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GENETIC DIVERSITY IN BRINJAL (*SOLANUM MELONGENA* L.) UNDER TEMPERATE HILLS OF UTTARAKHAND, INDIA

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Abstract

Genetic divergence among 21 genotypes of egg plant (*Solanum melongena* L.) estimated using Mahalanobis's D^2 statistics. The 21 genotypes were grouped into six clusters. The cluster IV was longest with 7 genotypes. Cluster III consisted of 4 genotypes. Whereas clusters I, II and V consisted of 3 genotypes in each. The cluster VI had only one genotype. The highest and lowest intra-cluster distance in cluster IV (628.54) and cluster I (93.87). Maximum inter-cluster genetic distance was between cluster V and cluster VI (3041.06), while it was the minimum between cluster II and cluster III (778.03). Cluster V (Punjab Nagini, Pusa Shyamal and Azad B-3) exhibited highest cluster mean for plant height at 50% flowering (51.67 cm), fruit length (20.33 cm), number of fruits per plant (31.82), number of pickings (6.00) and fruit yield per plant (1.57 kg). Fruit weight (31.90%), number of pickings and fruit yield per plant (14.29%), leaf area and fruit volume (12.86%), number of fruits per plant (4.76%), plant height at last picking (4.29%) and dry matter content (1.90%) had the highest contribution towards total divergence. Therefore, more emphasis should be given on cluster VI (JBGR-1) for selecting genotype as parent for crossing with the genotypes of cluster V, II and III are recommended for further hybrid breeding programmes in mid hills of Uttarakhand.

Key words : Genetic diversity, brinjal (*Solanum melongena* L.) and cluster analysis.

Introduction

Brinjal is a self-pollinated crop, but cross-pollination has been reported as high as 48%. This is because it has pronounced heterostyly, which favours cross pollination. Fruit setting in long styled flowers varies from 70% to 86.70% in different varieties. In medium styled flowers, fruit set ranges from 12.5% to 55.60%. Egg plant has been used in traditional medicines for treatment of asthma, bronchitis, cholera, dysuria and lowering blood cholesterol (Khan, 1979). The Indian Standards Institution (ISI) has recommended three grades of brinjal fruits, *viz*., super, fancy and commercial (Choudhury, 1976a). Earlier, brinjal cultivation was not practiced in the temperate hills but due to rise in temperature during last couple of decades this region has become ideal place for cultivation of brinjal. The period of April to September is suitable for longevity of this crop with remunerative yield of good quality fruits devoid of infestation of insect like borers. The crop during these months remains free from invasion of foliar or fruit diseases, however, bacterial wilt is common in certain pockets with acidic soils. The cultivars selected should have specific features like quick growth, early and flush bearing so that satisfactory yield could be obtained before onset of low temperature. Some hybrids have been found to assume these traits although the number of such hybrids suitable for rainfed mid hill regions is meagre. Therefore, evolution of suitable hybrids for this region is indispensable. The genetic divergence studies could be helpful in selection of parents for evolving heterotic hybrids with desirable traits. Fruit yield of brinjal is a polygenic in nature and is influenced by environmental factors. This crop having a greater genetic variation with regard to fruit yield and its components. Mahalanobis D^2 techniques as described by Rao (1952) appears to be a fruitful approach which is based on multivariate analysis and serves to be a good index of genetic diversity. The use of Mahalanobis D^2 statistics for estimating genetic divergence have been emphasized by many workers Patil *et al*. (1994) and Mishra *et al*. (1998) because it permits precise comparison among all possible pairs of population in any given group effecting actual crosses. For the improvement of crop genetic diversity is quite essential for any breeding programme. Existence of large variability among the genotypes necessitates further analysis of

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Table 1: Clustering pattern of 21 genotypes of brinjal on the basis of genetic divergence

Cluster	Number of genotypes	Genotypes	Sources
I	3	DBL-329,Utkal Tarni, Utkal keshri	IARI, New Delhi, OUA&T, Bhubaneswar, OUA&T, Bhubaneswar
II	3	Swarna Avilamb, NDB-3,Pant Samrat	ICAR Research Centre, Ranchi, NDUA&T, Faizabad, GBPUA&T, Pantnagar
III	4	Arka Shirish, Utkal Madhuri, Swarna Shoba, CH-10-45	IIHR, Bangalore, OUA&T, Bhubaneswar, ICAR Research Centre, Ranchi, IIVR,Varanasi
IV	7	Uttara, PR-5, Mukta Keshri, GOB -1, Azad T-3, Annamalai, Brinjal Local Long	IIVR,Varanasi, Century Seeds, New Delhi, IIVR, Varanasi, CSAUA&T, Kanpur, Vegetable Research Station, Tamil Nadu, IIVR,Varanasi
V	3	Punjab Nagini, Pusa Shyamal, Azad B-3	PAU, Ludhiana, IARI, New Delhi, CSAUA&T, Kanpur
VI	1	JBGR-1	IIVR,Varanasi

Table 2 : Intra (diagonal) and inter cluster distance $\sqrt{D^2}$ values among 21 genotypes of brinjal (*Solanum melongena* L.).

	I	II	III	IV	V	VI
I	93.87	363.17	291.56	672.75	561.24	1919.90
II		134.70	778.03	1291.00	611.35	2675.81
III			228.45	806.99	609.32	2240.75
IV				628.54	1282.79	1009.70
V					469.14	3041.06
VI						0.000

genetic divergence (Mehta *et al*., 2004).

Materials and Methods

The experiment was carried out during the *kharif* season of 2013 at Vegetable Research Block of Department of Vegetable Science, Uttarakhand University of Horticulture and Forestry, Ranichauri Campus (30° 18' N latitude and 78° 24' E longitude at an elevation of 2000 m), Tehri Garhwal (Uttarakhand), India. Seeds of twenty one genotypes (Arka Shirish, Utkal Madhuri, DBL-329, Uttara, JBGR-1, Azad T-3, Azad B-3, Utkal Keshri, Punjab Nagini, Swarna Avilamb, Pusa Shyamal, GOB-1, CH-10-45, NDB-3, Annamalai, Brinjal Local Long, Pant Samrat, Mukta Keshri, PR-5, Swarna Shoba and Utkal Tarni) were sown in different rows on a raised bed nursery followed by normal nursery practices. The experiment was laid out in randomized block design with three replications at the spacing of 60 cm and 45 cm between rows and plants, respectively. All the recommended cultural practices were followed to raise a healthy crop and data were recorded for sixteen plant growth and fruit yield characters *viz*., days to 50% flowering, plant height at 50% flowering (cm), number of branches per plant, leaf area (cm^2), flowers per cluster, fruits per cluster, fruit setting percentage (%), fruit length (cm), fruit diameter (cm), fruit volume (cm^3) number of fruits per plant, average fruit weight (g), plant height at last picking (cm), dry matter content (%), number of pickings and fruit yield per plant (kg). The data thus obtained were analyzed statistically for composition of clusters, intra-and inter cluster genetic distance (vD^2), cluster means and contribution of different characters to total divergence using Mabalanobis D^2 statistic as described by Rao (1952).

Results and Discussion

All the 21 genotypes were grouped into six clusters (table 1) based on Mahalanobis D^2 values. The clustering pattern did not necessarily bear any relevance with the geographical origin of the test germplasm as indicated in the present study. The observation was in conformity with the results obtained by Doshi *et al*. (1998), Sharma *et al*. (2000), Mohanty and Prusty (2000), Sharma and Maurya (2004) and Senapati *et al*. (2009) in brinjal.

The highest and lowest intra-cluster distance was noted in cluster IV (628.54) and cluster I (93.87), respectively. High intra-cluster distance indicated genetic heterogeneity among the genotypes included in the same cluster. Maximum inter-cluster genetic distance was observed between cluster V and cluster VI (3041.06) followed by cluster II and cluster VI (2675.81) (table 2). The clusters with higher inter-cluster distances indicated that the genotypes included in those clusters had high genetic variation and hybridization between genotypes of these cluster may result heterotic hybrids because of convergence of diverse genes scattered in parents to progeny.

Selection of genotypes belonging to clusters with

Table 3: Intra cluster group means for various components of fruit yield in brinjal (*Solanum melongena* L.)

S. No.	Characters	Cluster Means					
		I	II	III	IV	V	VI
1.	Days to 50 % flowering	68.11	62.77	67.41	65.00	54.00	65.66
2.	Plant height at 50 % flowering (cm)	45.01	42.28	41.97	48.15	51.67	45.66
3.	Number of branches per plant	11.81	10.26	10.11	10.96	11.80	8.26
4.	Leaf area (cm^2)	198.70	182.14	180.63	179.67	129.59	189.00
5.	Flowers per cluster	5.67	5.73	4.16	3.01	4.20	2.86
6.	Fruits per cluster	3.06	4.41	2.31	1.95	3.05	1.90
7.	Fruit setting percentage (%)	54.42	77.40	57.46	65.64	70.40	66.21
8.	Fruit length (cm)	16.38	18.60	17.89	15.14	20.33	14.33
9.	Fruit diameter (cm)	5.59	3.66	7.21	6.05	4.68	8.26
10.	Fruit volume (cm^3)	90.66	49.51	195.00	134.30	115.55	112.00
11.	Number of fruits per plant	18.23	31.42	12.09	9.60	31.82	2.6
12.	Average fruit weight (g)	68.55	28.22	81.19	129.19	54.22	192.66
13.	Plant height at last picking (cm)	78.63	73.44	69.39	81.36	79.58	76.433
14.	Dry matter content (%)	10.70	8.42	10.75	10.24	8.16	8.67
15.	Number of pickings	4.33	5.42	4.33	3.33	6.00	1.16
16.	Fruit yield per plant (kg)	1.26	0.87	1.08	1.22	1.57	0.45

Table 4 : Contribution of different plant growth and fruit yield characters to total divergence in brinjal (*Solanum melongena* L.).

S. no.	Characters	No. of times appearing first in ranking	Percent contribution
1.	Days to 50 % flowering	0.01	0.00
2.	Plant height at 50 % flowering (cm)	1	0.48
3.	Number of branches per plant	1	0.48
4.	Leaf area(cm^2)	27	12.86
5.	Flowers per cluster	1	0.48
6.	Fruits per cluster	0.01	0.00
7.	Fruit setting percentage (%)	1	0.48
8.	Fruit length (cm)	1	0.48
9.	Fruit diameter (cm)	1	0.48
10.	Fruit volume (cm^3)	27	12.86
11.	Number of fruits per plant	10	4.76
12.	Average fruit weight(g)	67	31.90
13.	Fruit yield per plant (kg)	30	14.29
14.	Plant height at last picking (cm)	9	4.29
15.	Dry matter content (%)	4	1.90
16.	Number of pickings	30	14.29

higher inter-cluster distance for hybridization had also been proposed by Mehta *et al*. (2004), Prabakaran (2010); Shinde *et al*. (2012) and Mishra *et al*. (2013) in brinjal. The cluster V had maximum cluster means for most of yield contributing characters *viz*., fruit yield per plant (1.57 kg), number of fruits per plant (31.82), fruit length (20.33 cm) and number of branches (11.80) (table 3). Therefore, hybridization of the genotypes included in this cluster with those included in the genetically most divergent cluster VI could lead to convergence of many desirable genes in progeny. Many earlier workers *e.g*. (Mehta *et al*., 2004; Senapati *et al*., 2009; Quamruzzaman *et al*., 2009; Islam *et al*., 2011 and Kumar *et al*., 2013) were also of similar opinion.

The relative contribution of different quantitative characters depicted that fruit weight contributed maximum (31.90%) towards genetic divergence followed by fruit yield per plant (14.29%) and fruit volume (12.86%) (table 4). These traits should be considered to be the most important characters for studies on genetic diversity point of view. The observations were in conformity with the result obtained by Senapati *et al*. (2009) and Kumar *et al*. (2013) in brinjal.

Conclusion

Based on high inter-cluster distance between cluster V with cluster VI, cluster II and cluster VI,

the genotypes JBGR-1 of cluster VI could be expected to give heterotic hybrid when crossed with genotypes of cluster V, and cluster II and as such JBGR-1 × Punjab Nagini, JBGR-1 × Pusa Shyamal, JBGR -1 × Azad B-3, JBGR -1 × Swarna Avilamb, JBGR-1 × NDB-3 and JBGR-1 × Pant Samrat are recommended for further hybrid breeding programmes in mid hills of Uttarakhand.

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