Studies on Genetic Diversity for Growth, Yield and Quality Traits in Chilli (*Capsicum annuum* L.)

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The genetic diversity was studied in 30 genotypes of chilli using 14 quantitative traits. D^2 analysis using Tocher's method resulted in eight clusters representing the genetic diversity among the genotypes studied. The cluster I (ACS 2000-02, Green Wonder, Motikeera 39) representing genotypes with highest fruit length, fruit width, fruit weight and ascorbic acid could be selected if the aim of the breeding programme is to improve any of these traits. The cluster VIII having a single genotype Pusa Sadabahar, possesses either higher or lower value for most of the traits, justifying its inclusion as a separate cluster. Cluster VII (DCL 228, DCL 335, DCL 901, DCL 001, DCL 268, Red Star, Soldier, DCL 344 and DCL 266) topped in having maximum number of genotypes among clusters formed, while maximum inter-cluster distance was noticed between cluster I and cluster VIII. Cluster I and VIII were identified as important clusters with respect to various traits. Therefore, the genotypes in these two clusters may be utilized in multiple breeding programmes to recover transgressive segregants with desirable combinations. The genotypes in cluster VI (RC 1-1,DCL-008) exhibiting high yield might be tested for their stability for few years in multilocation trials and if found suitable, may be directly adopted as high yielding varieties. Cluster VII topped in having maximum number of genotypes among clusters formed, while maximum inter-cluster distance was noticed between cluster I and cluster VIII. Cluster I and VIII were identified as important clusters with respect to various traits. Therefore, the genotypes in these two clusters may be utilized in multiple breeding programmes to recover transgressive segregants with desirable combinations.

Key words: *Capsicum annuum*, Genetic diversity, Cluster, Chilli

Chilli (*Capsicum annuum* L.) is a popular vegetable and spice crop in India and many parts of the world. It provides a wide range of variability and diversity with a tremendous scope for genetic studies and improvement by breeding. The selection of parents for the purpose of breeding depends on the existence of genetic diversity necessitating its assessment for improvement of quantitative traits. Several workers have evaluated germplasm of chilli for yield and its component traits (Singh and Singh 1976; Mehra and Peter 1980; Pandey and Dobhal 1994; Roy and Sarma 1996; Oliveira *et al.*, 1999).

Materials and Methods

The experimental material comprised of thirty genotypes of chilli assembled from various parts of India (Table 1). Genotypes were grown in three replications in a randomized block design during *Kharif* season of 2001. Spacing was maintained at 60 cm between the rows and 30 cm between the plants. Observations were recorded on five randomly selected plants in each replication for fourteen traits *viz.*, plant height (cm), number of primary branches, number of secondary branches, days to flowering, days to first fruit harvest, fruit length (cm), fruit width (cm), number of fruits

Table 1. Chilli genotypes used for evaluation

Genotype(s)	Place of collection
ACS 2000-02	Anand (Gujarat)
ACS 98-9	Anand (Gujarat)
DCL 408	Lam (Andhra Pradesh)
DKC 8	Sirmour (Himachal Pradesh)
Phule Sai	Rahuri (Maharashtra)
KDCS-810	Kalyanpur (Uttar Pradesh)
RC 1-1	Durgapura (Rajasthan)
DCL 228	Bhubaneshwar (Orissa)
DCL 236	Bangalore (Karnataka)
DCL 335	Jabalpur (Madhya Pradesh)
DCL 006	Bhatinda (Punjab)
DCL 358	Lam (Andhra Pradesh)
DCL 901	Rahuri (Maharashtra)
DCL 001	Akola (Maharashtra)
DCL 268	Lam (Andhra Pradesh)
DCL 270	Rahuri (Maharashtra)
Red Star	Delhi
DCL 008	Durgapura (Rajasthan)
Soldier	Delhi
Green Wonder	Delhi
PMR 57	Bangalore (Karnataka)
K 1	Kovilpatti (Tamil Nadu)
A 8	Almora (Uttaranchal)
DCL 344	Jalna (Maharashtra)
DCL 266	Coimbatore (Tamil Nadu)
DCL 271	Rahuri (Maharashtra)
Rajasthan Local	Jodhpur (Rajasthan)
Sel. 5	Jodhpur (Rajasthan)
Motikeera 39	Jodhpur (Rajasthan)
Pusa Sadabahar	Delhi

per plant, fruit weight (g), yield per plant (g), ascorbic acid (mg/100g), total carotenoids (µg/100g), capsicin (%) and TSS (%).

Genetic diversity was analysed using Mahalanobis D^2 statistics with Tocher's method (Rao 1952). All possible D^2 values between thirty genotypes were computed utilizing the genotypic mean with respect to fourteen traits.

Results and Discussion

The thirty genotypes (Table 1) were grouped into eight clusters based on their D^2 values. Four clusters *viz.*, cluster VII (9), cluster II (5), cluster III (5) and cluster IV (4) were having maximum number of genotypes. While cluster I had 3 genotypes and cluster VI comprised 2 genotypes. Cluster V and cluster VIII were solitary with one genotype in each cluster (Table 2). The genotypes Rajasthan Local and Pusa Sadabahar comprising individual clusters with valuable traits open up the chance of having new genetic combinations when hybridized with other genotypes of different clusters and may be used to broaden the genetic base among the selected germplasm pool.

The grouping (Table 3) showed that maximum divergence existed between cluster I and VIII (D^2=108.22), while closer proximity existed between cluster II and cluster VII (D^2= 6.52). Cluster VIII had maximum distance in six out of the seven combinations, indicating that it had wide diversity among all the clusters. Greater the genetic distance between the clusters, wider is the genetic diversity between genotypes. Maximum intra-cluster distance was recorded for cluster III (6.46).

The cluster means for the fourteen traits revealed considerable differences among all the clusters (Table 4). The cluster VIII having a single genotype Pusa Sadabahar, possesses either higher or lower value for most of the traits, justifying its inclusion as a separate cluster. Cluster I and cluster VIII among them, had the maximum values for the yield related traits and quality traits. Cluster I had late flowering genotypes with maximum fruit length (12.09), fruit width (1.59), fruit weight (5.57) and ascorbic acid content (175.89) whereas cluster VIII had genotype with maximum number of primary branches (4.60), secondary branches (22.53), number of fruits per plant (137.51), total carotenoids (3879.50) and capsicin content (0.45) with considerably high yield per plant. Incidentally these two clusters were also the most genetically divergent. Hence, the genotypes from these two clusters could be used as parents to obtain better recombinants and widen the genetic base of the germplasm pool (Edang *et al.*,1971).

For breeding programmes aimed at earliness coupled with high yield, Pusa Sadabahar exhibiting minimum days to flowering (47.00) and days to first fruit harvest (80.67) could be used as a parental source. Additionally it also possesses maximum number of fruits per plant, total carotenoids and capsicin content. However, this variety had lowest fruit length, fruit width, fruit weight and TSS. On the other hand cluster I representing genotypes with highest fruit length, fruit width, fruit weight and ascorbic acid could be selected if the aim of the breeding programme is to improve any of these traits. But genotypes in this cluster were late in maturity and comparatively low yielder. Hence, backcross breeding involving genotypes from both these clusters could be done to develop an early as well as high yielding cultivar with higher capsicin and/or ascorbic acid content. Edang *et al.* (1971) stated that the clustering pattern could be utilized for choosing parental combinations for generating maximum possible variability for various economic traits. The genotypes in cluster VI exhibiting high yield might be tested for their stability for few years in multilocation trials and if found suitable, may be directly adopted as high yielding varieties.

Table 2. Cluster classification of 30 genotypes

Cluster	Genotypes (No.)	Genotype(s)
I	3	ACS 2000-02, Green Wonder, Motikeera 39
II	5	DCL 408, DKC 8, Phule Sai, DCL 006, DCL 358
III	5	KDCS 810, DCL 236, PMR 57, K 1, A 8
IV	4	ACS 98-9, DCL 270, DCL 271, Sel. 5
V	1	Rajasthan Local
VI	2	RC 1-1, DCL 008
VII	9	DCL 228, DCL 335, DCL 901, DCL 001, DCL 268, Red Star, Soldier, DCL 344, DCL 266
VIII	1	Pusa Sadabahar

Table 3. Inter- and intra-cluster distance of 8 clusters in 30 genotypes

Cluster	I	II	III	IV	V	VI	VII	VIII
I	**4.87**	35.89	54.36	16.43	33.64	20.66	33.29	108.22
II		**3.87**	10.75	14.88	27.87	37.05	6.52	56.45
III			**6.46**	23.15	25.20	33.27	9.03	25.28
IV				**2.99**	26.83	10.39	10.18	70.09
V					**0.00**	24.94	27.81	53.46
VI						**5.15**	25.00	67.86
VII							**4.66**	41.22
VIII								**0.00**

Bold figures indicate the intra-cluster distance.

Table 4. Cluster means for various characters of chilli

Character	Cluster							
	I	II	III	IV	V	VI	VII	VIII
Plant height (cm)	44.16	47.70	54.75	60.86	44.40	56.18	49.80	51.73
Number of primary branches	2.70	2.76	3.51	3.40	3.20	4.00	3.40	4.60
Number of secondary branches	6.38	8.85	11.96	7.47	19.60	12.05	9.55	22.53
Days to flowering	64.11	58.93	48.47	61.83	60.00	58.67	53.93	47.00
Days to first fruit harvest	97.44	83.47	81.00	91.75	91.33	93.83	84.44	80.67
Fruit length (cm)	12.09	7.20	7.01	9.96	8.26	11.95	9.35	6.44
Fruit width (cm)	1.59	0.96	0.98	1.21	1.30	1.30	0.97	0.78
Number of fruits per plant	26.86	49.07	78.77	43.41	44.83	48.22	56.09	137.51
Fruit weight (g)	5.57	2.24	2.22	3.82	3.70	5.00	2.71	1.70
Yield/plant (g)	151.56	110.27	166.87	165.08	165.33	238.17	156.41	233.00
Ascorbic acid (mg/100g)	175.89	124.20	100.60	149.50	90.67	159.17	125.70	110.33
Total carotenoids (mg/100g)	2873.47	2391.02	2032.96	2576.16	2058.67	1687.44	3512.91	3879.50
Capsaicin (%)	0.38	0.44	0.43	0.37	0.33	0.35	0.42	0.45
TSS (%)	6.83	7.82	7.48	8.22	6.47	7.77	8.12	6.80

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