Electronic Journal of Plant Breeding, 2(2):275-281 (June 2011)
ISSN 0975-928X

Research Note

Variability studies in Brinjal (*Solanum melongena* L.) in Chhattisgarh plains

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(Received:01Dec 2010; Accepted:11Feb 2011)

Abstract:
Mean performance and genetic variability parameters were estimated in 7 parents and twenty one hybrids of brinjal derived from seven diallel cross combinations to identify suitable parents and F_1s for brinjal cultivation.. The study revealed that highly significant differences were observed for most of the traits. Mean performance showed that IBWL recorded highest fruit yield of 1004 g per plant followed by PPC (974g), GL (931g), MK (918g) and PPR (872g) whereas, in F_1, PPC x PPR registered a fruit yield of 1347 g per plant followed by WBPF x PPR (1317 g), IBWL x PPR (1293g), IBWL x PPC, PPL x PPR (1287g), WBPF x PPC (1282g), IBWL x WBPF and PPL x PPC (1274g). The moderate estimates of Genotypic coefficient of variation (GCV) and Phenotypic coefficient of variation (PCV) were observed for number of fruits per cluster, average fruit weight, total number of fruits per plant, fruit length. Maximum Genotypic coefficient of variation (GCV) & Phenotypic coefficient of variation (PCV) were observed for number of flowers per inflorescence, number of fruits per picking and fruit girth, indicating that selection can be predicted to improve the brinjal genotypes for these characters. The highest estimates of heritability coupled with high genetic advance estimated for the average fruit weight and number of fruits per plant showed effectiveness of simple selection for improvement of these characters.

Keywords:
Brinjal, variability

Brinjal (*Solanum melongena* L.) is an important Indian originated vegetable fruit of India and Chhattisgarh as well which is quite popular and widely cultivated as the poor man's vegetable crop, mostly grown in the rainy season. Whereas, in summer season brinjal can be grown as off- season vegetable and earn premium price. But due to high night and day temperature conditions markedly reduce the fruit set and yield. Hence, heat tolerant genotype has to be identified for Chhattisgarh plains. The optimum temperature for growth and fruit set is 20 ^{o}C to 30 ^{o}C. However, high night and day temperature condition of 22 ^{o}C to 24 ^{o}C and 33 ^{o}C to 35 ^{o}C markedly reduce the fruit set and yield (Kalloo *et al*., 1990, Kumar *et al*. ,2000, Mohanty and Prusti, 2002). In Chhattisgarh, during summer day and night temperature touches a high of about 45^{o}C& 30^{o}C, respectively. Hence, the heat tolerant variety has to be identified for Chhattisgarh plains. Therefore, unexploited genetic variability can be exploited to increase brinjal cultivation in summer for Chhattisgarh plains. Looking to this condition, the present investigation was undertaken to assess the mean performance and genetic variability parameters in 21 F_1's derived from 7 parents in 7 x 7 half diallel cross combinations.

The experimental materials comprised seven genotypes viz; Greenlong (GL), Muktakeshi (MK), Pusa Purple Long (PPL), IBWL-2007-1 (IBWL), White brinjal purple flower (WBPF), Pusa Purple Cluster (PPC) , Pusa Purple Round (PPR) and their 21 F_1's obtained from 7 X 7 half diallel crosses along with PH-6 (National Check). They were grown in randomized block design with three replication in All India Coordinated Vegetable Improvement Project at Horticulture Research Farm, IGKV, Raipur, Chhattisgarh during summer season 2009 following all the recommended package of practices to raise good crop. Observations were recorded on five randomly selected competitive plants from each genotype in each replication for 18 characters viz., days to Ist flowering, days to 50% flowering, days to Ist fruiting, days to Ist picking, plant height (cm), number of flowers per inflorescence, number of fruits per cluster, fruit length (cm), fruit girth (cm), plant height (cm), number of primary branches per plant,

total number of fruits per plant, total soluble solids (%), average fruit weight (g), stalk length (cm), number of fruits per picking, marketable fruit yield per plant and total fruit yield per plant (g**).** Analysis of variance and phenotypic and genotypic coefficient of variations, heritability in broad sense along with genetic advance were computed as per standard methods (Panse and Sukhatme, 1978; Johnson *et al.,*1955**).** Observation on morphological traits *viz.*, colour of flower, fruit colour, fruit shape, colour of leaves and spines on leaves were also recorded by visual observation.

Highly significant differences were observed for all the traits (Table 1) under study. The mean value (Table 2) was maximum for total fruit yield per plant among parents with range of 1004 g (IBWL) to 821 g (PPL). Among F_1's, the mean value ranged from 1347 g (PPC x PPR) to 958 g (GL x MK) and the number of fruits per cluster had the minimum value of 1.4 (PPC) to 2.2 (IBWL x WBPF). Earliest first flowering was recorded in PPL and IBWL (41 & 44 days) which is significantly superior to all the parents. Whereas, very late first flowering was recorded after 58 days in GL, while in case of hybrids earliest first flowering was recorded in 43 days in PPL x WPF, PPL x PPR, WBPF x PPR, PPC x PPR, and IBWL x WBPF; days to 50% flowering recorded minimum (48 days) in a parent IBWL, which is significantly superior from all and very late (63 days) in GL, while in hybrids minimum (49 days) days to 50% flowering recorded in MK x PPR, PPL x PPR and IBWL x WBPF; earliest fruiting (55 days) recorded in a parent viz., IBWL which is significantly superior from all, while in hybrids, earliest (55 days) fruiting recorded in MK x IBWL, MK x PPR, PPL x WBPF, PPL x PPR.

Earliest first picking was recorded 63 days (IBWL) showing significantly superiority from PPL (65 days), while, among F_1's, minimum was observed 61 days (PPL x WBPF) which is significantly superior from PPL x PPR (62 days). Earliness is desirable for market point of view particularly in summer. Similar results reported in agreement with the findings of Singh *et al*. (2003), Prasad *et al*. (2004), Suneetha and Katharia (2006), Vaddoria *et al*. (2007) and Kamalakkannan *et al*. (2007).

The number of fruits/picking was maximum (3) in IBWL, while in case of hybrids, maximum of 4 fruits/picking was recorded in PPL x WBPF hybrid followed by 3 / picking in IBWL x PPC, IBWL x PPR, WBPF x PPC, WBPF x PPR and PPC x PPR. The average fruit weight was maximum in check viz., PH-6 (130 gm) followed by MK (129 gm), GL (101 gm), MK & PPR (97 gm), while the hybrids recorded maximum of 118 gm in MK x WBPF followed by MK x PPL (97 gm), MK x PPR (97 gm), WBPF x PPR (93gm), & MK x IBWL (82gm)**.** This is in agreement with the findings of Singh *et al*. (2003), Prasad *et al*. (2004) and Ambade (2008). Total number of fruits/plant was maximum (27) in IBWL, whereas, among the hybrids, maximum of 24 was recorded in IBWL x WBPF. Total fruit yield/plant was recorded to be highest in (1004 gm/plant) IBWL which is significantly superior from PPC 974 gm followed by GL 931gm, MK 918gm and PPR 872gm, whereas, check PH-6 yielded maximum of 1080 gm/plant. Whereas, in case of hybrids highest fruit yield /plant was recorded in PPC x PPR (1347 gm) followed by WBPF x PPR (1317 gm), IBWL x PPR (1293g), IBWL x PPC, PPL x PPR (1287g), WBPF x PPC (1282g), IBWL x WBPF & PPL x PPC (1274g).; Marketable fruit yield/plant was highest in PPC (867 gm) which is followed by GL (829 gm) and IBWL (823 gm). Whereas, PH-6 check yielded 846 gm/plant. While, among the hybrids PPC x PPR (1158 gm) recorded the maximum followed by IBWL x PPC (1107 gm). This results are in agreement with the findings of Kumar *et al*. (2000), Paikra *et al*. (2003), Suneetha and Katharia (2006), Vaddoria *et al*. (2007) and Ram *et al*. (2007).

The lowest TSS was recorded (3.83 %) in WBPF and maximum of 4.37 % was observed in PPC. Whereas, in hybrids, minimum value of 3.23% TSS was recorded in PPC x PPR while it was maximum in MK x PPL followed by GL x PPC 4.83%. These results are in accordance with the findings of Suneetha and Katharia (2006).

The phenotypic coefficients of variations (PCV) were higher than genotypic coefficients of variations (GCV) for all the traits showed that there is less influence of environment for these traits (Table 3). Similar findings were reported by Sao (2006), Ambade (2008), Mishra *et al*. (2008) and Golani *et al.* (2007). Fruit girth (41.30 %), number of fruits per picking (41.65 %), number of flowers per inflorescence (44.04 %), exhibited high estimates of GCV. Moderate genotypic coefficient of variations were observed for number of fruits per cluster (32.21 %) followed by total number of fruits / plant (31.19 %), average fruit weight (31.02 %) and fruit length (23.35 %), whereas, low genotypic and phenotypic coefficient of variations were recorded for days to first flowering (9.95, 10.07 %), days to 50% flowering (8.46, 8.64%), days to first fruiting (7.62, 7.67%), days to first picking (6.34, 6.44%), plant height (15.585, 16.13), number of primary branches / plant (15.36, 16.60%), marketable fruit yield / plant

(5.89, 15.91%) and total fruit yield / plant (14.59, 14.63%) and total soluble solids (11.04, 16.07%), indicated less scope of its selection. The estimates of GCV and PCV of the present study was in agreement with the findings of Negi *et al.* (2000), Baswana *et al.* (2002), Singh *et al.* (2003), Mohanty and Prusti (2002), Suneetha *et al.* (2006), Naik (2006), Sao (2006), Kailash *et al.* (2007), Ambade (2008), Sherly and Shanthi (2009) and Ara *et al*. (2009).

The genotypic coefficient of variance (GCV), heritability along with genetic advance (GA) estimate provides a better picture for phenotypic selection (Burton and De vane, 1953).The narrow sense heritability estimates ranged between 4.79% (total fruit yield /plant) to 89.77 % (average fruit weight). The estimates of heritability in narrow sense were high for the characters, viz. average fruit weight (89.77%) followed by total number of fruits / plant (82.87%) and days to first flowering (71.18 %), indicating that the characters are under genotypic control and expected to give constant result under simple selection ; this is in accordance with the findings of Sao, Abhinav (2006) and Ambade (2008).

Heritability in conjunction with genetic advance is more effective and reliable in predicting the result and for effectiveness of selection (Johnson *et al.* 1955**).** The genetic advance expressed as percentage of mean varied from 12.38% (number of calyx / fruit) to 90.31% (number of flowers / inflorescence). The high estimates of GA were observed for number of flowers / inflorescence (90.31 %) followed by fruit girth (85.19 %), number of fruits / picking (80.10 %), average fruit weight (63.52%), total number of fruits /plant (63.37%), number of fruits / cluster (56.80%) and fruit length (45.95%) while, moderate genetic advance as percentage of mean were observed for days to first flowering, plant height, number of primary branches / plant and marketable fruit yield / plant. These findings are in close association with the study of Mohanty and Prusti (2002) and Mishra *et al.* (2008), Sao, Abhinav (2006) and Ambade (2008).

High heritability alone does not guarantee large gain from selection unless sufficient genetic advance attributable to additive gene action is present. The highest estimates of GCV, heritability coupled with high genetic advance was observed for the characters average fruit weight, number of flower per inflorescence, fruit girth indicating additive gene effects and effectiveness of simple selection for improvement of these characters. The moderate to high estimates of heritability and low estimates of GA and GCV were noted for days to 50% flowering, days to first fruiting, days to first picking, plant height, and number of calyx per fruit offer less scope for selection as they were more influenced by environment and accounted for non additive gene effects (Panse, 1957). These findings were in accordance with the findings of Ingale and Patil (1994), Prasad *et al.* (2004), Singh *et al*. (2003), Naik (2006), Ram *et al*. (2007).

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Table 1. Mean performance of parents in 7 x 7 diallel analysis in brinjal for summer season

Parents	Days to first flowering	Days to 50 % flowering	Days to first fruiting	Days to first picking	Plant height (cm)	Number of primary branches/plant	Number of flowers/inflorescence	Number of fruit/cluster	Fruit length (cm)	Fruit girth (cm)	Stalk length (cm)	Number of calyx/fruit	Number of fruits/picking	Average fruit weight (g)	Total number of fruit/plant	Total fruit yield/plant (g)	1.Marketable fruit yield/plant (g)	Total soluble solids (%
GL	58	63	68	75	150	10.20	3.05	1.00	17.18	7.40	6.10	5.60	2.00	101	9.00	931	829	3.50
MK	57	61	69	77	140	11.00	1.33	1.00	15.36	7.80	6.60	5.30	1.00	129	8.00	918	670	2.83
PPL	44	51	56	65	109	9.00	3.28	1.00	14.70	5.13	4.80	5.00	2.00	97	11.00	821	640	4.17
IBWL	41	48	55	63	105	13.00	2.92	2.02	11.18	5.50	5.30	5.00	3.00	40	27.00	1004	823	4.17
WBPF	52	57	63	70	133	9.00	3.89	2.20	13.66	4.90	5.77	5.00	2.00	61	15.00	869	695	3.83
PPC	51	57	62	70	99	8.00	5.16	1.67	11.30	4.70	4.90	5.40	2.00	29	24.00	974	867	4.37
PPR	47	52	59	67	123	10.00	1.96	1.00	8.82	11.20	4.40	6.00	1.00	97	11.00	872	663	4.17
PH – 6(c)	57	62	67	74	74	12.00	1.23	1.00	11.53	8.70	3.30	5.00	2.00	130	10.00	1080	864	3.80

Table 2. Mean performance of hybrids in 7 x 7 diallel analysis in brinjal for summer season

F_1's	Days to first flowering	Days to 50 % flowering	Days to first fruiting	Days to first picking	Plant height (cm)	Number of primary branches/plant	Number of flowers/inflorescenc	Number of fruit/cluster	Fruit length (cm)	Fruit girth (cm)	Stalk length (cm)	Number of calyx/fruit	Number of fruits/picking	Average fruit weight (g)	Total number of fruit/plant	Total fruit yield/plant (g)	2. Marketable fruit yield/plant (g)	Total soluble solids (%
GL X MK	54	61	67	75.00	133	10.10	1.30	1.00	12.72	4.00	6.53	5.50	2.00	59.00	18	958	786	3.63
GL X PPL	53	59	65	70.00	150	9.00	4.44	1.00	9.60	5.80	6.50	5.40	1.00	67.00	16	969	756	3.63
GL X IBWL	52	58	64	68.67	135	10.60	2.00	1.00	17.78	2.40	7.00	5.20	1.00	69.00	20	1107	930	4.77
GL X WBPF	51	58	65	69.00	145	8.00	3.44	1.00	13.30	6.10	5.50	5.20	2.00	79.00	11	990	802	4.50
GL X PPC	50	57	62	69.00	139	9.90	1.50	1.00	15.46	3.20	6.60	5.00	2.00	57.00	14	1053	948	4.83
GL X PPR	52	58	65	68.00	135	8.60	1.50	1.00	11.60	6.30	4.30	5.00	1.00	81.00	11	974	828	4.50
MK X PPL	48	54	59	67.00	144	12.00	1.50	1.00	15.36	3.90	5.50	5.00	1.00	97.00	11	1171	890	4.97
MK X IBWL	45	50	55	63.00	126	11.20	2.72	1.25	11.54	4.70	5.30	5.20	1.00	82.67	19	1107	852	4.37
MK X WBPF	46	53	59	67.00	123	8.60	2.00	1.00	9.34	6.20	4.50	5.00	2.00	118.00	11	1104	839	3.73
MK X PPC	53	59	65	70.00	139	9.00	1.00	1.00	10.50	4.60	4.90	5.00	2.00	77.00	11	988	790	3.87
MK X PPR	44	49	55	63.00	140	11.00	1.50	1.00	10.30	11.00	4.30	6.00	1.00	97.00	12	1161	940	3.57
PPL X IBWL	45	50	58	65.00	108	12.20	2.20	1.00	13.70	3.30	6.40	5.50	2.00	67.00	15	1220	1000	4.77
PPL X WBPF	43	49	55	61.00	102	12.70	2.00	1.00	10.40	2.70	4.80	5.07	4.00	43.00	22	1215	984	3.23
PPL X PPC	45	51	57	63.00	100	12.10	1.70	2.20	16.43	3.70	5.90	5.00	1.00	61.00	19	1274	1006	4.03
PPL X PPR	43	49	55	62.00	102	11.00	2.20	1.00	15.90	3.40	8.40	5.00	2.00	69.00	18	1287	1030	3.30
IBWLX WBPF	43	49	56	63.00	100	12.00	4.20	2.20	10.30	3.20	4.30	5.20	2.00	52.00	24	1274	1070	3.83
IBWLX PPC	45	51	57	64.00	99	12.00	2.20	1.50	7.30	4.60	5.40	5.30	3.00	77.00	18	1287	1107	3.77
IBWLX PPR	44	50	56	63.00	102	13.57	4.43	1.33	10.10	5.20	5.30	5.00	3.00	63.00	19	1293	1060	4.10
WBPF X PPC	44	50	57	64.00	99	12.00	2.50	1.67	14.40	8.90	5.10	5.00	3.00	59.00	16	1282	1064	4.17
WBPF X PPR	43	50	56	63.00	100	12.00	4.24	1.00	7.80	6.60	5.10	6.00	3.00	93.00	14	1317	988	4.17
PPC X PPR	43	50	56	63.00	99	14.00	2.30	1.00	9.60	5.00	4.60	5.40	3.00	63.00	15	1347	1158	3.23
Mean	**47.71**	**53.71**	**59.85**	**66.70**	**120.6**	**10.77**	**2.58**	**1.25**	**12.34**	**5.40**	**5.50**	**5.25**	**1.96**	**74.46**	**15.67**	**1098.83**	**893.39**	**4.00**
CD	**1.22**	**1.55**	**1.04**	**1.20**	**8.23**	**1.10**	**0.25**	**0.39**	**1.45**	**0.17**	**0.15**	**0.09**	**0.51**	**4.07**	**1.38**	**20.37**	**11.48**	**0.84**
CV	**1.57**	**1.76**	**1.06**	**1.10**	**4.17**	**6.28**	**5.93**	**19.25**	**7.20**	**1.93**	**1.69**	**1.08**	**16.03**	**3.34**	**5.39**	**1.13**	**0.78**	**12.88**

Table 3. Genetic variability and its components for fruit yield and its components in brinjal for summer season

Characters	Mean	Range		Heritability ns(%)	Genetic advance as % of mean	GCV %	PCV %
		Maximum	Minimum				
Days to first Flowering	47.71	58	41	71.18	20.25	9.95	10.07
Days to 50% flowering	53.71	63	47	54.86	17.05	8.46	8.64
Days to first fruiting	59.85	69	55	52.63	15.56	7.62	7.69
Days to first picking	66.70	77	63	55.02	12.88	6.34	6.44
Plant height (cm)	120.67	150	74	34.19	31.02	15.58	16.13
Number of primary branches /plant	10.77	13.57	8	24.07	29.34	15.36	16.60
Number of flowers /inflorescence	2.58	5.16	1	33.28	90.31	44.04	44.44
Number of fruits / cluster	1.25	2.2	1.4	44.81	56.80	32.21	37.53
Fruit length (cm)	12.34	17.18	7.8	24.18	45.95	23.35	24.44
Fruit girth (cm)	5.40	11.2	2.4	32.47	85.19	41.30	41.35
Stalk length	5.50	8.4	3.3	15.50	36.55	17.82	17.90
Number of calyx / fruit	5.25	6	5	35.78	12.38	6.09	6.18
Number of fruits /picking	1.96	4	4	16.11	80.10	41.65	44.63
Average fruit weight (g)	74.46	130	29	89.77	63.52	31.02	31.20
Total number of fruits / plant	15.67	27	8	82.87	63.37	31.19	31.65
Total fruit yield / plant (g)	1098.83	1347	821	4.79	29.96	14.59	14.63
Marketable fruit yield / plant (g)	893.39	1158	640	13.95	31.58	15.89	15.91
Total soluble solids (%)	4.00	4.97	2.83	14.89	14.75	11.04	16.97