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Genetic Variability Studies in Rainfed Rice (*Oryza sativa* L.)

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Abstract

The present experiment comprised with forty nine improved rice cultures obtained from All India Co-ordinated Rice Improvement Project. The analysis of variance revealed that all the treatments are highly significant for various characters studied *i.e.* days to 50% flowering, plant height, number of productive tillers per plant, number of productive tillers per square metre plot area, grain yield per plot, straw yield per plot and harvest index. The higher magnitude of PCV was recorded for grain yield per plot and straw yield per plot where as moderate magnitude of GCV was recorded for days to 50% flowering, plant height, grain yield per plot and harvest index. Days to 50% flowering and plant height showed high broad sense heritability and moderate for grain yield per plot and harvest index. High heritability coupled with high genetic advance was recorded for days to 50% flowering indicated the major role of additive gene action in the inheritance of this character. Thus, this character may serve as an effective selection parameter during breeding programme in the rainfed rice ecosystem.

Key words: variability, heritability, genetic advance, rainfed rice.

Introduction

Rice is one of the principle food crops and one third of the world population and two thirds of the Indian population is utilizing rice as staple food. It contributes 43 per cent of caloric requirement and 20-25% of agricultural income. In India, rice is grown in an area of 43.5 million ha (23% of gross cropped area) with an annual production of 90 million tons. Most of the Asian countries have been able to keep pace between rice production growth rate and that of population during the last four decades. This has been mainly possible due to the contributions made by the green revolution technologies. However, it is of great concern to note that the rate of growth in rice production has started declining during 90's and there has been a plateauing effect. The population growth in most of the Asian countries, except China, continues to be around 2% per year. Hence it is very pertinent to critically consider whether the rice production can be further increased to keep pace with population growth. With the current green revolution technologies it is estimated that by 2020 at least 115-120 million tonnes of milled rice is to be produced in India to maintain the present level of self-sufficiency. Yield is a complex character, which is highly influenced by the environment, hence direct selection for yield alone limit the selection efficiency and ultimately results in limited success in yield improvement. Genetic variability studies are important in selection of parents for hybridization (Chaudhary and Singh,1982) because crop improvement depends upon magnitude of genetic variability in base population (Adebisi *et al.*, 2001). Once genetic variability has been ascertained, crop improvement is possible through the use of appropriate selection method and increasing total yield would be made easier by selecting for yield components because they are more often easily in herited than total yield itself. An attempt was made in the present investigation to assess the variability, heritability and genetic advance of some quantitative characters in rice.

Materials and methods

The experimental material comprised with forty nine improved rice cultures *viz*, CB 13 805, CR3947-2-1-3-1-1, GNV 05-01, CRR 676-2, RRX-021, R-RF 105, REWA 966-1-5-1, Anna (R) 4, RP5587-B-B-B-210-1, RP5942-34-9-5-2-1-1, ADV 1501, CR2908-262-1, CB 13 804, R 1672-126-1-24-1, CR3949-1-2-2-1-1, CRR 616-B-66-2-1, RCPR-24-IR88867-4-1-1-4, CR3848-52-1-2-1-5, RCPR-16-IR84894-143-CRA-17-1, CRR 747-16-3-B, RP 5588-B-B-B-B-177-2, R-RF-112, CR3951-3-2-2-1-1, Rewa 843-1-1, Sahbhagidhan, RP 5943-68-17-6-3-1-1-1, CR 2878-215-1, CRR 753-8-1, Vandana, CR3848-1-2-1-2-4, CRR 752-9-1, RP5587-B-B-B-209-1, Tulasi, R1695-133-1-72-1, CR 3848-2-1-1-2, RP5940-20-3-2-1-1-1, US 314, RP 5944-34-13-7-2-1-1, CRR 562-19-2-1, CR 3846-2-1-2-1-1, R-RF-111, IR 95812-CR3948-1-2-1-2, RP 5945-117-10-5-2-1-1, RP5946-43-9-2-1-1-B, CRR688-25-B-1-B-4, ODR-1-2-CR3945, R 1670-3269-2-3926-1, CR 2900-250-3 and CRR 363-36 received from All India Co-ordinated Rice Improvement Project which were evaluated in a randomized block design with three replications at Agricultural Research Station, Tamil Nadu Agricultural University, Paramakudi during *Rabi* 2015-16. The experimental site is located at 9" 21' N latitude, 78" 22' E longitudes and an altitude of 242 m above mean sea level with average annual rainfall of 840 mm. This site has clay loam soil texture with pH of 8.0. Each genotype was raised in 5x2 m plot keeping 15 x 10 cm spacing. There commended agronomic practices followed to raise good crop stand. The data were recorded on ten randomly selected plants from each replication for various quantitative traits studied were *viz,* days to 50% flowering, plant height (cm), number of productive tillers per plant, number of productive tillers per square metre plot area, grain yield per plot (kg), straw yield per plot (kg) and harvest index (%). Mean values were subjected to analysis of variance to test the significance for each character as per methodology advocated by Panse & Sukhatme (1967). Phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were calculated by the formula given by Burton (1952), heritability in broad sense and genetic advance were calculated as per Johnson *et al.* (1955).

Results and Discussion

Greater variability in the initial breeding material ensures better chances of producing desired forms of a crop plant. Thus, the primary objective of germplasm conservation is to collect and preserve the genetic variability in indigenous collection of crop species to make it available to present and future generations. The analysis of variance (Table1.) revealed that for treatments are highly significant for various characters under studied *i.e.* days to 50% flowering, plant height, number of productive tillers per plant, number of productive tillers per square metre plot area, grain yield per plot, straw yield per plot and harvest index. This result was in conformity with the earlier findings of Salgotra *et al.* (2009) and Babu *et al*. (2012).

Table 1: Analysis of variance for different traits in rice

Source of variation	Degrees of freedom	Days to 50% flowering	Plant height	Productive tillers per plant	Productive tillers per square metre	Grain yield per plot	Straw yield per plot	Harvest index
Replication	2	23.11	299.59	1.93	261.27	0.55	7.24	0.04
Treatment	48	245.86*	485.98*	1.92*	956.25*	1.24*	1.65*	0.01*
Error	96	5.79	52.99	1.84	459.71	0.28	0.98	0.003

*significant at P=0.05 level

The perusal of coefficient of variability indicated that wide range of variability was present at both phenotypic and genotypic levels for all the characters under studied. The magnitude of phenotypic coefficient of variation (PCV) was higher than genotypic coefficient of variation (GCV) for all the traits which may be due to higher degree of interaction of genotypes with the environment (Kavitha & Reddy 2002). The differences in the magnitude of PCV and GCV for number of productive tillers per plant, number of productive tillers per square metre plot area, grain yield per plot and straw yield per plot were of high order. The higher magnitude of Phenotypic coefficient of variation was recorded for grain yield per plot and straw yield per plot where as moderate magnitude of PCV was recorded for days to 50% flowering, plant height, number of productive tillers per plant, number of productive tillers per square metre and harvest index (Table 2.).

Table 2: Estimates of mean, variability, heritability and genetic advance in rice

Traits	Mean ± SE	GCV	PCV	h^2	GA	GA as % of mean
Days to 50% flowering	71.25 ± 1.39	12.55	13.00	93.25	17.80	24.98
Plant height	110.86±4.19	10.84	12.66	73.31	21.20	19.12
Productive tillers per plant	7.90±0.78	2.08	17.30	1.44	0.04	0.51
Productive tillers per square metre	194.85 ± 12.38	6.60	12.83	26.47	13.64	7.00
Grain yield per plot	2.84±0.31	19.87	27.25	53.22	0.85	29.87
Straw yield per plot	4.68±0.57	8.51	22.80	13.92	0.31	6.54
Harvest index	0.38±0.03	12.99	19.88	42.70	0.07	17.49

SE=Standard Error; **GCV**=Genotypic Co-oefficient of Variation; **PCV**=Phenotypic Co-oefficient of Variation; $\mathbf{h^2}$=Heritability (Broad sense); **GA**=Genetic Advance.

Genotypic coefficient of variation was moderate for days to 50% flowering, plant height, grain yield per plot and harvest index and it was low for number of productive tillers per plant, number of productive tillers per square metre and straw yield (Table 2.); indicating little opportunity of selection for these characters. Coefficients of variability for various characters observed in the present study were in agreement with the findings of Singh *et al* (2006), Pandey *et al* (2010) and Babu *et al*. (2012).

The proportion of genetic variability which is transmitted from parents to offspring is reflected by heritability (Lush, 1949). Robinson *et al.* (1949) viewed that the knowledge of heritability of a character is important to the breeder, as it indicates the possibility and extent to which improvement is possible through selection. It is a measure of genetic relationship between parents and their progeny and has been widely used in determining the degree to which a character may be transmitted from parents to offspring. High heritability is not enough to make efficient selection in the advanced generations unless it is accompanied by substantial amount of genetic advance. Burton (1952) pointed out that the heritability in combination with intensity of selection and amount of variability present in the population influences gains to be obtained from selection. Thus, genetic advance is yet another important selection parameter which although independent, represents the expected genetic advance under selection. It measures the differences between the mean genotypic values of the selected lines and the mean genotypic values of original population from which these were selected. According to Panse (1957) if a character is governed by non-additive gene action, it may give high heritability but low genetic advance, whereas, if it is governed by additive geneaction, high heritability along with high genetic advance provided good scope for further improvement. In the present study, high broad sense heritability estimates were obtained for days to 50% flowering and plant height (Table 2.), indicating the major role of additive gene action in inheritance of these traits. The broad sense heritability of these characters are in accordance with those of Pandey and Anurag (2010) and Babu *et al*. (2012).

High heritability alone does not guarantee large gain from selection unless sufficient genetic advance (GA) attributed to additive gene action is present. High heritability coupled with high genetic advance was recorded for days to 50% flowering (Table 2.). It indicates that most likely the heritability is due to additive gene effects and selection may be effective. This finding is in close agreement with the findings of Vaithiyalingan and Nadarajan (2006) and Babu *et al*. (2012). Low heritability coupled with low genetic advance was recorded for number of productive tillers per plant, number of productive tillers per square metre and straw yield (Table 2.). It indicates that these characters are highly influenced by environmental effects and selection would be ineffective.

An overall consideration of results revealed that high heritability coupled with high genetic advance was recorded for days to 50% flowering and the major role of additive gene action involved in the inheritance of this character. Thus, this character may serve as an effective selection parameter during breeding programme in the rainfed rice ecosystem.

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