pondicherry (table 1). Seeds of twenty three divergent genotypes were sown in raised nursery beds during samba season 2012 (August–December). In each genotype one seedling per hill was transplanted in the main field after 25 days with the spacing of 30 cm between rows and 15 cm between plants in 3 m long rows (IRRI method). The experiment was carried out in randomized block design with three replications.

All the 20 plants were taken for recording the data on days to 50 per cent flowering, plant height, number of tillers per plant, number of productive tillers per plant,

panicle length, panicle weight, number of grains per panicle, 1000 grain weight, grain length, grain breadth, grain L/B ratio and grain yield per plant. Analysis of variance was carried out as suggested by Panse and Sukhatme (1978) GCV and PCV were carried out as per the methods suggested by Burton (1952) and Singh and Chaudhry (1979). Heritability (BS) and Genetic Advance were estimated by using the formula suggested by Burton and Devane (1953) and Lush (1949).

Results and Discussion

Analysis of variance revealed that significant differences existed among the genotypes for all the characters studied. The grand mean, range mean sum of squares (treatments) phenotypic and genotypic coefficients of variation, heritability and genetic advance as percentage of mean are presented in table 2.

The average number of days to 50 per cent flowering was 80.75 with a range of 69.00 to 89.00 days and coefficient of variation of 5.00 per cent. The average height of plant was observed as 99.15 cm with the range of 80.80 to 133.20 cm and coefficient of variation of 13.01 per cent. The genotype TKM12 recorded the highest plant height (133.20 cm) followed by TKM11 (126.05 cm). The lowest plant height was recorded by ADT 48 (80.80 cm). The range of number of productive tillers per plant was from 11.30 to 18.30. The genotype MDU5 had the least number of productive tillers per plant while the genotypes IR 64 registered the highest number of productive tillers plant. The average 1000 grain weight was 20.99 ranging from 14.85 to 24.68 g. The genotype IR 64 registered highest 1000 grain weight (24.68).

The average grain length was observed as 7.36 mm ranging from 6.33 mm to 8.45 mm. The maximum grain length was noted by the genotype IR64 (8.45 mm) and coefficient of variation of 0.01 per cent. The average grain breadth was observed as 2.34 mm with a range of 1.84 to 2.78 mm and coefficient of variation of 0.01 per cent. The genotype ADT 48 (184 mm) recorded minimum grain breadth and maximum was recorded by IR64 followed by PY5 (2.64mm) among the genotypes. The average grain yield per plant was observed as 29.11 gm with a coefficient of variation 0.48 per cent. Among the genotypes minimum grain yield per plant was recorded ADT 43 (20.35 g) and maximum was recorded by ADT 37 (34.63 g) followed by PY5 (33.75 g).

A high magnitude of phenotypic (16.94) and genotypic (14.28) coefficients of variation were observed for panicle weight which was also reported by Hasib *et al*. (2004) and Chandra Kishore *et al*. (2008). Comparatively low genotypic and phenotypic. Coefficient of variation were observed for panicle length and days to 50 per cent flowering. The differences between the values of PCV and GCV were low for grain breadth and grain L/B ratio that these traits were less influenced by environment. Similar studies were reported in rice by Ganapathy *et al*. (2006). It was suggested by Bidhanroy *et al*. (2001) that only genetic coefficients of variation and heritability is not sufficient enough for the estimation of the amount of heritable variation. The heritable variation can be determined with greater degree of accuracy if genetic advance is also studied along with heritability.

In the present study, the heritability estimates were high for all the characters as per Robinson's (1966) classification. Genetic advance as percentage of mean is impendent until the measurement and hence it is used for comparison among characters. High genetic advance was obtained for number of grains per panicle followed by grain L/B ratio and grain yield per plant and low genetic advance was obtained for Panicle length (2.35).

High values of heritability for grain yield per plant was observed in the present study and a similar finding was reported by Sanghera and Waseem Hussain (2012), Dalvi and Patel (2009), Malani *et al*. (2006), Saidaiah *et al*. (2010), Silvaraj *et al*. (2011), Swamy *et al*. (2003), Ganapathy *et al*. (2006) and Nayak *et al*. (2002). High genetic advance coupled with high heritability were exhibited for grain breadth, grain L/B ratio, plant height, number of grains per panicle and grain yield per plant indicating the predominance of additive gene action for these traits enabling case of selection. These finding are in agreement with Bidhan Roy *et al*. (2001) for grain yield per plant.

High heritability coupled with moderate genetic advance as per cent of mean was recorded for days to 50 per cent flowering, grain length, 1000 grain weight, suggesting the influence of both additive and non additive gene effects in the expression of these traits. High heritability coupled with high genetic advance would be the traits for grain yield per plant in the breeding programme. Similar results were obtained by Mirarab *et al*. (2011) that showed low narrow sense heritability for different traits studied thus indicating that non-additive effects play an important role in controlling the traits.

It is concluded that sufficient genetic variability existed for all the characters studied and best genotypes can be used as parent in further breeding programs for improving the specified characters. High heritability along with the high genetic advance might be due to additive gene action.

Table 1 : List of genotypes selected for D^2 analysis.

S. no.	Varieties /cultures	Origin
G1	IR 36	International Rice Research Institute (IRRI), Philippines
G2	IR 42	International Rice Research Institute (IRRI), Philippines
G3	IR 50	International Rice Research Institute (IRRI), Philippines
G4	IR 64	International Rice Research Institute (IRRI), Philippines
G5	IR 72	International Rice Research Institute (IRRI), Philippines
G6	IR 74	International Rice Research Institute (IRRI), Philippines
G7	TKM 9	Rice Research Station, Tirurkuppam
G8	TKM 11	Rice Research Station, Tirurkuppam
G9	TKM 12	Rice Research Station, Tirurkuppam
G10	ADT 36	Tamil Nadu Rice Research Institute (TRRI), Aduthurai, Tamil Nadu, India
G11	ADT 37	Tamil Nadu Rice Research Institute (TRRI), Aduthurai, Tamil Nadu, India
G12	ADT 41	Tamil Nadu Rice Research Institute (TRRI), Aduthurai, Tamil Nadu, India
G13	ADT 42	Tamil Nadu Rice Research Institute (TRRI), Aduthurai, Tamil Nadu, India
G14	ADT 43	Tamil Nadu Rice Research Institute (TRRI), Aduthurai, Tamil Nadu, India
G15	ADT 45	Tamil Nadu Rice Research Institute (TRRI), Aduthurai, Tamil Nadu, India
G16	ADT 47	Tamil Nadu Rice Research Institute (TRRI), Aduthurai, Tamil Nadu, India
G17	ADT 48	Tamil Nadu Rice Research Institute (TRRI), Aduthurai, Tamil Nadu, India
G18	PY 2	Krishi Vigyan Kendra, Pondicherry, India
G19	PY 3	Krishi Vigyan Kendra, Pondicherry, India
G20	PY 5	Krishi Vigyan Kendra, Pondicherry, India
G21	ASD 16	Rice Research Station, Ambasamuthiram
G22	ASD 18	Rice Research Station, Ambasamuthiram
G23	MDU 5	Agricultural College and Research Institute, Madurai

Table 2 : Grand mean, CV, range, MSS, PCV, GCV, heritability and genetic advance for various characters in rice.

S. no.	Characters	Grand mean	CV	Range	MSS	PCV %	GCV %	Heritability %	GA% of mean
1.	Days to 50% flowering	80.75	5.00	69.00 – 89.00	56.21	6.57	6.35	87.86	12.26
2.	Plant height	99.15	13.01	80.80– 133.20	273.96	11.80	11.53	91.37	22.71
3.	Number of tillers per plant	17.86	21.30	13.80– 21.45	8.56	11.58	9.67	53.50	14.56
4.	Number of productive tillers per plant	14.41	5.58	11.31-18.30	7.24	13.20	11.41	59.72	18.16
5.	Panicle length	22.98	17.14	21.43-25.84	2.75	5.10	2.76	17.13	2.35
6.	Panicle weight	2.51	0.28	1.74-3.26	0.36	16.94	14.28	55.11	21.83
7.	Number of grains per panicle	150.00	109.28	117.50-194.55	763.53	13.02	12.67	89.88	24.74
8.	1000 grain weight	20.99	0.09	14.85-24.68	14.38	12.77	11.59	69.87	19.95
9.	Grain length	7.36	0.01	6.33-8.45	0.62	7.87	7.26	85.20	13.82
10.	Grain breadth	2.34	0.01	1.84-2.78	0.13	11.18	11.17	99.92	23.01
11.	Grain L/B ratio	3.17	0.01	2.73-3.99	0.29	12.29	11.95	94.44	23.92
12.	Grain yield per plant	29.11	0.48	20.35-34.63	34.80	14.33	13.26	74.91	23.64

This suggests that the characters grain breath, grain L/B ratio, plant height number of grains per panicle and grain yield per plant had high estimates of percentage of phenotypic and genotypic coefficient of variation, heritability and genetic advance. Therefore, selection based on phenotypic values of these characters will be instrumental for effecting improvement in these characters.

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