The Pharma Innovation Journal 2022; SP-11(11): 231-235

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(11): 231-235

www.thepharmajournal.com
Received: 08-09-2022
Accepted: 12-10-2022

Azra Lateef
SRF, Department of Vegetable Science, ICAR–CITH, Srinagar, Jammu and Kashmir, India

MI Makhdoomi
Associate Professor, Department of Vegetable Science, SKUAST–K, Srinagar, Jammu and Kashmir, India

Taibah Bashir
Post Student, Department of Entomology, SKUAST–K, Srinagar, Jammu and Kashmir, India

Insha Hamid
Post Student, Department of Entomology, SKUAST-K, Jammu and Kashmir, India

Saima Farooq
Post Young Professional, Department of Vegetable Science, ICAR-CITH, Srinagar, Jammu and Kashmir, India

Corresponding Author:
Azra Lateef
SRF, Department of Vegetable Science, ICAR–CITH, Srinagar, Jammu and Kashmir, India

Cluster analysis and percent contribution of individual traits towards total genetic divergence in brinjal

Azra Lateef, MI Makhdoomi, Taibah Bashir, Insha Hamid and Saima Farooq

Abstract
The genetic divergence study was conducted in 50 genotypes of Brinjal (*Solanum melongena* L.) for 19 agro-morphological traits. Significant divergence existed among all the 50 genotypes with respect to various quantitative and qualitative traits. The genotypes under study were grouped into 11 clusters as per Mahalanobis D^2 (1928) analysis employing Tochers method with maximum number of genotypes in cluster I (32) followed by cluster IV(9), and rest of the clusters were monogenotypic. The percent contribution towards the total genetic divergence revealed that fruit yield, plant height, plant spread, dry matter, anthocyanin content were the main contributing characters towards total genetic divergence. The crosses between the genotypes of cluster VIII with VII and III and cluster XI with those of VIII, VI and IX are likely to exhibit high heterosis and produce recombinants with desired traits in segregating generations. The genotypes selected on the basis of *per se* performance of fruit yield, yield contributing and quality traits can be used in Brinjal improvement programme as elite germplasm lines or may be recommended for commercial cultivation after testing them over years and locations.

Keywords: Agro-morphological traits, *Solanum melongena* L. brinjal, d^2statistic, genetic divergence

Introduction
Brinjal, native to India (Tsao and Lo, 2006; Doijode, 2001) [6, 2], is among the most common, popular, and a very important common man's vegetable in India. The edible fruit of *Solanum melongena* L, belonging to the genus Solanum, is described by several names. It is the second largest vegetable crop in India. The annual production of 12 million tons amounts to one quarter of the global production (Choudary and Gaur, 2012) [7]. Brinjal is a versatile crop, adapted to different agro-climatic regions and grown throughout the year and throughout the country. It is primarily grown by small farmers and holds a coveted position as it is an important source of income for them. It ranks as the second most consumed vegetable in India after potato.

As an initial step to develop high yielding and superior quality Brinjal varieties for cultivation under temperate conditions of Kashmir valley, it is imperative to evaluate a large number of existing genotypes. These genotypes must have been selected on the basis of their per se performance from diverse sources. Superior genotypes are selected and used as parents in hybridization programmes. However, the selection of superior parents from a large number of genotypes is a difficult task to perform. Genetic divergence analysis among genotypes is helpful to screen the genetically diverse parents that are likely to produce high hetero tic effects among crosses and also generate large spectrum of variability during segregation and recombination of genes at heterozygous polygenic blocks. Multivariate technique using D2 statistics (Mahalanobis, 1928) [5] is a powerful tool in quantifying the parents showing wide genetic divergence are best suited for being used in the hybridization programme degree of divergence among the genotypes. This would help to identify putative parents for executing an effective breeding strategy to obtain high hetero tic response and transgressed sergeants. Estimation of genetic divergence helps in reducing the large data of genotypes to manageable proportions.

Materials and Methods
In the present investigation, fifty diverse lines/genotypes of Brinjal (Table 1), maintained by the Division of Vegetable Science, SKUAST-K Shalimar Srinagar. The Genotypes were evaluated for various yield and yield attributing traits at the Experimental fields of the Division of Vegetable science, during Kharif 2015.

The experiment was laid in Random Complete Block Design with three replications. The plots of size 2.4 × 1.8 m (4.32 m2), consisted of 3 rows of each genotype in each replication at spacing of 45 x 45 cm. Observations were recorded on five randomly selected plants for each entry per replication. The genetic divergence was calculated using multivariate technique Mahalanobis (1928) [5] D2 statistics by employing Tocher's method (Rao, 1952) [8].

Table 1: Brinjal (*Solanum melongena* L.) genotypes used in the present study

S. No.	Genotype	Source	S. No.	Genotype	Source	S. No.	Genotype	Source
1.	SK-BL-01	SKUAST-KASHMIR	23.	SK-BL-23	SKUAST-KASHMIR	45.	SK-BL-45	SKUAST-KASHMIR
2.	SK-BL-02		24.	SK-BL-24		46.	SK-BL-46	
3.	SK-BL-03		25.	SK-BL-25		47.	SK-BL-47	
4.	SK-BL-04		26.	SK-BL-26		48.	SK-BL-48	
5.	SK-BR-05		27.	SK-BL-27		49.	SK-BL-49	
6.	SK-BL-06		28.	SK-BL-28		50.	SK-BL-50	
7.	SK-BL-07		29.	SK-BL-29				
8.	SK-BL-08		30.	SK-BL-30				
9.	SK-BL-09		31.	SK-BR-31				
10.	SK-BL-10		32.	SK-BL-32				
11.	SK-BL-11		33.	SK-BR-33				
12.	SK-BL-12		34.	SK-BL-34				
13.	SK-BL-13		35.	SK-BL-35				
14.	SK-BL-14		36.	SK-BR-36				
15.	SK-BL-15		37.	SK-BL-37				
16.	SK-BL-16		38.	SK-BL-38				
17.	SK-BL-17		39.	SK-BL-39				
18.	SK-BL-18		40.	SK-BL-40				
19.	SK-BL-19		41.	SK-BL-41				
20.	SK-BL-20		42.	SK-BL-42				
21.	SK-BL-21		43.	SK-BL-43				
22.	SK-BL-22		44.	SK-BL-44				

Result and Discussion

Analysis of variance for dispersion revealed that the genotypes expressed significant variability for various traits under study. Based upon the performance of genotypes, 50 brinjal genotypes were grouped into eleven clusters (Fig.) as per Mahalanobis D2 analysis employing Tochers method (Rao, 1952) [8]. The cluster diagram (Fig.) indicated that the maximum number of genotypes fall in cluster I (32) followed by cluster IV (9), and cluster II, cluster III, cluster V, cluster VI, cluster VII, cluster VIII, cluster IX, cluster X, and cluster XI (one each).

Cluster means for different characters (Table-2 and 3) revealed that cluster I having maximum genotypes (32), took 48.63 days to first flower, 54.75 days to first fruit set, 69.59 days to first fruit picking. The average plant height and plant spread was 44.00 and 30.41 cm respectively. The average number of branches plant-1 were 4.14. The average fruit length was 13.43 cm with an average fruit diameter of 4.03 cm. Average fruit weight was 73.86g with an average fruit yield plant-1 of 290 g. Number of fruits plant-1 was 3.88 and number of pickings plant-1 2.21. The average dry matter, average vitamin C, Anthocyanin content, TSS content were 8.14, 1.94, 1.49 and 5.26 respectively (Patel, 2003) [9]. The mean of the traits in cluster II, that consisted of one genotype, was 49.40 days (days to first flower), 55.53 days (days to first fruit set), 67.53 days (days to first fruit picking), 37.60 cm (plant height), 57.80cm (plant spread), 3.43 (number of branches plant-1), 11.2 cm (fruit length), 4.41cm (fruit diameter), 73.86g (average fruit weight), 3.88 (number of fruits plant-1), 288 g (fruit yield plant-1), 2.20 (number of pickings plant-1), 8.23mg/100g (dry matter content) 2.20 (Vitamin C content), 1.62(Anthocyanin) and 5.50 (TSS). Cluster III constituted of only one genotype with a mean of traits as 45.53 days (days to first flower), 53.20 days (days to first fruit set), 67.60 days

(days to first fruit picking), 39.07 cm (plant height), 59.13 cm (plant spread), 5.40 (number of branches plant-1), 16.13 cm (fruit length), 5.08cm (fruit diameter), 72.31g (average fruit weight), 3.67 (number of fruits plant-1s), 312 g (fruit yield plant-1), 2.13 (number of pickings plant-1), 9.28 (dry matter), 1.75 (vitamin C), 1.44 (Anthocyanin) and 5.47 (TSS). (Murty and Qadri, 1966) [4]

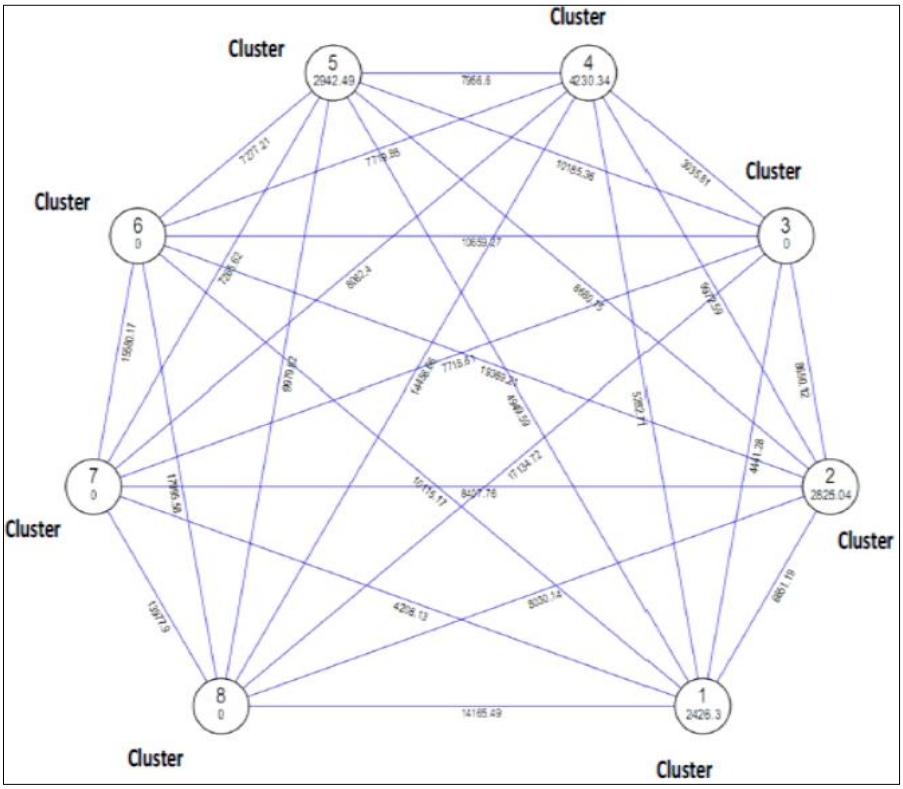

Fig 1: Cluster

Cluster IV consisting of 9 genotypes possessed an average of 62.88cm for plant height, 53.06cm for plant spread, 5.16 for number of branches, 15.13 for fruit length, 4.12 cm for fruit diameter and 4.71 for number of fruits plant-1. The genotypes possessed an average fruit weight of 60.60g with an average fruit yield plant-1 of 253 g. The average number of pickings plant-1, average dry matter, vitamin C, Anthocyanin and TSS were 2.41, 8.06, 2.05, 1.39 and 5.39 respectively. These genotypes took 47.22 days to first flower, 53.48 days to first fruit set and 67.23 days to first picking.

Table 2: Cluster means for various characters in different clusters of brinjal (*Solanum melongena* L) genotypes

S. No.	Cluster	Days to first flower	Days to first fruit set	Days to first fruit picking	Plant height (cm)	Plant spread (cm)	Number of branches per plant	Fruit length (cm)	Fruit diameter (cm)
1.	I	48.63	54.75	69.59	44.00	30.41	4.14	13.43	4.03
2.	II	49.40	55.53	67.53	37.60	57.80	3.43	11.20	4.41
3.	III	45.53	53.20	67.60	39.07	59.13	5.40	16.13	5.08
4.	IV	47.22	53.48	67.23	62.88	53.06	5.16	15.13	4.12
5.	V	47.67	52.53	66.40	57.13	32.00	3.67	13.27	5.54
6.	VI	42.37	47.80	62.47	32.47	33.87	3.47	14.40	5.47
7.	VII	52.07	56.07	73.00	30.93	62.53	8.60	13.43	3.87
8.	VIII	48.00	53.73	70.00	42.80	33.53	3.80	12.73	5.03
9.	IX	47.47	53.33	69.40	57.87	72.87	5.07	20.20	4.91
10.	X	48.80	54.93	67.73	55.13	67.60	7.93	15.20	2.73
11.	XI	52.67	59.00	73.53	80.60	28.00	15.67	15.50	4.64

Table 3: Cluster means for various characters in different clusters of brinjal (*Solanum melongena* L) genotypes

S. No.	Cluster	Average fruit weight (g)	Number of fruits per plant	Fruit yield per plant (g)	Number of pickings per plant	Dry matter content	Vitamin C	Anthocyanin	TSS
1.	I	73.86	3.88	290	2.21	8.14	1.94	1.49	5.26
2.	II	75.61	3.87	288	2.20	8.23	2.20	1.62	5.50
3.	III	72.31	3.67	312	2.13	9.28	1.75	1.44	5.47
4.	IV	60.60	4.71	253	2.41	8.06	2.05	1.39	5.39
5.	V	85.59	3.53	286	2.20	7.62	2.24	1.28	5.80
6.	VI	72.36	4.40	312	2.40	8.38	1.85	1.71	5.47
7.	VII	76.95	3.60	315	2.13	7.19	1.94	1.53	5.50
8.	VIII	58.48	4.27	250	2.27	8.21	2.07	1.58	5.50
9.	IX	56.32	4.07	271	2.07	9.12	2.17	1.97	5.43
10.	X	72.86	4.61	273	2.31	7.44	2.18	1.83	5.47
11.	XI	74.83	4.40	283	2.47	9.19	1.48	1.56	5.67

Cluster V consisted of 1 genotypes with a mean of traits as 47.67 days (days to first flower), 52.53 days (days to first fruit set), 66.40 days (days to first fruit picking), 57.13 cm (plant height), 32 cm (plant spread), 3.67 (number of branches plant-1), 13.27cm (fruit length), 5.54 cm (fruit diameter), 85.59 g (average fruit weight), 3.53 (number of fruits plant-1), 286 g (fruit yield plant-1), 2.20 (number of pickings plant-1), 7.62 (dry matter content), 2.24 (vitamin C), 1.28 (Anthocyanin) and 5.80 (TSS). Cluster VI also included one genotype with a mean of traits as 42.37 days (days to first flower), 47.80 days (days to first fruit set), 62.47 days (days to first fruit picking), 32.47cm (plant height), 33.87 cm (plant spread), 3.47 (number of branches plant-1), 14.40 cm (fruit length), 5.47 cm (fruit diameter), 72.37 g (average fruit weight), 4.40(number of fruits plant-1), 312 g (fruit yield plant-1), 2.40 (number of pickings plant-1), 8.38(dry matter content), 1.85 (vitamin C), 1.71 (Anthocyanin) and 5.47 (TSS).Cluster VII consisted of 1 genotypes with a mean of traits as 52.07 days (days to first flower), 56.07days (days to first fruit set), 73 days (days to first fruit picking), 30.93 cm (plant height), 62.53 cm (plant spread), 8.60 (number of branches plant-1), 13.43cm (fruit length), 3.87cm (fruit diameter), 76.59 g (average fruit weight), 3.60 (number of fruits plant-1), 315 g (fruit yield plant-1), 2.13 (number of pickings plant-1), 7.19 (dry matter content), 1.94 (vitamin C), 1.53(Anthocyanin) and 5.50 (TSS). Cluster VIII consisted of 1 genotypes with a mean of traits as 48 days (days to first flower), 53.73 days (days to first fruit set), 70 days (days to first fruit picking), 42.80 cm (plant height), 33.53 cm (plant spread), 3.80 (number of branches plant-1), 12.73 cm (fruit length), 5.03 cm (fruit diameter), 58.48 g (average fruit weight), 4.27 (number of fruits plant-1), 250 g (fruit yield plant-1), 2.27 (number of pickings plant-1), 8.21(dry matter content), 2.07 (vitamin C), 1.58 (Anthocyanin) and 5.50 (TSS). Cluster IX consisted of 1 genotypes with a mean of traits as 47.47 days (days to first flower), 53.33 days (days to first fruit set), 69.40 days (days to first fruit picking), 57.87 cm (plant height), 72.87cm (plant spread), 5.07 (number of branches plant-1), 20.20 cm (fruit length), 4.91 cm (fruit diameter), 56.32 g (average fruit weight), 4.07 (number of fruits plant-1), 271 g (fruit yield plant-1), 2.07 (number of pickings plant-1), 9.12(dry matter content), 2.17 (vitamin C), 1.97(Anthocyanin) and 5.43 (TSS).Cluster X consisted of 1 genotype with a mean of traits as 48.80 days (days to first flower), 54.93 days (days to first fruit set), 67.73 days (days to first fruit picking), 55.13 cm (plant height), 67.60 cm (plant spread), 7.93 (number of branches plant-1), 15.20 cm (fruit length), 2.73 cm (fruit diameter), 72.86 g (average fruit weight), 4.61 (number of fruits plant-1), 273 g (fruit yield plant-1), 2.31 (number of pickings plant-1), 7.44(dry matter content), 2.18 (vitamin C), 1.83 (Anthocyanin) and 5.47 (TSS). Cluster XI consisted of 1 genotype with a mean of traits as 52.67 days (days to first flower), 59 days (days to first fruit set), 73.53 days (days to first fruit picking), 80.60 cm (plant height), 28 cm (plant spread), 15.67 (number of branches plant-1), 15.50 cm (fruit length), 4.64 cm (fruit diameter), 74.83 g (average fruit weight), 4.40 (number of fruits plant-1), 283 g (fruit yield plant-1), 2.47 (number of pickings plant-1), 9.19 (dry matter content), 1.48 (vitamin C), 1.56 (Anthocyanin) and 5.67 (TSS) (Arunkumar, 2013) [1]

The percent contributions of the traits towards total genetic divergence (Table-4) revealed that fruit yield was the main factor contributing to divergence accounting for 32.67% followed by plant height (24.50%), plant spread (13.07%), dry matter (6.12%), Anthocyanin (4.65%), fruit length (4.57%), average fruit weight (359%), Vitamin C (3.26), number of branches plant-1 (2.22%) and days to first fruit picking (1.47), days to first flower (4.01%), and fruit diameter (2.88%). The minimum contribution towards divergence was from days to first flower (0.57%) followed by number of fruits plant-1 (0.41%) and fruit diameter, days to first fruit set and TSS (0.08) each. (Mehta and Sahu, 2004) [3]

Table 4: Percent contribution of individual traits towards total genetic divergence

S. No.	Traits	Contribution (%)
1.	Fruit yield	32.67
2.	Plant height	24.50
3.	Plant spread (cm)	13.07
4.	Dry matter	6.12
5.	Anthocyanin content	4.65
6.	Average fruit weight	3.59
7.	Number of branches per plant	2.22
8.	Fruit diameter (cm)	0.08
9.	Days to first fruit flower	0.57
10.	Days to first fruit set	0.08
11.	Number of fruits per plant	0.41
12.	TSS	0.08
13.	Days to first fruit picking	1.47
14.	Fruit length	4.57
15.	Number of pickings per plant	2.69
16.	Vitamin C content	3.26

Conclusion

Cluster means for different growth characters revealed substantial genetic variability for all the traits. The mean values were maximum mostly in those clusters containing genotypes having high values for the traits contributing maximum towards divergence i.e. plant spread, fruit diameter, average fruit weight, number of fruits plant-1, and number of pickings plant-1. Thus these characters *viz*., plant spread, fruit diameter, number of fruits plant-1, average fruit weight and number of pickings plant-1 should be given priority over other traits for selecting high yielding genotypes. The genotypes SK-BL-19, SK-BL-17, SK-BL-01, were proven superior with respect to total fruit yield and most of its contributing traits hence these genotypes can be used in Brinjal improvement programme as elite germplasm lines or may be recommended for commercial cultivation after testing them over years and locations. Selection of parents from (i) most divergent clusters (ii) having high cluster means and (iii)

showing high performance can be used in hybridization programme for development of high yielding varieties.

References

1. Arunkumar B, Kumar SVS, Prakash CG. Genetic variability and divergence studies in brinjal (*Solanum melongena* L). Bioinfolet. 2013;10:739-744.
2. Doijode SD. Seed storage of horticultural crops; c2001 .p. 157. Haworth Press: ISBN 1-56022-901-2
3. Mehta N, Sahu M. Genetic diversity in brinjal (Solanum melongena L.), Vegetable Science. 2004;31(2):142-145.
4. Murty BR, Qadri MI. Analysis of divergence in some self-compatible forms of Brassica compestris var. Brown sarson. The Indian Journal of Genetics and Plant Breeding. 1966;26:45-55.
5. Mahalanobis PC. A statistical study of Chinese head measurement. Man in India. 1928;8:32-64.
6. Tsao Lo. In Vegetables: Types and Biology. Handbook of Food Science, Technology, and Engineering by Yiu H. Hui.CRC Press. ISBN 1- 57444-551- 0. Zoological Researches. 2006;19(1):42-45.
7. Choudhary B, Gaur K. The Status of Commercialized Bt Brinjal in Bangladesh. ISAAA Brief No. 47. ISAAA: Ithaca NY; c2012.
8. Rao CR. Advanced Statistical Methods in Biometrical Research. Wiley and Sons, New York; c1952.
9. Patel KK, Sarnaik DA, Asati BS, Tirkey T. Studies on variability, heritability and genetic advance in brinjal (*Solanum melongena* L.). Agric. Sci. Digest. 2003;24(4):256-259.