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GENETIC ANALYSIS FOR YIELD AND QUALITY TRAITS IN SEGREGATING GENERATIONS OF BASMATI RICE (*ORYZA SATIVA* L.)

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ABSTRACT

Present study was conducted to assess the genetic parameters for yield and quality traits in segregating generations of Basmati rice (*Oryza sativa* L.). 14 BC_1F_3 segregants along with eight parents were evaluated in Randomized Block Design (RBD) with three replications at the experimental area of Division of Plant Breeding & Genetics, Main Campus Chatha, Jammu during *kharif* 2013. Analysis of variance for various morphological, phenological, yield attributes and quality parameters revealed that all the 22 genotypes differ significantly for all the characters except number of effective tillers per plant. Data of genetic parameters showed that genotypic coefficients of variation ranged from 4.13 to 24.35 whereas, phenotypic coefficient of variation ranged from 5.04 to 26.00 among various characters studied. Highest genotypic as well as phenotypic coefficients of variation were obtained in case of grain yield per plant followed by 1000 grain weight and amylose content. High heritability and genetic advance as percent of mean values related to 1000 grain weight, amylose content, days to 50 % flowering, grain yield per plant and plant height were obtained which indicated reasonable variation for these traits.

KEY WORDS
Basmati
Genetic variability
Heritability
Genetic advance

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INTRODUCTION

Rice (*Oryza sativa* L.), belonging to family *Poaceae* is one of the oldest domesticated crops which provides food for more than half of the world's population. J&K state is rich in rice culture from the ancient times and it plays a pivotal role in the socio-cultural life of the people of the state. In J&K during 2013-14 rice was grown over an area of 271.49 thousand hectare with production and productivity of 5567 thousand quintals and 20.51 quintals per hectare respectively (Anonymous, 2014), while in Jammu region Basmati is cultivated on an approx. area of 42 thousand hectares. Traditional Basmati cultivars being grown are low yielding, have a tendency to lodge and susceptible to foliar diseases, hence there is a need to develop new cultivars combining the grain quality attributes of basmati with high yield potential (Amarawathi *et al.,* 2008). Since knowledge on the genetic architecture of genotypes is a prerequisite to devise efficient breeding strategy. Therefore, relative magnitude of additive and non additive genetic variances, heritability and genetic advance are essential. Keeping in view the above perspectives the present experiment was carried out to estimate the genetic variability parameters for various yield attributing and quality traits in rice.

MATERIALS AND METHODS

The material for the present study consists of 14 BC_1F_3 genotypes developed by crossing 4 popular basmati cultivars of the region (Basmati 370, Saanwal basmati, Basmati 564 and Ranbir basmati) with 4 non-basmati sources of Bacterial Blight Resistance viz., Improved Samba Masuari, IRBB 50, IRBB 52 and IRBB 54. These 14 BC_1F_3 genotypes of various cross combinations along with parents were evaluated in RBD with three replications during *kharif* 2013 in which, 21 days old seedlings were transplanted in 2 rows of 5m length with a spacing of 30 x 20 cm. All the agronomic and plant protection practices as applicable for Basmati rice were adopted. The data was recorded on five randomly selected plants from each replication for plant height (cm), days to 50 per cent flowering, number of effective tillers per plant, number of spikelets per panicle, panicle length (cm), days to maturity, 1000 grain weight (gm) and grain yield per plant (gm). Seeds of each genotype were dehulled after harvesting for evaluation of the grain quality *viz*. kernel length, kernel breadth and length-breadth ratio based on their dimension according to Digimatic Caliper (Mitutoyo) Model CD-8″CSX having range 0-200mm/0-8inch. The amylose content was determined following laboratory manual on Rice Grain quality (DRR, Hyderabad, 2013).

Analysis of variance was done as suggested by Panse and Sukhatme (1967). Variability for different characters was estimated by Burton and Devane (1953). Heritability and expected genetic advance was calculated according to Hanson *et al.* (1956) and Johnson *et al.* (1955) respectively.

RESULTS AND DISCUSSION

Analysis of variance (Table 1) revealed significant differences among the genotypes for all the traits except number of effective tillers per plant and panicle length thereby, indicating the existence of sufficient variability. The estimates of genetic parameters (Table 2 and figure 1) revealed that genotypic coefficient of variation (GCV) was lower than the respective phenotypic coefficient of variation (PCV) thereby, manifesting the effect of environment on the expression of traits. Similar results were also revealed by Chaubey and Singh (1994), Kumar *et al*. (2013) and Sandhya *et al*. (2014). PCV was found to be highest in grain yield per plant (26.00) followed by 1000 grain weight (16.09), amylose content (15.17), plant height (15.16), L/B ratio (13.23) and panicle length (11.88) while days to 50 per cent flowering had the least PCV value (5.04) which significantly differed by days to maturity (5.06) and kernel breadth (6.54). Similarly, GCV was found to be highest in grain yield per plant (24.35) followed by 1000 grain weight (15.92), amylose content (14.91), plant height (13.53) and L/B ratio (11.93) while days to maturity had the least GCV value (4.13) which significantly differed by panicle length (4.16), days to 50 per cent flowering (4.84), kernel breadth (5.19) and effective tillers per plant (5.81). Bidhan *et al*. (2001) also reported similar results. Characters exhibiting low GCV and PCV indicate that the scope for improving these characters by selection is limited.

Consistency of the performance of genotypes in succeeding generations depends on the magnitude of the variation present in relation to the observed variation. Heritability is the measurement of such a relationship. Heritability estimates (h^2(bs)%) for yield and quality traits (Table 2) ranged from 12.26% to 97.90%. 1000 grain weight exhibited highest value of heritability (97.90%) which was statistically at par with amylose content (96.64%) followed by days to 50% flowering (91.97%), grain yield/plant (87.70%), L/B ratio (81.38%) and kernel length (77.08%). Least heritability value was observed in panicle length (12.26%) followed by effective tillers per plant (25.07%). Panwar (2005), Kumar *et al*. (2007), Chaurasia *et al*. (2012), Kumar *et al*. (2012) and Nilanjaya and Kumar (2015) also reported high heritability for grain yield. Genetic advance as percent of mean for yield and quality characters ranged from 2.97% (panicle length) to 46.94% (grain yield per plant) as depicted in table 2. Moderate genetic advance was shown by 1000 grain weight (32.41%) and amylose content (30.24%) while low genetic advance was observed in panicle length (2.97%), effective tillers per plant (5.72%), days to maturity (6.96%), kernel breadth (7.83%) and days to 50% flowering (9.55%). However, 1000 grain weight (97.90%, 32.41%), amylose content (96.64%, 30.24% and grain yield per plant (87.70%, 46.94%) exhibited high heritability coupled with moderate genetic advance. Elayaraja *et al*. (2005) also reported high heritability associated with moderate genetic advance for grain yield per plant. Characters viz., panicle length

Table 1: Analysis of variance for yield and quality traits in parents/cross combinations

Character	Mean sum of squares		
	Replication (df=2)	Treatment(df=21)	Error(df=42)
Plant height	263.13	778.08**	61.16
Days to 50% flowering	8.08	98.17**	2.77
Effective tillers/plant	3.18	1.25	0.62
Spikelets/panicle	302.50	518.68*	110.16
Panicle length	39.33	12.41	8.74
Days to maturity	1.53	121.59**	17.35
1000 grain weight	0.517	38.75**	0.273
Grain yield/plant	6.47	28.03**	1.25
Kernel length	0.118	1.259**	0.113
Kernel breadth	0.01	0.02**	0.01
L/B ratio	0.026	0.731**	0.051
Amylose content	0.028	25.00**	0.285

** indicate 1% level of significance; * indicate 5% level of significance

Table 2: Genetic parameters of yield and quality traits in parents/cross combinations

Character	Mean	Range	Variance		Coefficient of variation(%)		h^2(bs)%	GA	GA as % of mean
			$\sigma^2 g$	$\sigma^2 p$	GCV	PCV			
Plant height	114.23	79.67 - 135.20	238.97	300.13	13.53	15.16	79.62	28.41	24.87
Days to 50% flowering	116.44	101.33-125.00	31.79	34.57	4.84	5.04	91.97	11.13	9.55
Effective tillers/plant	7.86	6.83 - 9.30	0.20	0.83	5.81	11.60	25.07	0.45	5.72
Spikelets/panicle	136.39	116.34- 171.33	136.17	246.33	8.55	11.50	55.27	17.87	13.10
Panicle length	26.57	23.33 - 30.80	1.22	9.96	4.16	11.88	12.26	0.79	2.97
Days to maturity	142.38	130.21- 155.56	34.74	52.10	4.13	5.06	66.68	9.91	6.96
1000-grain weight	22.49	16.50-27.10	12.82	13.10	15.92	16.09	97.90	7.29	32.41
Grain yield/plant	12.27	9.07 - 22.13	8.92	10.17	24.35	26.00	87.70	5.76	46.94
Kernel length	6.58	5.13 - 7.52	0.38	0.49	9.40	10.70	77.08	1.11	16.86
Kernel breadth	1.66	1.39 – 1.77	0.007	0.011	5.19	6.54	63.00	0.13	7.83
L/B ratio	3.99	2.92 – 5.04	0.227	0.278	11.93	13.23	81.38	0.88	22.05
Amylose content	19.21	15.53 – 24.68	8.24	8.52	14.91	15.17	96.64	5.81	30.24

Table 3: Mean values of various yield and quality attributes

S.no.	Genotype/Cross combination	Plant Height (cm)	Days to 50% flowering	Effective tillers/ plant (no.)	Spikelets /panicle (no.)	Panicle length (cms)	Days to maturity (no.)	1000 grain weight	Grain yield/ plant (gms)	Kernel length (mm)	Kernel breadth (mm)	L/B ratio	Amylose content (%)
1	Basmati 370	135.20	125.00	8.27	171.33	26.63	155.56	20.97	16.10	6.86	1.63	4.20	22.36
2	Saanwal Basmati	125.67	117.33	7.17	131.53	28.27	145.67	20.41	12.35	7.52	1.67	4.51	23.03
3	Basmati 564	127.10	114.33	8.13	152.33	30.80	136.67	20.58	16.87	7.00	1.63	4.31	23.13
4	Ranbir Basmati	130.73	101.33	7.30	155.67	28.53	130.21	18.10	10.52	6.87	1.51	4.56	22.51
5	Improved Samba Masuri	95.33	111.33	7.47	133.33	25.60	135.67	27.47	11.74	5.13	1.76	2.92	24.32
6	IBBB 50	90.33	110.67	7.00	123.00	24.27	139.33	25.17	14.53	5.77	1.77	3.25	18.24
7	IRBB 52	86.67	110.33	6.90	116.34	23.33	138.22	28.20	11.20	5.73	1.72	3.34	19.18
8	IRBB 54	79.67	111.33	7.57	130.00	24.53	137.33	23.05	11.94	5.67	1.70	3.33	17.61
9	Basmati 370 x ISM	128.33	121.67	8.20	146.00	30.37	153.32	19.93	9.28	6.99	1.39	5.04	20.74
10	Basmati 370 x IRBB 50	94.63	111.67	8.07	148.62	26.60	140.67	25.68	10.55	7.15	1.77	4.03	18.11
11	Basmati 370 x IRBB 52	110.33	121.33	7.40	135.00	24.93	140.33	21.73	11.83	6.89	1.77	3.89	16.08
12	Basmati 370 x IRBB 54	113.60	122.33	8.40	139.67	26.43	139.95	19.99	11.28	6.82	1.71	4.00	15.53
13	Saanwal x ISM	104.07	123.67	8.70	120.67	24.17	153.67	16.50	9.76	6.03	1.59	3.80	19.86
14	Saanwal x IRBB 50	107.57	116.00	7.77	131.99	23.80	142.84	26.60	10.20	6.73	1.61	4.20	18.16
15	Saanwal x IRBB 52	123.27	116.33	6.83	141.00	26.13	140.33	24.10	9.07	6.82	1.71	4.00	17.68
16	Saanwal x IRBB 54	126.00	115.33	8.20	120.67	26.33	143.00	25.27	9.80	6.53	1.60	4.08	15.53
17	Basmati 564 x ISM	120.43	116.67	8.67	145.45	27.37	148.67	26.90	22.13	7.17	1.66	4.31	24.68
18	Basmati 564 x IRBB 52	115.92	121.33	9.30	135.00	25.80	139.33	27.10	12.42	6.92	1.73	4.01	16.75
19	Basmati 564 x IRBB 54	123.33	118.33	8.07	135.40	28.33	150.33	20.41	15.13	6.99	1.75	3.99	18.70
20	Ranbir Basmati x ISM	116.10	123.00	7.93	137.33	26.53	141.00	20.39	11.60	5.68	1.54	3.70	17.75
21	Ranbir Basmati x IRBB 50	130.43	119.67	8.33	124.33	26.67	140.33	19.12	10.32	6.62	1.68	3.94	16.56
22	Ranbir Basmati x IRBB 54	128.33	112.67	7.33	126.00	29.07	140.00	17.07	11.32	6.27	1.69	3.72	16.08
Mean		114.23	116.44	7.86	136.39	26.57	142.38	22.49	12.27	6.55	1.66	3.96	19.21
CV		6.85	1.43	10.05	7.70	11.13	2.93	2.32	9.12	5.13	3.98	5.71	2.78
SE(±)		4.52	0.96	0.46	6.06	1.71	2.40	0.30	0.64	0.19	0.04	0.13	0.31
CD (0.05)		12.90	2.75	1.30	17.32	4.88	6.88	0.86	1.85	0.56	0.11	0.38	0.88

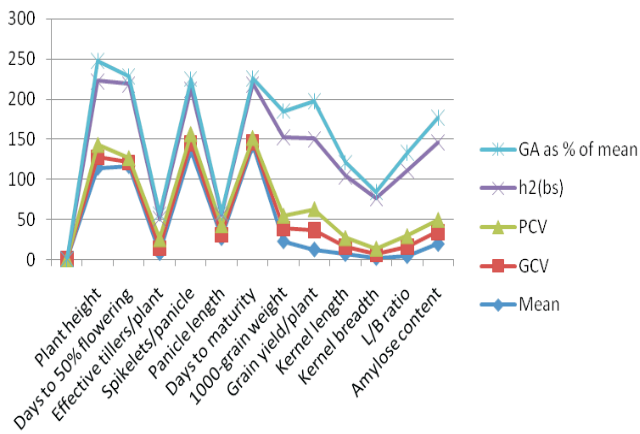

Figure 1: Estimates of genetic parameters for yield and quality traits

(12.26%, 2.97%) and effective tillers per plant (25.07%, 5.72%) showed comparatively low heritability and low genetic advance. Characters exhibiting high heritability coupled with high genetic advance as percent of mean indicated the broad sense of additive gene effects and can be improved by selection (Panse 1957) whereas, characters showing high values of heritability coupled with moderate genetic advance suggest that selection for the improvement of these characters may be rewarding. It also indicates greater role of non-additive gene action in their inheritance suggesting heterosis breeding could be useful for improving these traits. Mean values on yield and quality traits (Table 3) indicated that kernel length ranged between 5.13 mm to 7.52 mm with a overall mean of 6.55 ± 0.19 mm while kernel breadth ranged between 1.39 mm to 1.77 mm. with a overall mean of 1.66 ± 0.04 mm. Length breadth ratio ranged between 2.92 mm to 5.04 mm. with a overall mean of 3.96 ± 0.13 mm. Amylose content ranged between 15.53% to 24.68 % and minimum amylose content was recorded in Basmati 370 x IRBB 54 while Basmati 564 x ISM recorded maximum amylose content with a overall mean of 19.21 ± 0.31%. Among the various progenies involving recipient x donor parents the progeny of cross combination Basmati 564 x Improved Samba Masuri was found to be promising in terms of yield and quality parameters and need to be assessed in segregating generations for deriving promising segregants.

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