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STUDIES ON GENETIC VARIABILITY FOR YIELD AND YIELD CONTRIBUTING TRAITS IN F_4 GENERATION OF RICE (*ORYZA SATIVA* L.)

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ABSTRACT

Genetic variability holds the potential to give rise to higher yields. The experiment was conducted with thirty segregating F4 lines of rice, along with their parents Pusa Basmati 1, BPT 5204 and three check varieties viz Karjat-4, Karjat-8 and Trombay Karjat Kolam in Kharif 2019 in randomized block design. Wide range of variability was observed in the F4 lines of rice under study. The range of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) was 3.81% to 20.82% and 4.48% to 22.62% respectively. The results of phenotypic, genotypic and environmental variances revealed that phenotypic variances were higher in magnitude over the respective genotypic variances for all the characters under research. PCV and GCV were high for straw yield per plant and harvest index. The broad sense heritability ranged from 48.60 % to 98.25%. High estimates of broad sense heritability were observed for days to maturity, days to 50% flowering, test weight, plant height and straw yield per plant. The genetic advance and genetic advance as percent of mean ranged from 1.85% to 25.09% and 6.69% to 39.49% respectively. Heritability along with genetic advance is more beneficial for selection rather than only heritability.

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1. INTRODUCTION

"Rice is life" today rice is grown and harvested on every continent except Antarctica, so it is a staple food for most of the world population. India ranks first in area and second in production. Rice is grown in 114 countries across the world. The United State Department of Agriculture (USDA 2020) estimated that the world rice production was 497.7 million metric tons of global rice during (2019-20) and constituting the world's cultivated land more than 90 % of the world's rice is produced and consumed in Asia where it is an integral part of culture and tradition. It is one of the oldest and second most intensively grown cereals crops. During 2019-20 rice production of India was around 118.87 million metric tons from an area of 43.66 million hectares.

In Maharashtra, rice is the second important food crop next to sorghum. Maharashtra ranks thirteenth in rice production in India. The average productivity of the Maharashtra state is low as compared to other rice producing states. Konkan and Vidarbha are the traditional rice producing areas of Maharashtra and Marathwada is the non-traditional rice producing area. It is grown over an area of 15.39 lakh hectares in almost all four regions viz., Vidarbha (8.252 lakh ha.), Konkan (3.497 lakh ha.), Western Maharashtra (3.62 lakh ha.) and Marathwada (0.0233 lakh ha.) with an annual production of 29.53 lakh tons with an average productivity of 1.92 tons per hectare in 2019-20. The area and production of rice crop is more in Vidarbha region while the average productivity is low. The Konkan region occupies an area of about 3.497 lakh hectares with an annual production of about 8.064 lakh tons and productivity around 2.30 tons per ha (Krishi.maharashtra.gov.in/1238/District-level). In the peri urban areas of Maharashtra nowadays, there is an increasing demand of fine quality rice with this view cross was made between Pusa - Basmati 1 and BPT 5204 which are leading varieties known for quality grain.

2. MATERIALS AND METHODS

The experiment was conducted at the Research Farm of Regional Agricultural Research Station, Karjat under Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, India during Kharif, 2019. The experimental material for the present study consisted of thirty segregating F4 lines, along with their parents Pusa Basmati 1, BPT 5204 and three check viz Karjat-4, Karjat-8 and Trombay Karjat Kolam. The present investigation was carried out by adopting Randomized Block Design with three replications. Twenty-nine days old seedlings were transplanted with 20 cm distance between rows and 15 cm distance between plants within rows. All the recommended package of practices was followed along with necessary prophylactic plant protection measures to raise a good crop. Observations were recorded of thirty plants of each segregating replication on twelve characters i.e., days to 50% flowering is the difference between the date of sowing to the date of 50% flowering of a plot was counted and recorded when 50% plant of a plot were at the flowering stage, days to maturity means numbers of days taken from the date of sowing to the date on which more than 95 per cent grain on the panicles were fully ripened, plant height is height of plant in centimeter at the time of harvesting was measured from the ground level to the tip of the main panicle, number of tillers per plant are the total number of ear bearing tillers per plant were counted at the time of harvest, panicle length per plant was measured in centimeters at the time of plant maturity from the base of panicle (neck node) to the tip of last spikelet prior to harvesting, number of spikelets per panicle are the total -

numbers of spikelets (both filled and unfilled) counted from the panicle, number of filled spikelets per panicle are the total numbers of filled spikelets on the panicle, Spikelet fertility was calculated by dividing the number of filled spikelets per panicle by total number of spikelets per panicle and multiplying by 100 and expressed in percentage, test weight means seeds of all panicles per plant were bulked and 1000 grains were taken randomly and weighted in grams, grain yield per plant is the harvested panicles of the randomly selected plants were threshed and cleaned, grains were dried and their weight was measured in grams, straw yield per plant means after removing the panicle from the plant, they were dried in sunlight and its weight was measured in gram and harvest index is the biological yield of the total dry weight (Grain yield+Straw yield) of the plant and the data was subjected to statistical analysis. The variability was estimated as per procedure for analysis of variation suggested by Panse and Sukhatme (1967). PCV and GCV were calculated by the given formula by Burton and De Vane (1953), broad sense heritability (h2b) by Johnson *et al.* (1955) and the range of genetic advance as per cent of mean was classified as suggested by Johnson *et al*. (1955).

3. RESULTS AND DISCUSSION

The analysis of variance revealed that the differences among the genotypes were significant for all the characters under study. The genotypes were thus suitable for genetic studies, as their contribution to the genotypic sum of squares was significant for all the characters. The total variability in each of these characters could be partitioned into three components *viz.*, phenotypic, genotypic and environmental. The phenotypic and genotypic variance were maximum for number of spikelets per panicle and lowest in test weight. Genotypic and phenotypic variances were high for number of spikelets per panicle (344.63, 226.17) followed by number of filled spikelets per panicle (231.70, 112.61), plant height (86.61, 76.97), days to 50% flowering (81.19, 79.35), days to maturity (80.25, 78.85) and straw yield per plant (57.67, 48.86) indicating wide variability for these characters. Similar results were reported by Pandey and Awasthi (2002). The magnitude of PCV and GCV was highest for Straw yield per plant (22.62%), (20.82%) followed by harvest index (20.45%), (16.33%) respectively. High GCV indicated high genetic variability within the test line, results were consistent with Kunkerkar *et al.* (2017) and Jadhav *et al.* (2020).

Phenotypic coefficients of variation (PCV) was maximum for straw yield per plant (22.62%) followed by harvest index (20.45%), grain yield per plant (16.04%) and number of tillers per plant (15.52 %), number of spikelets per panicle (12.28%), number of filled spikelets per panicle (11.83%), days to 50 per cent flowering (11.82%), panicle length (10.36%), plant height (8.81 %). days to maturity (8.45%), text grain weight (7.77%) and spikelet fertility (4.48%) (Table 2). The genotypic coefficient of variation was maximum for straw yield per plant (20.82%) followed by harvest index (16.33%), grain yield per plant (13.04%) and number of tillers per plant (12.01%), 50 per cent flowering (11.69%), number of spikelets per panicle (9.95%), days to panicle length (8.98%), days to maturity (8.37%), plant height (8.31%) number of filled spikelets per panicle (8.24%), test grain weight (7.42%) and spikelet fertility (3.81%). The results were accordance with Chauhan and Tandon (1984), Jangale *et al.* (1985), Roy *et. al* (1995), Deb Choudhury and Das (1998), Naik *et al.* (2002), Khaire *et al.* (2017) and Elisama *et al.* (2018).

The broad sense heritability was observed for days to maturity (98.25%), days to 50 per cent flowering (97.14%), test weight (91.10%), plant -

height (88.87%), straw yield per plant (84.73%), panicle length (75.16%), spikelet fertility (77.42%), grain yield per plant (g) (66.14%), number of spikelets per panicle (65.63%), harvest index (63.78%), number of tillers per plant (59.84) and number of filled spikelets per panicle (48.60%). Sinha and Bhattacharyya (1980), Ghost *et al.* (1981), Singh and Sharma (1982), Ravindranath *et al.* (1983), Chauhan and Tandon (1984), Sawant and Patil (1995), Naik *et al.* (2002), Kunkerkar *et al.* (2017) and Jadhav *et al.* (2020) also observed high heritability for these characters.

Genetic advance is a measure of expected progress under a selection scheme. The heritability estimates provide the information on the magnitude of inheritance of quantitative characters, but it does not indicate the magnitude of genetic gain obtained from selection of the best individual from the best population. So, heritability along with genetic advance is more beneficial for selection rather than only heritability. The estimates of genetic advance ranged from 1.90% for test weight to 25.09% for number of spikelets per panicle. Similar results were obtained by Singh and Sharma (1982), Ravindranath *et al.* (1983), Chauhan and Tandon (1984), Sawant and Patil (1995), Naik *et al.* (2002), Kunkerkar *et al.* (2017) and Jadhav *et al.* (2020).

Table 1. Analysis of variance for yield and yield contributing characters in F4 generation of rice

Sr. No	Characters	Mean sum of squares		
		Replication	Genotypes	Error
	DF	2	34	68
1	Days to 50% flowering	1.50	239.89**	1.83
2	Days to maturity	0.76	237.95**	1.40
3	Plant height (cm)	21.87	240.56**	9.64
4	No. of tillers/ plant	1.01	4.99**	0.91
5	Panicle length (cm)/ plant	5.28	12.87**	1.27
6	No. of spikelet/panicle	59.77	796.98**	118.45
7	No. of filled spikelet/ panicle	88.26	456.92**	119.09
8	Spikelet fertility (%)	0.40	35.89**	4.04
9	Test weight (gm)	0.054	2.91*	0.09
10	Yield/ plant (g)	2.74	10.35**	1.50
11	Straw yield/ plant (gm)	22.32	155.40**	8.80
12	Harvest index (%)	18.98	61.68**	9.81

Table 2. Components of variation for yield attributing characters in F4 generation of rice

Sl.	Characters	Mean	Range Value	PCV	GCV	h^2b (%)	GA (%)	GAM (%)
1	Days to 50% flowering	76.19	65.13-89.33	11.82	11.69	97.74	18.14	23.81
2	Days to maturity	106.00	94.2-119.33	8.45	8.37	98.25	18.13	17.10
3	Plant height (cm)	105.55	76.90-139.53	8.81	8.31	88.87	17.03	16.14
4	No. of tillers/ plant	9.71	7.00-12.66	15.52	12.01	59.84	1.85	19.14
5	Panicle length (cm)/ plant	21.87	17.40-30.46	10.36	8.98	75.16	3.51	16.04
6	No. of spikelet/ panicle	151.08	132.00-190.33	12.28	9.95	65.63	25.09	16.61
7	No. of filled spikelet/panicle	128.64	113-166.33	11.83	8.24	48.60	15.23	11.84
8	Spikelet fertility (%)	85.38	79.03-91.56	4.48	3.81	72.42	5.71	6.69
9	Test weight (g)	13.06	11.93-15.70	7.77	7.42	91.10	1.90	14.59
10	Yield/ plant (g)	13.15	9.90-17.20	16.04	13.04	66.14	2.87	21.85
11	Straw yield/ plant (g)	33.56	20.9-47.67	22.62	20.82	84.73	13.25	39.49
12	Harvest index (%)	25.45	18.96-41.06	20.45	16.33	63.78	6.84	26.87

4. CONCLUSION

It is concluded that yield is controlled by both GCV and PCV also to use appropriate selection procedure for improvement of the characters in general and yield since high heritability coupled with high genetic advance reveals the presence of lesser environmental influence and prevalence of additive gene action in their expression. High heritability with low genetic-advance indicated the influence of nonadditive gene action. The heritability provides the information on the magnitude of inheritance for quantitative characters, but it does not indicate the magnitude of genetic gain obtained by selection of the best individual from the best population. So, heritability along with genetic advance is more beneficial for selection rather than only heritability.

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6. FUNDING

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