Study about the heritability and Genetic advance in Brinjal (*Solanummelongean* L) for yield

Abstract:

Brinjal is an important vegetable crop grown in India, Asia, and many parts of the world. The primary objective of brinjal breeding is to develop varieties that are resistant to pests and diseases, have higher yields, and better fruit quality.In this study, 10 brinjal varieties were crossed to obtain F1 hybrids. The F1 hybrids were evaluated for yield and yield-related characters. The results showed a wide range of variation for all characters. The estimates of heritability in F1 varied from 45.43% (number of primary branches per plant) to 97.69% (Average Fruit weight). The genetic advance percent over mean for F1 varied from 6.25 % (Number of primary branches per plant) to 62.16 % (Average Fruit weight). Seven characters showed high performance *viz.* Average Fruit weight (62.16%) , Number of Fruit per Plant (50.37%), Fruit yield per plant (49.37), Fruit circumference (35.18), Plant height (32.77), Number of Secondary branches per plant (29.14%) and Fruit length (27.11%); three medium performance viz. Days of 50% Flowering after transplanting (18.09), Days of First Fruit harvest after transplanting (15.35) and Fruit T.S.S (11.92%); one low performance i.e., Number of primary Branches per plant (6.25%). The PCV was higher than GCV indicate the role of environment in performance of characters while value of both have narrow difference indicate the mainly genetic factors is responsible for the performance of the characters of genotypes.High heritability coupled with high genetic advance was found for yield and yield attributing characters, which indicates that selection for these traits will be effective.

Keywords: vegetable crop, heritability, diploid chromosome, brinjal cultivars

INTRODUCTION

Brinjal, also known as eggplant or aubergine, is an important vegetable crop grown in India, Asia, and many parts of the world. It is a member of the Solanaceae family, which also includes tomatoes, potatoes, and peppers. It is scientifically known as *Solanummelongena* with a diploid chromosome number of 2n = 24. The primary center of origin of brinjal is India, and the secondary center of origin is China.

At present, brinjal cultivars belong to three varieties: esculentum (round and egg-shaped), serpentinum (long and slender type), and depressum (all other early dwarf brinjal cultivars).

Brinjal is a good source of vitamins and minerals, including vitamin C, potassium, and dietary fiber. White brinjal is suitable for diabetic patients due to its low caloric value. It is a relatively easy crop to grow and can be cultivated in a variety of climates.

Plant breeding is the process of developing new plant varieties with desirable characteristics. It involves crossing different varieties of plants, selecting for desirable traits in the offspring, and repeating the process until a new variety with the desired characteristics is developed.

The primary objective of brinjal breeding is to develop varieties that are resistant to pests and diseases, have higher yields, and better fruit quality. All breeding activity primarily depends on the basic material or parent used in the breeding program. The material is selected on the basis of breeding direct selection parameters like

genotypic coefficient of variation, phenotypic coefficient of variation, correlation, heritability, and genetic advance.

Materials and Methods

The present study was conducted at the Department of Vegetable Science C. S. Azad University of Agriculture and Technology, Kanpur, Utter Pradesh, India, during the Rabi season of 2022.

10brinjal varieties, viz.,Kalyanpur T-3, Azad B-2, Azad B-3, Azad B-4, Azad Kranti, KS-449, KS-421, KS-451, KS-448 and Azad B-1 were crossed to obtain F1 hybrids. The p F1 generations was evaluated in a randomized block design with three replications. Each plot consisted of five rows of five plants each. The spacing between rows and plants was 60 cm and 45 cm, respectively and performed all agronomical practices as usual.

Five randomly selected plants was used for taking observation on the yield and yield attributing characters viz, days to 50 % flowering after transplanting, Days of First Fruit Harvest after Transplanting, Number of Primary Branches per plant, Number of Secondry Branches per plant, plant height, number of primary branch per plant, number of secondry branches per plant, Number of fruit per plant , Average Fruit weight (g), Fruit weight/yield per plant , Fruit Length, Fruit Circumference and Fruit T.S.S.

The mean overof three replications for each character was subjected to statistical analysis. The phenotypic and genotypic coefficients of variations (PCV and GCV) were estimated by using the formulae suggested by Burton (1952). Heritability in

narrow sense and expected genetic advance were computed by using formulae suggested byCrumpacker& Allard, 1962 and Johnson *et al.*, 1955.

Result and Discussion

A wide range of variation occurred for all characters days to 50 % flowering after transplanting the range was 71 (KS-449) to 46(Azad B-2 x KS 448) with mean of 56., for Days of First Fruit Harvest after Transplanting 71 (Azad Kranti x KS 421

) to 99.33 (Azad B-1) with mean of 84.42, plant height 62.27(Azad B-4 x KS 421

) to 106.13 (Azad Kranti x KS 451) with mean of 80.16, for Number of Primary Branches per plant 2.93 (Azad B-3 x KS 421) to 2.20 (KS-449) with mean of 2.46 , Number of Secondry Branches per plant 6.73 (Azad B-4 x Azad Kranti) to 13.27 (Azad B-3 x KS 449) with mean of 2.46 , Fruit Length 9.75 (Azad B-2) to 18.86 (Kalyanpur T-3 x Azad Kranti) with mean of 13.04, Average Fruit weight (g) 103.27 (Azad B-3 x Azad Kranti) to 427.40 (KS 449 x KS 448) with mean of 232.24, Number of fruit per plant 5.87 (KS-448) to 21.07 (Azad B-3 x Azad Kranti) with mean of 11.20 , , Fruit Circumference 13.33 (KS-451) to 36.17 (KS 449 x KS 448) with mean of 26.98, Fruit T.S.S. 4.20 (Azad B-4) to 5.63 (Azad Kranti x KS 451) with mean of 5.02and Fruit yield per plant 1.34 (KS-451) to 4.03 (Kalyanpur T-3 x Azad Kranti) to 2.51.

The maximum yield was found in 4.03 (Kalyanpur T-3 x Azad Kranti).

The estimate of GCV and PCV for yield and yield related characters were for days to 50 % flowering after transplanting (9.58 and 10.44), Days of First Fruit Harvest after Transplanting (7.90 and 8.39), plant height (16.13 and 16.36) for Number of Primary Branches per plant (16.13 and 16.36), Number of Secondary Branches per plant (14.62 and 15.11) , Fruit Length (13.77 and 14.40), Average Fruit weight

(30.53 and 30.89), Number of fruit per (25.01 and 25.59), Fruit Circumference (17.55 and 18.03), Fruit T.S.S (6.80 and 7.99) and Fruit yield per plant (24.70 and 25.46).

The PCV was higher than corresponding GCV for all the traits which might be due to the interaction of genotypes with the environment to some degree or due to higher influence of environmental factors in the expression of these characters.

Narrow difference between PCV and GCV for the all characters indicated to least environmental variation, suggesting that genetic factors were predominantly responsible for expression of these attributes and selection could be made effectively on the basis of phenotypic performance. This result was in consonance with that of Mohanty and Prusti (2002),Ravali*et al* (2017), Jirankali*et al.*(2019), Dhaka and Soni (2021).If the estimated value of heritability is below 10% it will be said to be having low heritability, while if heritability ranged from 10 – 30 % then medium heritability but if it is greater than 30% it would be highly heritable.

The estimates of heritability in F_1 varied from 45.43% (number of primary branches per plant) to 97.69% (Average Fruit weight).The heritability estimates high for all characters viz. Average Fruit weight (97.69%), Plant height (97.22%), Number of Fruit per plant (95.57%), Fruit circumference (94.72), Fruit yield per plant (94.13%), Number of Secondary branches per plant (93.60%), Fruit length (91.38%), Days of First Fruit harvest after transplanting (88.82%), Days of 50% Flowering after transplanting (84.10%), Fruit T.S.S. (72.38%) and Number of Primary branches per plant (45.43%). The similar report was also found by **Tirkey*et al.*(2018), Ravali*et al.* (2017) ,Yadav*et al.* (2016),**

The expression of genetic advance in percent over mean was calculated for all 11 characters. The arbitrary scale for genetic advance suggested that if

estimated value of genetic advance if less than 10 per cent, it is low, if it is ranged between 10 to 20 per cent, it is medium and above 20 per cent, it is high.

The genetic advance percent over mean for F_1 varied from 6.25 % (Number of primary branches per plant) to 62.16 % (Average Fruit weight). Seven characters showed high performance viz. Average Fruit weight (62.16%) , Number of Fruit per Plant (50.37%), Fruit yield per plant (49.37), Fruit circumference (35.18), Plant height (32.77), Number of Secondary branches per plant (29.14%) and Fruit length (27.11%); three medium performance viz. Days of 50% Flowering after transplanting (18.09), Days of First Fruit harvest after transplanting (15.35) and Fruit T.S.S (11.92%); one low performance i.e., Number of primary Branches per plant (6.25%). This was also observed by Indiresh*et al.* (2020), Sonagara*et al.*(2022), Rathava*et al.* (2021) and Verma*et al.* (2023).

Conclusion

High heritability coupled with high genetic advance was found for Fruit yield per plant, Average Fruit weight, Number of Fruit per Plant, , Fruit circumference, Plant height, Number of Secondary branches per plant and Fruit length, indicates the most likely the characters is governed by additive gene action and selection for such traits will be effective.

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Table 1. Genetic variability parents and F_1

Characters	Mean	Min	Max	var (g)	var (p)	Heritability (%)	GA	GA% mean	GCV (%)	PCV (%)
Days of 50% flowering after TP	56.78	46.00	71.00	29.57	35.16	84.10	10.27	18.09	9.58	10.44
Days of First Fruit Harvest after TP	84.42	71.00	99.33	44.53	50.14	88.82	12.96	15.35	7.90	8.39
Plant Height (cm)	80.16	62.27	106.13	167.21	172.00	97.22	26.27	32.77	16.13	16.36
Number of Primary Branches per plant	2.46	2.20	2.93	0.01	0.03	45.43	0.15	6.25	4.50	6.68
Number of Secondry Branches per plant	9.63	6.73	13.27	1.98	2.12	93.60	2.81	29.14	14.62	15.11
Fruit Length (cm)	13.04	9.75	18.86	3.22	3.53	91.38	3.53	27.11	13.77	14.40
Average Fruit weight (gm)	232.24	103.27	427.40	5027.22	5146.08	97.69	144.36	62.16	30.53	30.89
Number of fruit per plant	11.20	5.87	21.07	7.84	8.21	95.57	5.64	50.37	25.01	25.59
Fruit Circumference (cm)	26.98	13.33	36.17	22.41	23.66	94.72	9.49	35.18	17.55	18.03
Fruit T.S.S.	5.02	4.20	5.63	0.12	0.16	72.38	0.60	11.92	6.80	7.99
Fruit weight per plant (Kg)	2.51	1.34	4.03	0.38	0.41	94.13	1.24	49.37	24.70	25.46

TP: Transplanting

Table 2 Mean performance parents and F1 hybrids

S. No.	Parents/Hybrids	Days of 50% flowering after transplanting	Days of First Fruit Harvest after Transplanting	Plant Height (cm)	Number of Primary Branches per plant	Number of Secondry Branches per plant	Fruit Length (cm)	Average Fruit weight (gm)	Number of fruit per plant	Fruit Circumference (cm)	Fruit T.S.S.	Fruit weight per plant (Kg)
1	Kalyanpur T-3	54.67	84.33	65.75	2.33	8.00	10.73	204.33	9.20	27.01	4.69	1.88
2	Azad B-2	54.33	83.67	79.27	2.40	7.00	9.75	126.73	11.20	25.38	4.51	1.42
3	Azad B-3	58.67	86.33	103.80	2.60	10.40	16.65	135.50	15.87	16.70	4.63	2.00
4	Azad B-4	62.33	87.33	83.07	2.47	8.27	11.53	259.87	9.73	26.93	4.20	2.53
5	Azad Kranti	60.33	89.33	101.07	2.53	10.60	16.71	255.43	19.33	13.45	4.89	3.68
6	KS-449	71.00	91.33	69.07	2.20	8.20	11.79	279.67	7.13	27.02	4.29	1.99
7	KS-421	56.00	88.33	76.47	2.33	9.73	11.10	249.27	8.27	27.50	4.48	2.06
8	KS-451	57.67	80.00	81.07	2.40	9.20	10.88	139.03	9.93	13.33	4.64	1.34
9	KS-448	53.67	88.33	75.41	2.40	9.00	12.26	411.40	5.87	32.61	5.23	2.41
10	Azad B-1	69.33	99.33	70.37	2.47	8.47	11.23	214.07	8.40	26.90	4.47	1.80
	Mean	**59.80**	**87.83**	**80.53**	**2.41**	**8.89**	**12.26**	**227.53**	**10.49**	**23.68**	**4.60**	**2.11**
	Min	**53.67**	**80.00**	**65.75**	**2.20**	**7.00**	**9.75**	**126.73**	**5.87**	**13.33**	**4.20**	**1.34**
	Max	**71.00**	**99.33**	**103.80**	**2.60**	**10.60**	**16.71**	**411.40**	**19.33**	**32.61**	**5.23**	**3.68**
1	Kalyanpur T-3 x Azad B-2	51.67	85.00	73.13	2.33	9.27	15.74	284.60	11.07	27.61	4.29	3.15
2	Kalyanpur T-3 x Azad B-3	53.00	86.00	101.07	2.20	8.40	14.55	216.53	10.87	25.97	4.78	2.44
3	Kalyanpur T-3 x Azad B-4	56.00	79.33	77.23	2.53	10.40	15.16	287.73	11.20	29.85	4.55	3.18
4	Kalyanpur T-3 x Azad Kranti	52.00	85.00	101.59	2.40	9.73	18.86	244.33	16.53	24.54	5.04	4.03

5	Kalyanpur T-3 x KS 449	54.33	78.00	68.67	2.33	8.40	14.19	264.73	10.13	28.23	5.04	2.68
6	Kalyanpur T-3 x KS 421	47.67	84.00	73.07	2.33	10.20	15.34	240.87	11.93	29.52	4.70	2.88
7	Kalyanpur T-3 x KS 451	55.33	81.33	73.53	2.33	8.20	11.25	166.47	11.67	22.66	4.90	1.94
8	Kalyanpur T-3 x KS 448	47.00	81.33	71.20	2.33	9.87	14.31	410.73	8.87	30.30	4.73	3.64
9	Kalyanpur T-3 x Azad B-1	53.33	85.33	77.67	2.47	6.93	12.68	231.80	10.07	29.29	4.98	2.50
10	Azad B-2 x Azad B-3	51.00	93.00	89.80	2.47	8.53	12.02	185.73	12.80	26.75	4.91	2.38
11	Azad B-2 x Azad B-4	57.33	74.00	63.33	2.47	9.60	12.19	279.33	10.53	29.74	4.99	2.94
12	Azad B-2 x Azad Kranti	53.67	81.33	98.93	2.40	7.33	15.03	172.33	15.60	25.24	4.82	2.70
13	Azad B-2 x KS 449	58.00	77.67	69.32	2.47	7.53	15.41	310.20	11.33	28.78	4.37	3.51
14	Azad B-2 x KS 421	48.00	95.00	65.80	2.47	8.33	14.93	231.73	11.60	29.43	4.96	3.33
15	Azad B-2 x KS 451	47.67	97.67	72.27	2.40	8.93	12.98	143.53	10.93	31.61	5.08	1.57
16	Azad B-2 x KS 448	46.00	75.00	72.33	2.53	7.60	11.56	269.60	10.27	34.02	5.63	2.77
17	Azad B-2 x Azad B-1	59.67	85.00	68.09	2.47	11.13	11.70	195.80	10.13	29.53	5.55	1.99
18	Azad B-3 x Azad B-4	59.00	83.00	80.60	2.47	10.40	11.89	233.60	12.53	26.69	5.11	3.08
19	Azad B-3 x Azad Kranti	58.33	83.33	90.60	2.73	11.07	12.00	103.27	21.07	16.53	5.33	2.18
20	Azad B-3 x KS 449	60.00	84.33	81.87	2.47	13.27	13.63	220.00	13.27	25.70	5.15	2.91
21	Azad B-3 x KS 421	54.67	79.00	82.73	2.93	9.87	14.27	186.33	11.07	27.19	5.03	2.07
22	Azad B-3 x KS 451	54.00	75.67	92.60	2.60	12.47	10.87	112.47	12.60	20.69	5.13	1.55
23	Azad B-3 x KS 448	59.00	75.33	101.07	2.60	10.73	11.67	212.27	9.20	27.65	5.10	2.09
24	Azad B-3 x Azad B-1	64.33	89.67	97.07	2.67	9.80	11.83	150.07	11.73	25.79	5.03	1.76
25	Azad B-4 x Azad Kranti	60.33	73.00	96.13	2.47	6.73	11.20	158.67	13.13	25.38	4.89	2.08
26	Azad B-4 x KS 449	62.00	87.67	65.87	2.53	11.87	12.70	280.40	9.47	30.25	5.10	2.66
27	Azad B-4 x KS 421	58.33	90.33	62.27	2.67	8.07	11.99	274.67	10.33	30.70	5.14	2.84
28	Azad B-4 x KS 451	56.00	96.33	76.87	2.33	9.40	11.94	173.07	10.47	29.63	5.12	1.81
29	Azad B-4 x KS 448	62.00	88.00	75.20	2.40	10.73	12.54	298.73	9.87	33.94	5.41	2.94
30	Azad B-4 x Azad B-1	65.00	90.67	65.87	2.40	10.27	13.58	264.87	9.87	28.32	5.43	2.62
31	Azad Kranti x KS 449	58.33	76.33	102.87	2.60	9.00	16.80	210.87	15.07	23.39	5.28	3.18
32	Azad Kranti x KS 421	60.67	71.00	96.17	2.47	10.20	14.22	177.33	17.13	22.91	5.62	3.17
33	Azad Kranti x KS 451	49.33	83.67	106.13	2.60	9.93	14.01	119.67	11.87	20.53	5.63	1.42

34	Azad Kranti x KS 448	54.00	84.00	101.27	2.53	10.80	13.87	204.53	10.13	25.17	5.61	2.07
35	Azad Kranti x Azad B-1	69.00	91.33	96.20	2.40	10.53	13.85	173.47	12.00	24.45	5.44	2.08
36	KS 449 x KS 421	60.67	91.67	72.33	2.60	10.40	12.11	260.67	9.33	31.69	5.21	2.53
37	KS 449 x KS 451	60.33	72.00	72.53	2.33	11.13	12.58	213.07	10.80	31.00	4.86	2.68
38	KS 449 x KS 448	57.33	75.33	70.53	2.47	11.67	13.15	427.40	8.27	36.17	5.10	3.54
39	KS 449 x Azad B-1	63.33	89.33	76.53	2.53	11.00	11.87	256.67	9.27	32.88	5.20	2.38
40	KS 421x KS 451	49.33	90.67	71.27	2.33	11.20	12.64	202.87	10.40	31.26	5.26	2.11
41	KS 421x KS 448	53.00	73.00	62.47	2.40	9.27	12.46	298.20	9.47	30.69	5.34	2.89
42	KS 421x Azad B-1	61.33	91.33	68.73	2.27	10.13	12.47	269.33	9.40	29.79	5.27	2.53
43	KS 451x KS 448	49.33	81.33	75.80	2.53	10.33	12.41	295.40	8.27	23.21	5.34	2.45
44	KS 451x Azad B-1	57.33	84.33	71.13	2.47	9.27	11.65	257.67	10.60	21.89	5.42	2.73
45	KS 448 x Azad B-1	56.67	89.00	73.47	2.33	10.87	12.55	326.33	8.80	30.43	5.05	2.86
	Mean F1	**56.70**	**84.31**	**80.07**	**2.46**	**9.71**	**13.15**	**234.24**	**11.33**	**27.42**	**5.07**	**2.57**
	Min	46.00	71.00	62.27	2.20	6.73	9.75	103.27	5.87	13.33	4.20	1.34
	Max	71.00	99.33	106.13	2.93	13.27	18.86	427.40	21.07	36.17	5.63	4.03
	Mean Gen	**56.78**	**84.42**	**80.16**	**2.46**	**9.63**	**13.04**	**232.24**	**11.20**	**26.98**	**5.02**	**2.51**
	Min	46.00	71.00	62.27	2.20	6.73	9.75	103.27	5.87	13.33	4.20	1.34
	Max	71.00	99.33	106.13	2.93	13.27	18.86	427.40	21.07	36.17	5.63	4.03
	SE(d) ±	1.93	1.93	1.79	0.10	0.30	0.45	8.90	0.49	0.91	0.17	0.13
	C.D. at 5%	3.83	3.84	3.55	0.20	0.60	0.89	17.67	0.98	1.81	0.34	0.25
	C.V. (%)	4.16	2.81	2.73	4.93	3.82	4.23	4.69	5.39	4.14	4.20	6.17