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Study on Genetic Variability, Heritability and Genetic Advance in Rice (*Oryza sativa* L.) Genotypes

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ABSTRACT

The present investigation is carried to study genetic parameters for ten yield and yield attributing characters in forty rice genotypes including two checks during kharif 2015. Analysis of variance shows significant difference among all characters under study. The phenotypic variance was higher in magnitude than that of genotypic variance for the yield and yield contributing characters indicates the influence of environmental factors on these traits. The magnitude of difference between phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) was relatively high. High phenotypic and genotypic coefficient of variation was recorded for Yield per plant, followed by total no of grains per plant, effective tillers per square meter. Heritability in broad sense estimates were highest for total number of grains per plant, followed by yield per plant, effective tillers per square meter, 1000 grain weight, Effective tillers/plant, number of filled grains per panicle, plant height. High expected genetic advance were observed for characters viz., yield per plant, total number of grains per plant, effective tillers per square meter, Effective tillers per plant, 1000 grain weight. High heritability along with high genetic advance as percent of mean was registered for yield per plant, effective tillers per square meter, total number of grains per plant, effective tillers per plant, 1000 grain weight.

Key words: *Rice, GCV, PCV, heritability, genetic advance.*

INTRODUCTION

Rice (*Oryza sativa* L.) 2n=24 is the world's most staple food for about 2.5 billion people and which may escalate to 4.6 billion by the year 2050. More than 40 per cent of the world's population depends on rice as the major source of calories. In India, rice is grown in varying degrees in almost all parts of the country excepting higher parts of the Himalayan ranges exceeding 2,500 meters in altitude, Marusthali part of Rajasthan, Kuchchh-Surashtra, Malwa and Marathwada regions due to various geographical constraints.

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For planning and execution of a successful breeding program, the most essential pre-requite is the availability of substantial desirable genetic variability for important characters in the germplasm collections of the plant species. The available variability in a population can be partitioned into genetic parameters such as coefficients of variation, heritability and genetic advance to serve as basis for selection of desirable genotypes than existing ones. However, yield is a complex character which is controlled by association of number of components most of which are under polygenic control. Thus the yield and other traits are very useful for developing efficient breeding strategy for evolving high yielding varieties[10].

Progenies originating from the crosses involving diverse parents exhibit greater heterosis and provide broad spectrum of variability in segregating generations. Such crosses not only results in inducing variation but also provide new recombination of the genes in the gene pool, which may have great impact on future breeding programme. Choice of parents is not only based on desirable agronomic traits, components of yield and extent of diversity but also on heritability of yield contributing traits. The environment, in which selection is made, is also important because heritability and genetic advance estimates vary with change in environment. Genetic improvement mainly depends upon the amount of genetic variability present in the population. In any crop, the germplasm serves as a valuable source of base population and provides scope for wide variability. Keeping in view on the importance of varietal improvement of rice, the present investigation was undertaken to study the genetic variability for yield and its component characters in various rice germplasm lines.

MATERIALS AND METHODS

The experimental material for the present study consisted of 40 rice genotypes were collected from Upland Paddy Research Station. Genotypes were sown at College of Agriculture, Golegaon Tq. Aundha (N) Dist. Hingoli, Research Farm, Department of Agricultural Botany, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (Maharashtra) during *kharif*, 2015. The experimental material was evaluated in Randomized Block Design (R.B.D.) with 2 replications under rainfed condition. The sowing was carried out at the spacing of 30 cm and 15 cm between the rows and plants, respectively. One plant per hill was maintained by thinning 15 days after sowing. The recommended dose of fertilizer 100 kg N + 50 kg P_2O_5 + 50 kg K_2O per hectare was applied out of which nitrogen is applied in two split doses 50 kg at the time of sowing and 50 kg 30 days after sowing. All other cultural practices were undertaken to maintain healthy crop.

The data were recorded on five randomly selected plants from each replication leaving the first two border rows from all the four sides, in order to avoid the sampling error, for ten characters *viz.,* Days to 50% flowering, Days to maturity, Plant height (cm), Effective tillers per plant, Effective tillers per sq meter, Panicle length (cm), Number of filled grains per panicle, Total number of grains per plant, 1000-seed weight) (g), Grain yield per plant (g) were recorded.

The mean data collected on five competitive plants in each replication on each line were subjected to analysis of variance on the basis of model proposed by Panse and Sukhatme[9]. The genotypic and phenotypic variances were calculated as per formulae proposed by Burton[2]. The genotypic (GCV) and phenotypic (PCV) coefficient of variation was calculated by formulae given by Burton[2]. Heritability (broad sense) was calculated according to the method suggested by Hanson *et al*[5]. Expected genetic advance (GA) was calculated by the method suggested by Johnson *et al*[6].

RESULTS AND DISCUSSION

The analysis of variance for different characters is presented in Table 1. The treatments *i.e.* mean sum of squares due to genotypes showed significant differences for all 10 characters under study at 5% and 1%

level of significance, suggesting that the genotypes were genetically divergent. This indicates that there is ample scope for selection of promising lines from the present gene pool for yield and its components. These findings are in accordance with the findings of Vivek *et al*[15]., and Singh *et al*[13]., who also observed significant variability for yield and its components in rice.

Table 1: ANOVA for yield and yield contributing characters

Source of variation	Replications (df=1)	Treatments (df=39)	Errors (r-1) (t-1)
Day to 50 % flowering	0.80	24.88**	12.10
Days to maturity	0.05	34.8**	12.2
Plant height (cm)	3.20	192.7**	37.9
Effective tillers per plant	0.18	1.50**	0.22
Effective tillers per sq meter	130.0	814.9**	94.8
Panicle length (cm)	0.60	6.06**	2.26
Number of filled grains per panicle	115.6	499.3**	88.7
Total number of grains per plant	3.87	27858.0**	1702.5
1000 grain weight (gm)	0.136	16.86**	4.601
Yield per plant (gm)	1.32	22.94**	4.49

* and ** indicate significant at 5% and 1% level respectively.

The phenotypic variance was higher in magnitude than that of genotypic variance for the yield and yield contributing characters indicates the influence of environmental factors on these traits. Similar findings were reported by Ganapati *et al*[4]., and Shiva Prasad *et al*[11]. High phenotypic and genotypic coefficient of variation was recorded for Yield per plant (23.96 and 23.75), followed by total no of grains per plant (18.15 and 18.08), effective tillers per square meter (17.52 and 16.85). The results are given in Table 4.3. The estimates of phenotypic and genotypic coefficient of variation were moderate for Effective tillers per plant (16.38 and 15.22), 1000 grain weight (15.32 and 14.41) and Plant height (15.55 and 12.73). Whereas low phenotypic and genotypic coefficient of variation was observed for number of filled grains per panicle (12.73 and 10.63), Panicle length (9.03 and 6.10), Days to 50% flowering (5.40 and 3.17) and Days to maturity (4.18 and 2.90). These results are presented in Table 2. Similar findings were observed by Nayak *et al*[8]., Vivek *et al*[16]., Relatively high differences between genotypic coefficient of variation and phenotypic coefficient of variation were observed most of the characters. The coefficient of variation doesn't offer the full scope of heritable variation. It can be find out with greater degree of accuracy when heritability is conjunction with genetic advance study. Heritability and genetic advance were determined to study the scope of improvement in various characters through selection. Heritability and genetic advance are important selection parameters. High heritability estimate along with high genetic advance are more helpful in prediction the grain under selection than heritability estimates alone. However, it is not necessary that a character showing high heritability will also exhibit high genetic advance (Johanson *et al.*, 1955). Heritability in broad sense estimates were highest for total number of grains per plant (99.25), followed by yield per plant (98.24), effective tillers per square meter (92.48), 1000 grain wt. (88.54), Effective tillers/plant (86.43), number of filled grains per panicle (69.83), plant height (67.07). The estimates of heritability were moderate for Days to maturity (48.15), Panicle length (45.68) and Days to 50% flowering (34.54). According to Panse, and Sukhatme[9] such characters governed predominantly by additive gene action and could be improved through individual plant selection. Bhandarkar *et al*[1]., recorded high heritability for plant height. However, similar finding was earlier reported by Vivek *et al*[16]., and Fukrei *et al*[3].

Among all the characters studied high expected genetic advance were observed for characters *viz.*, yield per plant (48.50%), total number of grains per plant (37.12%), effective tillers per square meter (33.38%), Effective tillers per plant (29.16%), 1000 grain weight (27.94%),which is in accordance with results of Nayak *et al*[8].,; Singh *et al*[12].,; and Vivek *et al*[16]., and number of tillers per plant as reported by Mohammad *et al*[7]., and Vaithiyalingan *et al*[14]. Whereas moderate genetic advance was observed for characters plant height (21.48%) and number of filled grains per panicle (18.31%). However, lowest genetic advance was observed for the characters panicle length (8.50%), days to maturity (4.14%) and days to 50% flowering (3.84%). High heritability along with high genetic advance as percent of mean was registered for yield per plant, effective tillers per square meter, total number of grains per plant, effective tillers per plant, 1000 grain weight, suggesting preponderance of additive gene action in the expression of these characters. This type of characters could be improved by mass selection and other breeding methods based on progeny testing. However, high heritability associated with moderate genetic advance as percent of mean was observed for plant height (cm), filled grains per panicle and suggesting greater role of non-additive gene action in their inheritance. Therefore heterosis breeding could be used to improve these traits. Whereas panicle length, days to maturity, days to 50% flowering recorded high heritability and low genetic advance as percent of mean.

Table 2: Genetic parameters for 10 quantitative characters of 40 Rice genotypes

Sr. No	Characters	Min	Max	General mean	Genotypic variance	Phenotypic variance	GCV	PCV	Heritability) (%)	Genetic Advance (GA)%
1	Days to 50% flowering	71.0	86.50	79.58	6.39	18.49	3.17	5.40	34.54	3.84
2	Days to maturity	108.0	125.5	116.0	11.33	13.53	2.90	4.18	48.15	4.14
3	Plant height (cm)	53.0	92.5	69.04	77.4	115.37	12.73	15.55	67.07	21.48
4	Effective tillers/plant	4.30	8.00	5.47	0.636	0.865	15.22	16.38	86.43	29.16
5	Effective tillers per square meter	96.0	170.5	118.1	360.04	454.85	16.85	17.52	92.48	33.38
6	Panicle length (cm)	20.53	28.23	22.56	1.90	4.16	6.10	9.03	45.68	8.50
7	Number of filled grains per panicle	107.7	173.5	134.69	205.3	294.0	10.63	12.73	69.83	18.31
8	Total no of grains per plant	499.9	964.4	646.0	11834.15	15402.85	18.08	18.15	99.25	37.12
9	1000 grain wt.	15.10	27.50	19.50	6.13	10.73	14.41	15.32	88.54	27.94
10	Yield per plant	9.70	22.70	14.18	9.22	13.71	23.75	23.96	98.24	48.50

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