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Original Research Article

Assessment of Selection Response by Different Methods of Selection in Early Generation of Rice Cross (*Oryza sativa* L.)

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A B S T R A C T

High h^2 coupled with high GA as per cent of mean has been recorded for the trait Tw in LY group of I^{st} date TP as well as 2^{nd} date TP, indicates the preponderance of additive gene action and such character could be used as a selection criterion for future hybridisation programme. High magnitude of standardized selection differential was recorded under HY selection method followed by RPS, LY and MTL. Average selection response for the studied traits viz; PH, PPP and GYP plant had exhibited maximum in HY followed by LY selection method, it might be due to the frequency of best genotypes rapidly decreases with advancing generation.

Keywords

Selection response, Standardized selection Differential and realized heritability

Introduction

Rice (*Oryza sativa* L.) is the staple food for around 2.5 billion world's population which is about 60% of the total population and may escalate to 4.6 billion by the year 2050; especially for most of the people of South-East Asia. Among the rice growing countries in the world, India has the largest area under rice crop and ranks second in production next to China. It plays vital role in the national food grain supply. It accounts for about 43% of food grain production in the country. Rice is grown in three seasons in India, where *Kharif* season accounts for 88% production while *Rabi* contributes only 12% production. Rice is the single most important food crop in India and occupies 44.6 m ha under rice cultivation Meera *et al.* (2014). The population growth in most of the Asian countries, except China, continues to be around 2 percent 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 tons of milled rice is to be produced in India to maintain the present level of self-sufficiency.

The total production could be enhanced either by making horizontal expansion in area, which is not possible owing to high population growth, so none of the option left other than vertical expansion, which could be done opting a suitable breeding method. The early generation testing is one of the

best option to reduce the amount of material to be handled in the segregating generations and at the same time retain the good recombinant lines for the traits under improvement. It is also enhanced by selection response which maximises either by selecting the best genotype available in the population or by increasing the rigour of selection. A very rigorous selection may not be desirable as it can eliminate some promising genotypes. Whan *et al.* (1982) suggested that selection for grain yield in early generation need to be done at many sites simultaneously at an early growth stage. Grain yield is a complex character and is the result of interaction of many variables due to different gene association that might exist in different population and might result in quite different relationships. It is also largely influenced by environment. Further genotype and environmental interaction reduces the effectiveness of early generation selection (Whan *et al.* (1981), Rahman *et al*. 1986). Large environmental differences may lead to failure of parental yield to be indicative of the yield of progeny. Recognizing the importance of response to selection by different methods of selection in plant breeding experiments, the main objective of present research work was to assess the effective method of selection and genetic variability. In the present investigation, selection and evaluation of genotypes were carried out in direct seeding as well as transplanted rice to get the information on response to early generation selection and realized heritability for adopting efficient selection in BG102/Naveen derived gene pool of rice for yield improvement.

Materials and Methods

The experimental material of F_2 generation from the cross BG102/Naveen was obtained from Rice Project, Department of Plant Breeding and Genetics, Birsa Agricultural University, Ranchi, Jharkhand. It was grown in nursery on 6th June, 2013. Thirty (30) days old seedlings were transplanted in the puddled field. Out of total 5000 F_2 established population, 1000 F_2 were tagged randomly after flowering of BG102/Naveen. The data recording and harvesting of each plants were done separately so that these F_2 plants be categorized and selected. On the basis of these data 50 plants were selected in each groups viz., high yielder (HY), low yielder (LY), multi trait limit (MTL) and random plant selection (RPS). Each group comprising 50 plants but in MTL having only 49 plants. High and low yielder plants were selected on the basis of their high and low yield potential, however, in MTL group optimum plants were selected by fixing certain traits range viz; PH (70-110 cm), PPP (5-25), PL (18-35 cm), GPP (80-250) and test wt. (100 seed, 1.9-3.0 g) but in RPS group plant was selected on random basis. These F_2 selected plants were grown during *kharif*, 2014 in RBD with two replication and two methods of sowing such as, direct seeded and transplanted at twenty days interval; each plot measuring 2.7 x 0.4 meter size. The row to row distance was kept at 20cm while plant to plant distance was maintained at 15 cm. A fertilizer dose of 80 : 40 : 30 N:P:K Kg/ ha was applied in two parts 40 kg of N, all phosphate and potash were applied as a basal and the remaining 40 kg N was applied as top dressing in two split doses. The analysis of variance was carried out separately for each trait as per formula suggested by Panse and Sukhatme (1967), phenotypic and genotypic coefficient of variation by Burton (1952), heritability (Broad sense) and genetic advance as per cent of mean were estimated by the formula as suggested by Johanson *et al.* (1955). Standardized selection differential, response to selection and realized heritability were estimated as per Falconer (1989).

Table.1 Genetic Parameters of 50 F_3 progenies selected from F_2 population (BG102/Naveen) based from different selection indices and grown under different crop ecology

Characters	Genetic parameters	I st method of selection (HY)				2nd method of selection (LY)				3rd method of selection (MTL)				4th method of selection (RPS)			
		I st Date		2nd Date		I st Date		2nd Date		I st Date		2nd Date		I st Date		2nd Date	
		DS	TP	DS	TP	DS	TP	DS	TP	DS	TP	DS	TP	DS	TP	DS	TP
DFF	**h^2 (%)**	68.00	63.74	24.30	77.46	61.05	65.91	50.17	43.31	3.06	45.02	9.85	95.72	53.34	65.94	32.59	55.04
	GA (%)	4.83	4.26	2.06	4.38	4.28	4.17	3.69	2.65	0.11	1.42	0.45	26.92	2.67	3.18	1.94	2.75
	GCV (%)	2.94	2.57	1.94	2.54	2.68	2.41	2.34	1.99	0.40	1.13	0.83	14.33	2.24	2.09	1.97	1.88
	PCV (%)	3.56	3.22	3.93	2.88	3.43	2.96	3.30	3.03	2.30	1.69	2.66	14.65	3.07	2.58	3.45	2.53
PH (cm)	**h^2 (%)**	17.14	15.52	14.91	10.41	15.95	12.03	11.02	17.08	10.75	23.14	13.55	60.23	6.53	5.71	14.20	12.15
	GA (%)	2.20	2.09	2.00	1.06	2.21	1.50	1.46	1.67	1.35	2.88	2.18	20.53	0.75	0.63	1.59	1.12
	GCV (%)	2.58	2.58	2.51	1.58	2.69	2.09	2.13	1.96	1.99	2.90	2.87	13.10	1.42	1.27	2.04	1.55
	PCV (%)	6.23	6.56	6.51	4.92	6.75	6.03	6.44	4.75	6.09	6.03	7.79	16.88	5.57	5.34	5.43	4.46
PPP	**h^2 (%)**	12.99	11.94	20.25	23.72	10.29	56.15	19.21	36.13	11.93	28.85	11.32	39.68	14.29	29.60	18.95	27.98
	GA (%)	4.26	3.28	6.47	8.55	3.52	15.17	7.11	11.96	5.48	10.65	5.20	11.45	3.94	7.59	6.26	7.61
	GCV (%)	5.73	4.39	8.65	8.41	5.18	10.13	7.64	9.89	7.13	8.74	4.77	16.16	5.20	6.32	6.98	6.58
	PCV (%)	15.90	12.71	19.23	17.27	16.14	13.52	17.44	16.46	20.65	16.28	14.19	25.66	13.77	11.62	16.03	12.45
GPP	**h^2 (%)**	52.06	40.26	39.69	36.43	18.22	57.45	20.14	19.28	26.57	25.39	19.47	45.58	47.41	40.39	56.89	46.98
	GA (%)	19.38	14.60	17.15	12.42	6.53	19.78	7.63	7.03	8.19	7.94	6.30	20.13	19.60	15.18	23.26	16.32
	GCV (%)	13.03	11.17	13.21	9.98	7.42	12.67	8.25	7.77	7.73	7.63	6.92	14.76	13.81	11.59	14.96	11.55
	PCV (%)	18.06	17.60	20.97	16.54	17.39	16.72	18.39	17.69	14.99	15.15	15.70	21.87	20.06	18.23	19.84	16.85
TW(g)	**h^2 (%)**	57.46	90.64	87.24	94.25	64.83	95.61	93.37	95.13	81.65	92.16	94.49	95.28	89.75	95.28	90.05	94.65
	GA (%)	9.36	13.98	14.41	21.54	16.00	21.61	21.46	21.69	19.61	21.44	22.16	35.47	21.12	22.07	21.35	21.74
	GCV (%)	5.98	7.12	7.49	10.76	9.64	10.72	10.70	10.79	10.53	10.84	11.06	18.00	10.81	10.97	10.91	10.84
	PCV (%)	7.90	7.48	8.01	11.09	11.98	10.97	11.15	11.06	11.66	11.29	11.38	18.44	11.41	11.24	11.50	11.14
GYP Plant (g)	**h^2 (%)**	37.93	43.56	59.96	21.44	53.37	72.25	55.45	65.28	39.62	47.11	59.73	35.14	46.53	45.26	15.98	59.05
	GA (%)	13.12	14.52	27.20	8.33	30.46	37.25	31.19	39.26	21.93	23.91	37.90	22.89	20.82	19.51	7.47	27.70
	GCV (%)	10.24	10.48	16.88	8.65	19.29	20.31	19.35	22.43	15.16	15.12	21.81	17.57	14.81	14.07	9.06	17.48
	PCV (%)	16.62	15.88	21.80	18.68	26.40	23.90	25.99	27.77	24.09	22.03	28.21	29.65	21.71	20.92	22.67	22.75
GYP Plot (g)	**h^2 (%)**	10.09	12.67	49.11	22.18	14.11	14.50	15.58	10.24	27.14	32.28	14.33	21.72	2.96	11.36	18.98	10.39
	GA (%)	1.49	1.95	22.21	4.61	9.29	7.55	3.31	2.24	92.64	39.07	45.13	71.57	0.35	1.87	2.25	1.30
	GCV (%)	2.28	2.65	15.38	4.74	4.07	3.90	4.06	3.39	11.25	3.96	2.88	9.29	0.99	2.68	2.50	1.96
	PCV (%)	7.17	7.45	21.95	10.07	10.83	10.24	10.30	10.60	21.59	6.98	7.61	19.94	5.78	7.96	5.75	6.08

Table.2 Estimates of Standardized selection differential, standardized selection response and realized heritability for different traits from two methods as well as two date of sowing based on different methods of selection of BG102/Naveen

Methods of selection and selection intensity (5%)	Population mean	No. of selected lines	Mean of selected parent	Standardized selection differential (S/σ p)	Progeny mean				Standardized selection response (R/σp)				Average standardized selection response	Realized heritability (R/S)				Average Realized heritability
					Ist Date		2nd Date		Ist Date		2nd Date			Ist Date		2nd Date		
					DS	TP	DS	TP	DS	TP	DS	TP		DS	TP	DS	TP	
Based on HY		50																
PH (cm)	115.36		117.52	77.88	117.10	116.70	115.90	117.00	77.45	77.06	76.26	77.36	77.03	0.99	0.99	0.98	0.99	0.99
PPP	7.57		9.98	7.14	9.29	9.74	7.86	7.96	6.46	6.91	5.02	5.12	5.88	0.90	0.97	0.70	0.72	0.82
GPP	69.6		80.58	67.47	80.23	74.27	71.01	73.38	67.12	61.16	57.90	60.28	61.62	0.99	0.91	0.86	0.89	0.91
GYP Plant (g)	10.01		23.06	21.17	18.31	18.62	12.97	17.38	16.42	16.74	11.08	15.50	14.94	0.78	0.79	0.52	0.73	0.71
Based on LY		50																
PH (cm)	115.36		118.20	78.56	115.00	113.66	115.60	117.00	75.36	74.02	75.96	77.36	75.68	0.96	0.94	0.97	0.98	0.96
PPP	7.57		8.32	5.48	8.18	7.92	8.16	7.96	5.34	5.09	5.32	5.12	5.22	0.97	0.93	0.97	0.93	0.95
GPP	69.6		81.82	68.71	80.00	74.97	72.59	73.30	66.90	61.87	59.48	60.19	62.11	0.97	0.90	0.87	0.88	0.91
GYP Plant (g)	10.01		14.17	12.28	10.82	11.30	10.89	9.89	8.94	9.42	9.00	8.01	8.84	0.73	0.77	0.73	0.65	0.72
Based on MTL		49																
PH (cm)	115.36		105.69	66.05	103.5	91.76	92.94	92.05	63.8	52.1	53.2	52.4	55.42	0.97	0.79	0.81	0.79	0.84
PPP	7.57		9.14	6.31	8.58	7.44	8.82	8.30	5.75	4.60	5.98	5.46	5.45	0.91	0.73	0.95	0.87	0.87
GPP	69.6		90.61	77.50	79.79	74.33	70.61	71.53	66.6	61.2	57.5	58.4	60.96	0.86	0.79	0.74	0.75	0.79
GYP Plant (g)	10.01		11.51	9.63	9.74	10.17	7.91	10.54	7.85	8.28	6.03	8.65	7.70	0.82	0.86	0.63	0.90	0.80
Based on RPS		50																
PH (cm)	115.36		115.76	76.12	115.37	113.58	115.06	114.48	75.72	73.94	75.42	74.84	74.98	0.99	0.97	0.99	0.98	0.98
PPP	7.57		8.76	5.92	8.05	8.62	8.60	9.11	5.22	5.78	5.77	6.28	5.76	0.88	0.98	0.97	1.06	0.97
GPP	69.6		73.42	60.31	72.90	72.26	72.61	69.32	59.79	59.15	59.50	56.21	58.66	0.99	0.98	0.99	0.93	0.97
GYP Plant (g)	10.01		14.14	12.25	11.35	11.83	14.03	10.40	9.47	9.95	12.15	8.51	10.02	0.77	0.81	0.99	0.69	0.82

Results and Discussion

Table 1 revealed that $50F_2$ progenies exhibited high h^2 coupled with high GA as per cent of mean has been recorded for Tw in LY group of I^{st} date TP and 2^{nd} date TP along with MTL and RPS. GYP plant had also exhibited high h^2 coupled with high genetic advance as per cent of mean in all most all the selection methods except in HY group and I^{st} date of DS and TP indicating the preponderance of additive gene action earlier finding reported by Lokprakash *et al*. (1992), Kumar *et al*. (2013) Dhurai *et al*. (2014) and Lingaiah (2015). The high heritability of characters indicated selection for these characters should be fairly easy and could be used as a selection criterion for future hybridisation programme. This is because there would be close correspondence between the genotype and phenotype due to a relatively smaller contribution of the environment to the phenotype. Heritability estimates along with genetic gain are normally more helpful in predicting the gain under selection than heritability estimates alone (Johanson *et al*., 1955).

Maximum standardized selection response was observed under HY selection method followed by LY selection method, RPS and MTL for all studied traits while high magnitude of standardized selection differential was recorded under HY selection method followed by RPS, LY and MTL (Table 2). While average selection response for the studied traits viz., PH, PPP and GYP plant had exhibited maximum in HY followed by LY selection method, it might be due to the frequency of best genotypes rapidly decreases with advancing generation similar finding earlier reported by Shebeshki L. H. 1967, Verma and Mani (2000), and Ahmad *et al*. (2017).

High realized h^2 was observed in different methods of planting under different methods of sowing for all the characters under all methods of selection however, as revealed by the table based on the HY selection method would be more effective. This finding is corroborated with Vir and Singh (2005), Kumar *et al.* (2009) and Singh *et al.* (2013).

In the present investigation it can be concluded that among different methods of selection HY followed by LY, RPS and MTL methods of selection may be effective in early segregating generation

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