SHORT COMMUNICATION

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Study of heritability, genetic advance and variability for yield attributing characters in exotic germplasm of rice

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ABSTRACT

The efficiency of selection depends on the magnitude of genetic variability present in the plant population. Parameters of genetic variability were estimated for 123 exotic germplasm of rice including two local checks. Most of the characters showed high values of genotypic and phenotypic coefficient of variation. Number of unfilled grains panicle^{-1} recorded the highest phenotypic and genotypic coefficient of variation followed by panicle index. Plant height and 1000 grain weight showed moderate values. High heritability with high genetic advance was observed for panicle weight plant^{-1}, number of tillers plant^{-1}, number of effective tillers plant^{-1}, number of grains panicle^{-1}, number of filled and unfilled grains panicle^{-1}, spikelet density, biological yield plant^{-1}, grain yield plant^{-1} and harvest index which suggests that selection may be effective for these characters.

Key words: *rice, variability, genetic advance, heritability*

Success of hybridization and there after selection of desirable segregants of rice depend largely on the selection of parents with high magnitude of genetic variability for different characters present in the plant population. Thus, the success of genetic improvement in any character depends on the nature of variability present in the gene pool for that character. Heritability and genetic advance are important selection parameters when considered together help the breeders in determining traits having better correspondence between phenotypes and genotypes and are expected to give better response to selection (Bisne *et al*., 2009). Therefore, the present investigation was undertaken to study the heritability, genetic advance and variability of selected exotic germplasm of rice.

The experiment was carried out with 39 aromatic/fine grain lines from CIAT, Argentina, IRRI, Myanmar, WARDA, IITA, Senegal, Pakistan, and 84 non-aromatic lines from IRRI, Indonesia and Myanmar along with two checks grown in randomized complete block design with three replications at J.N. Agricultural University, Jabalpur (M.P.) (Table 1). Twenty-one day old seedlings were transplanted in three rows of five meter length for each genotype with a row to row spacing of 20 cm. Fertilizer dose of 120 Kg N, 60 Kg P_2O_5, and 60 Kg K_2O was applied. The standard agronomic practices were adopted for normal crop growth.

Five competitive plants from each plot were randomly selected and tagged for recording various quantitative characters. Observations were recorded on days to 50 % flowering, plant height, panicle length, panicle weight plant^{-1}, number of tillers plant^{-1}, number of filled and unfilled grains panicle^{-1}, spikelet fertility and spikelet sterility %, number of grains panicle^{-1}, days to 50% flowering, 1000 grain weight, spikelet density, biological yield plant^{-1}, grain yield plant^{-1}, harvest index and panicle index.

Analysis of variance indicated that the differences among genotypes were highly significant for all the traits studied indicating that the genotypes were highly diversified (Table 2). The parameters of genetic variability yield and yield attributing characters indicated that, the phenotypic coefficient of variation was higher in magnitude than that of genotypic coefficient of variation for all the characters studied (Zahid *et al.,* 2006). Phenotypic coefficient of variation

Table 1. Details of aromatic /fine grain and non-aromatic lines used in the study.

Aromatic/fine grain lines	Non-aromatic lines	Non-aromatic lines
88023-RE	BATANG LEMBANG	IR 79504-5-3-3-2
CT9882-16-4-2-3-2P-M	CIAPUS	IR 79505-51-2-2-2
H013-5-3-B4	CIASEM	IR 79511-47-2-6-3
H014-1-1-B2	IR 72164-348-6-2-2-2-2	IR 79515-25-1-6-1
IR 60080-46A	IR 72890-81-3-2-2	IR 79525-20-2-2-2
IR 74	IR 73007-44-1-2-3	IR 79532-21-2-2-1
IR 77734-93-2-3-2	IR 73546-66-1-1-1	IR 79538-1-1-1-1
IR 77736-54-3-1-2	IR 73718-26-1-2-5	IR 79585-61-2-3-3
IR 78006-55-2-3-3	IR 74052-153-5-3-1-3	IR 79597-56-1-2-1
IR 78537-32-1-2-1	IR 74288-153-5-1-1-3	IR 79643-23-3-3-3
IR 78554-145-1-3-2	IR 74642-195-1-3-2	IR 80285-34-3-3-2
IR 77298-14-1-2	IR 74646-96-2-3-3	IR 80290-74-1-5-6-3
IR 77512-2-1-2-2	IR 75287-19-3-3-3	IR 80375-13-3-3
IR 77629-72-2-1-3	IR 75299-94-1-2-2	IR 80376-36-2-2-1
M1-10-29 UL	IR 76494-28-1-2-2	IR 80376-51-2-2-1
TOX 3226-5-2-2-2-2	IR 77140-24-2-1-2	IR 80395-97-3-3-2
TOX 3867-19-1-2-3-3	IR 77495-10-2-6-2	IR 80658-67-2-1-2
WAB 272-B-B-5-H5	IR 77498-47-2-6-2-3	IR 80705-36-1-3-3
WAB 99-84	IR 77533-29-2-2-2	IR 807070-69-1-3-3
WAB 337-B-B-15-H1	IR 77721-93-2-2-1-2-2	IR 80894-66-3-2-3
WAB 515-B-10 A1-4	IR 78126-1-2-1	IR 80894-8-1-1-3
WAS 169-B-B-4-2-7	IR 78566-1-2-1-2	IR 80897-20-1-2-2
WAS 169-B-B-4-2-9	IR 78585-64-2-4-3	IR 80901-32-3-3-2
WAS 197-B-4-1-22	IR 79195-115-2-2-3	IR 80904-50-3-1-3
WAS 197-B-4-1-25	IR 79200-65-2-2-1	IR 80919-57-2-2-1
WAS 197-B-5-2-16	IR 79201-49-1-1-1	IR 81166-150-2-1-3
WAS 197-B-5-2-5	IR 79203-105-1-1-3	IR 81168-31-2-3-2
WAS 197-B-6-3-12	IR 79204-84-2-2-3	IR 81172-140-1-3-2
WAS 197-B-6-3-16	IR 79216-141-1-3-3	IR 81174-83-2-1-3
WAS 197-B-6-3-2	IR 79226-98-1-1-3	IR 81178-29-2-3-2
WAS 197-B-6-3-4	IR 79228-67-1-1-3	IR 81309-67-3-2-3
WITA 7(TOX 3440-171-1-1-1-1)	IR 79228-9-2-3-1	IR 81310-25-3-2-2
BASMATI 370	IR 79233-28-2-1-2	IR 81328-74-2-2-2
IR 50	IR 79242-28-3-2-3	IR 81336-39-3-3-3
IR 64	IR 79246-105-2-2-4	IR 81346-22-1-1-1
IR 72	IR 79246-47-1-3-3	IR 81347-10-2-3-3
PSB RC2(IR 32809-26-3-3)	IR 79247-107-1-2-1	IR 81873-31-2-2-2
PSB RC18(IR51672-62-2-1-1-2-3)	IR 79254-48-2-1-1	IRYN 1068-7-1
PSB RC64(IR59552-21-3-2-2)	IR 79254-86-2-3-1	KALIMAS
JR-201	IR 79327-107-2-3-3	MARO
IR-36	IR 79327-9-3-3-1	PEPE
	IR 79504-48-1-6-2	CIAPUS

ranged from 6.92 to 65.44, while, genotypic coefficient of variation ranged from 6.25 to 61.33. The character *viz*., number of unfilled grains panicle^{-1} recorded the highest phenotypic (65.44%) and genotypic coefficient of variation (61.33%) followed by panicle index, spikelet sterility % , harvest index, panicle weight plant^{-1}, grain yield plant^{-1}, biological yield plant^{-1}, number of tillers plant^{-1}, number of grains panicle^{-1}, number of filled grains panicle^{-1}, spikelet density and number of effective tillers plant^{-1}. Plant height and 1000 grain weight showed moderate values, whereas panicle length, days to 50% flowering, and spikelet fertility %

Table 2. Analysis of variance for yield and its components in rice genotypes

Source	d. f.	Plant height (cm)	Panicle length (cm)	Panicle weight plant^{-1} (g)	No. of tillers plant^{-1}	No. of effective tillers plant^{-1}	No. of filled grains panicle^{-1}	No. of unfilled grains panicle^{-1}	No. of grains panicle^{-1}	Days to 50 % flowering	1000 grain weight (g)	Spikelet density	Biological yield plant^{-1} (g)	Grain yield plant^{-1} (g)	Harvest index (%)	Panicle index	Spikelet fertility (%)	Spikelet sterility (%)
Replication	2	14.86	0.51	72.93	5.76	14.24	93.84	31.17	232.97	45.06	0.18	0.22	1.20	260.93	0.01	0.04	4.10	2.82
Genotypes	124	407.33**	19.86**	413.28**	28.74**	20.40**	2861.07**	421.08**	3694.52**	122.07**	41.41**	5.67**	2983.56**	517.63**	0.07**	1.38	98.47**	108.66**
Error	248	3.42	1.54	17.76	2.50	1.56	53.95	18.60	72.75	2.28	0.07	0.20	6.76	24.35	0.002	0.26	6.85	22.28
SEm		1.06	0.71	2.43	0.91	0.72	4.24	2.49	4.92	0.87	0.15	0.26	1.50	2.84	0.029	0.29	1.51	2.72
CD(P<0.05)		2.97	2.00	6.77	2.54	2.01	11.81	6.93	13.71	2.43	0.43	0.72	4.18	7.93	0.08	0.82	4.21	

** Significant at 5 % level of probability

showed low values of phenotypic and genotypic coefficient of variation. The phenotypic (6.92%) and genotypic coefficient (6.25%) values were smallest for spikelet fertility %.

The difference between the values of phenotypic and genotypic coefficient of variation for plant height, panicle length, panicle weight plant^{-1}, number of filled grains panicle^{-1}, number of grains panicle^{-1}, days to 50% flowering, 1000 grain weight, spikelet density, biological yield plant^{-1} and spikelet fertility % were very low indicating that these traits were less sensitive to environmental changes and consequently the estimates of heritability for these traits were high.

Broad sense heritability estimates varied for different morphological and agronomical traits. All the characters expressed high to very high estimate of broad sense heritability. The heritability estimates ranged from 99.48% for 1000 grain weight to 56.37% for spikelet sterility %. Biological yield plant^{-1}, plant height, days to 50% flowering, number of filled grains panicle^{-1}, number of grains panicle^{-1}, harvest index, spikelet density, panicle weight plant^{-1}, number of unfilled grains panicle^{-1}, grain yield plant^{-1}, spikelet fertility %, number of effective tillers plant^{-1}, panicle length, number of tillers plant^{-1} recorded high broad sense heritability. High heritability indicates the scope of genetic improvement of these characters through selection. Moderate heritability was recorded for the character panicle index (58.42%). Similar findings were reported by Hasib *et al.* (2004), Panwar (2005), Muthuswamy and Ananda Kumar (2006) and Kole *et al.* (2008).

High heritability with high genetic advance was observed for panicle weight plant^{-1}, number of tillers plant^{-1}, number of effective tillers plant^{-1}, number of filled grains and unfilled grains panicle^{-1}, number of grains panicle^{-1}, spikelet density, biological yield plant^{-1}, grain yield plant^{-1}, harvest index and 1000 grain weight indicating additive gene effects (Table 3). Similar findings reported by Panwar (2005), Suresh and Anbuselvam (2005), Muthuswamy and Ananda Kumar (2006), Kole *et al.* (2008), Saleem *et al.* (2008) and Chandra *et al.* (2009).

Panicle index and spikelet sterility (%) recorded moderate heritability with high genetic

Table 3. Parameters of genetic variability of yield and yield contributing traits in rice genotypes

Character	Mean	Range		PCV(%)	GCV (%)	h^2b (%)	G A	G A as % of mean (at 5% selection intensity)
		Min.	Max.					
Plant height(cm)	100.70	76.86	169.80	11.66	11.52	97.52	23.60	23.43
Panicle length(cm)	25.75	19.83	32.00	10.74	9.59	79.76	4.54	17.65
Panicle weight plant^{-1} (g)	36.71	10.00	94.66	33.31	31.27	88.12	22.20	60.47
Number of tillers plant^{-1}	12.44	5.33	27.00	26.96	23.77	77.76	5.37	43.18
Number of effective tillers plant^{-1}	11.75	5.33	23.66	23.82	21.30	80.01	4.61	39.26
Number of filled grains panicle^{-1}	140.71	80.66	261.33	22.35	21.73	94.55	61.27	43.34
Number of unfilled grains panicle^{-1}	18.88	3.00	83.00	65.44	61.33	87.82	22.36	118.40
Number of grains panicle^{-1}	159.60	90.66	279.00	22.41	21.77	94.32	69.51	43.55
Days to 50% flowering	97.09	81.00	112.66	6.69	6.50	94.59	12.66	13.04
1000 grain weight (g)	25.83	16.33	45.13	14.41	14.37	99.48	7.62	29.53
Spikelet density	6.22	3.64	12.00	22.84	21.67	89.97	2.63	42.34
Biological yield plant^{-1} (g)	109.88	46.36	190.58	28.76	28.66	99.32	64.67	58.85
Grain yield plant^{-1} (g)	42.30	16.46	91.03	32.47	30.30	87.10	24.65	58.27
Harvest Index (%)	40.74	15.00	85.00	40.32	38.46	90.96	0.31	75.57
Panicle Index	1.28	0.48	5.15	62.47	47.74	58.42	0.96	75.17
Spikelet Fertility (%)	88.32	73.20	97.53	6.92	6.25	81.66	10.28	11.64
Spikelet Sterility (%)	11.76	3.07	33.13	60.75	45.61	56.37	8.29	70.54

advance. Similar findings were reported by Panwar (2005), Muthuswamy and Ananda Kumar (2006) and Chandra *et al.* (2009). High heritability with low genetic advance was recorded for days to 50 % flowering, plant height, panicle length and spikelet fertility (%). Similar results were given by Satyanarayana *et al.* (2005), and Kole and Hasib (2008). High heritability with low genetic advance is indicative of non-additive gene action and exhibited due to favourable influence of environment.

Genetic advance as percentage of mean were recorded for yield, morphological and other traits (Table 3). Estimates of genetic advance as percentage of mean ranged from 11.64 to 118.40. The highest genetic advance as percentage of mean were recorded for number of unfilled grains panicle^{-1} followed by harvest index, panicle index, spikelet sterility %, panicle weight plant^{-1}, biological yield plant^{-1}, grain yield plant^{-1}, number of grains panicle^{-1}, number of filled grains panicle^{-1}, number of tillers plant^{-1}, spikelet density and number of effective tillers plant^{-1}.

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