VARIABILITY AND GENETIC PARAMETER ANALYSIS IN AROMATIC RICE

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ABSTRACT

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An attempt was made to study variability and genetic parameter analysis in 41 aromatic rice genotypes. Significant variations observed, the phenotypic variance was higher than the corresponding genotypic variance for the characters. These differences were in case of number of panicles per hill, number of primary branches, number of filled grains per panicle, spikelet sterility (%) and grain yield per hill indicating greater influence on environment for expression of these characters.1000-grain weight and days to maturity showed least difference between phenotypic and genotypic variance, which indicated additive gene action for expression of the characters. Considering genetic parameters high genotypic coefficient of variation (GCV) value was observed for 1000-grain weight followed by spikelet sterility (%), grain yield per hill and number of filled grains per panicle, whereas days to maturity showed very low GCV. High heritability with high genetic advance in percent of mean (GAPM) was observed for 1000-grain weight followed by spikelet sterility (%) and number of filled grains per panicle indicated that these characters were under additive gene control and selection for improvement might be effective. Days to maturity showed high heritability but low genetic advance (GA) (%), which indicated that non additive gene effects were involved for phenotypic expression of this character.

Keywords: Aromatic rice, variability, phenotypic and genotypic parameters

INTRODUCTION

Rice (*Oryza sativa* L.) is the world's second most important cereal crop, belonging to the family gramineae. Rice is the staple food for over one third of the world's people (Poehlman and Sleper 1995). More than 90% of the world's rice is produced and consumed in Asia. Bangladesh is the fourth largest producer and consumer of rice in the world, it occupies 77% of total cropped areas and it alone constitutes about 92% of the total food grains produced annually in the country (Anonymous, 2000). Rice provides 75% of the calories and 55% of the protein in the average daily diet of the people (Bhuiyan *et al*., 2002).

Breeding strategies should be emphasis on fine and aromatic rice production. Most of the aromatic rice germplasm available in our country are low yielding, photoperiod sensitive and grown during Aman season in the rain fed low land ecosystem (Begum *et al*., 1993). The quantitative measurement of individual character provides the basis for an interpretation of analysis of variance. The available variability in a population can be partitioned into heritable and non heritable parts with the aid of genetic parameters such as genetic coefficient of variation, heritability and genetic advance (Miller *et al*., 1958). However the present study was undertaken to study the variability among the available genotypes, and to find out the genetic parameters in the selected genotypes.

MATERIALS AND METHODS

The soil of the experimental field was Red Brown Terrace type under Salna series of Madhupur Tract in Agro Ecological Zone (AEZ) 28. 41 varieties of aromatic rice from diversed sources were used (Chinikamini, Maloti, Buchi, Kalijira-5, Khasha, Kalijira-8, Kalijira-11, Badshabhog-6, Ovaltapi-600, Badshabhog-11, Duksail, Saibail, Badshabhog-7, Kalijira-6, Kalijira (3)-4, Awned-2, Radhunipagal, Badshabhog-10, KalgochiRajbhog, Jirabhog(finer), Sorukamini, Keora, Badshabhog-8, Kalijira-13, Badshabhog-4, Benaful, Kalijira-9, Kalijira-12, Dakshahi, Badshabhog (colored), Kataribhog, Kaminisaru, Badshabhog-9, Thakurbhog, Kalijira-14, Badshabhog-5, Kalijira-10, Chinis akkor, Kalijira-7 and Agali). The experiment was conducted using Randomized Complete Block Design with three replications. Two lines of 3 m long were constituted as experimental unit. Single seedling/hill was transplanted maintaining 20 cm × 20 cm spacing from row to row and plant to plant, respectively. Data on number of panicles per hill, number of primary branches per panicle, number of filled grains per panicle, spikelet sterility (%), 1000-grain weight, days to maturity, harvest index and grain yield per hill were recorded. All data obtained for each character were subjected to the analysis of variance. Mean (8) and range for each character were also estimated. The mean sum of square (MS) of error and phenotypic variances were estimated followed by Johnson *et al.* (1955). The error mean sum of square was considered as error variance. Genotypic variances were divided by subtracting error mean sum of square from the variety mean sum of square and dividing by number of replications.

RESULT AND DISCUSSION

Number of panicles per hill: The phenotypic variance (4.16) was much higher than genotypic variance (1.83) while mean value ranged from 6.8 to 17.8 (Table 2). Higher influence of environment on the expression of the trait and genetic factor had low expressivity on the number of panicles per hill. The character showed high phenotypic (17.75) and genotypic (11.78) coefficient of variation which indicate the apparent variation not only due to genotypes but also due to the influence of environment. Estimation of heritability (44.04) for this trait was the lowest among the characters studied. However, the genetic advance was very low (1.85) with high genetic advance in percent of mean (16.10). Gomathinayagam *et al*. (1990) and Biswas *et al.* (2000) also reported similar result.

Number of primary branches per panicle: The character showed low phenotypic (1.03) and genotypic (0.48) variance. The considerable difference between genotypic and phenotypic variance is indicating effect of environment for the expression of the trait (Table 2). The PCV (8.06) was higher than the GCV (5.47) for this character. Number of primary branches per panicle showed moderate heritability (46.08) with low genetic advance (0.96) and genetic advance in percent of mean (7.65). Selection based on this trait will not be effective (Reddy and Kumar, 1996).

Number of filled grains per panicle: The mean values ranged from 66 to 322. The phenotypic variance (2466.40) was much higher than genotypic variance (1460.68) indicating significant environmental role expressing the character (Table 2). The PCV (31.71) and GCV (24.41) were high (Table 3). Moderate heritability (59.22) with high genetic advance (60.59) and genetic advance in percent of mean (38.69) were reported for number of filled grains per panicle that confirmed the findings of Choudhury & Das (1998) and Iftekharuddaula *et al*. (2001).

Spikelet Sterility (%): Analysis of variance showed that spikelet sterility (%) varied significantly among the genotypes used (Table 1). The mean value ranged from 5.27 to 46.56. The components of variation for spikelet sterility (%) showed considerable phenotypic variation (80.77) in comparison to genotypic variation (46.11) indicating the effect of environment. Phenotypic and genotypic coefficients of variance (45.53 and 34.4) were comparatively high (Table 3). Spikelet sterility (%) represented moderate heritability (57.09) and genetic advance (10.57) but high genetic advance in percent of mean (53.54). De and Suriya (1988) and Akanda *et al*. (1997) also reported higher estimation of coefficient of variation and genetic advance in percent of mean for spikelet sterility (%).

1000-grain weight: Mean sum of square for 1000-grain weight was highly significant (Table 1) while the mean value ranged from 5.9 to 30.72 g. The value of PCV and GCV presented in Table 3, were high and the difference was very close (40.08 and 39.77). Heritability value for 1000-grain weight (98.46) was very high. This character also represented very high genetic advance in percent of mean (81.29). This feature suggesting that the environmental influence on the phenotypic expression of this character was not considerable and the phenotypic expression of this character was true representation of the genetic make up. Therefore selection based on this character would be effective. Akanda *et al.* (1997) and Choudhury & Das (1997) reported similar findings.

Days to maturity: Analysis of variance for days to maturity showed highly significant mean sum of square due to genotypes (Table 1). The mean value ranged from 142 to 173 days. The genotypic and phenotypic variances were 16.85 and 18.52 respectively (Table 2). The values were high and phenotypic variance was more or less close to its corresponding genotypic variance. There was a pronounced variation for the character days to maturity and this variability was conserved by genetic constituent rather than environment. The values of GCV (2.74) and PCV (2.87) were low (Table 3) and had least difference. Similar findings were reported by Balan *et al.* (1999). Very high heritability (90.99%) but low genetic advance in percent of mean (5.39%) was observed for the character of days to maturity. It revealed non-additive gene action was involved for expression of this character. The high heritability was exhibited due to influenced of favorable environment rather than genotype and selection for such trait may not be rewarding. High heritability with low genetic advance was also reported by Gomathinayagam *et al.* (1990) for days to maturity.

Harvest index: Mean sum of square for harvest index was highly significant due to genotypes, indicating existence of considerable difference among the genotypes for this trait (Table 1). The mean values ranged from 0.25 to 0.46 (Table 2). Harvest index showed moderately high heritability (64.78) with high genetic advance in percent of mean (16.81) (Table 3). Therefore, selection based on this character might be effective for increasing grain yield. Iftekharuddaula *et al.* (2001) reported similar types of result.

Grain yield per hill: Mean sum of square for grain yield per hill was highly significant due to genotypes. The highly significant varietals difference indicated that there was a wide range of variation among the varieties for grain yield (Table 1). The mean values ranged from 6.50 to 43.65 g. The components of variance for grain yield per hill showed considerable phenotypic variance (33.28) in comparison to genotypic variance (17.60) indicating the influence of environment to a great extent for this trait (Table 2). The phenotypic coefficient of variation (34.54) and genotypic coefficient of variation (25.12) were high and PCV was higher than GCV. Reddy and Kumar (1996) reported higher PCV than GCV for grain yield per plant, where Choudhury and Das (1997) reported higher values of PCV and GCV. In case of heritability estimation this character showed moderate heritability (52.90) with high genetic advance in percent of mean (37.64) and low genetic advance (6.29). These findings resemble Kumar *et al.* (1998) and Shanthakumar *et al.* (1998). Selection for this trait could not bring satisfactory improvement over the population mean.

Table 1. Analysis of variance for 08 yield and its related characters in 41 genotypes of aromatic rice

Sources of variation	df	Mean sum of squares							
		No. of panicles per hill	No. of primary branches per panicle	No. of filled grains per panicle	Spikelet sterility %	1000-grain weight (g)	Days to maturity	Harvest index	Grain yield per hill (g)
Genotype	40	7.82*	1.98*	5387.75*	172.99*	90.51*	52.23*	0.19*	68.49*
Replication	2	2.19	0.80	2521.52	92.30	0.001	1.33	0.00	0.27
Error	80	2.33	0.56	1005.73	34.66	0.47	1.67	0.06	15.68
CV%		13.28	5.92	20.25	29.83	4.98	0.86	7.48	23.71

* P<0.05

Table 2. Population mean, range, phenotypic (PV), genotypic (GV) and error (EV) variances for 08 yield and its related characters in aromatic rice

Parameter	Number of panicles per hill	Number of primary branches per panicle	Number of filled grains per panicle	Spikelet sterility (%)	1000-grain weight (g)	Days to maturity	Harvest index	Grain yield per hill (g)
Mean	11.48	12.61	156.60	19.74	13.78	149.75	0.37	16.7
Range	6.8 – 17.8	9.8 – 15.8	66 - 322	5.27 – 46.56	5.9 – 30.72	142 - 173	0.25 – 0.46	6.50 - 43.65
Genotypic Variance	1.83	0.48	1460.68	46.11	30.01	16.85	0.003	17.60
Phenotypic Variance	4.16	1.03	2466.40	80.77	30.48	18.52	0.004	33.28
Error Variance	2.33	0.56	1005.73	34.66	0.47	1.67	0.001	15.68

Table 3. Genotypic and Phenotypic coefficient of variation (GCV and PCV), heritability, genetic advance (GA) and genetic advance in percent of mean for 08 yield and its related characters in aromatic rice

Parameter	Number of panicles per hill	Number of primary branches per panicle	Number of filled grains per panicle	Spikelet sterility (%)	1000-grain weight (g)	Days to maturity	Harvest index	Grain yield per hill (g)
GCV	11.78	5.47	24.41	34.4	39.77	2.74	10.14	25.12
PCV	17.75	8.06	31.71	45.53	40.08	2.87	12.6	34.54
Heritability %	44.04	46.08	59.22	57.09	98.46	90.99	64.78	52.90
Genetic Advance	1.85	0.96	60.59	10.57	11.2	8.07	0.06	6.29
Genetic Advance in percent of mean	16.10	7.65	38.69	53.54	81.29	5.39	16.81	37.64

GCV=Genotypic coefficient of variation, PCV= Phenotypic coefficient of variation

The highest mean value was observed for number of filled grains per panicle, the character also exhibited highest range of variation (66-322) indicated that all the genotypes showed wide variation in respect of this character. All the characters showed moderate to high phenotypic and genotypic coefficient of variation except days to maturity (2.87 and 2.74). Amongst the characters the highest genotypic coefficient of variation was recorded for 1000-grain weight (39.77) followed by spikelet sterility (%) (34.4), grain yield per hill (25.12),

number of panicles per hill (11.78), harvest index (10.14), number of primary branches per panicle (5.47) and days to maturity (2.74) in order of merit. The highest heritability value was observed for 1000-grain weight (98.46) and the lowest for number of panicles per hill (44.04). The highest genetic advance in percent of mean was observed for 1000-grain weight (81.29), followed by spikelet sterility (%) (53.34), number of filled grains per panicle (38.69) and grain yield per hill (37.64), where the lowest for days to maturity (5.39). The parameter 1000-grain weight showed both the highest heritability and genetic advance in percent of mean, indicated additive gene action for expression of the character and selection for such trait might be rewarding. Days to maturity showed high heritability but low genetic advance in percent of mean. It revealed non-additive gene action for expression of the character. Here high heritability was exhibited due to favorable environment rather than genotype.

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