ISSN-1991-3036 (Online)
Int. J. Sustain. Crop Prod. 6(1):63-75(April 2011)

SELECTION OF PARENTS IN CHILLI (*Capsicum annuum* L.)

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Accepted for publication on 30 March 2011

ABSTRACT

Hasanuzzaman M, Faruq Golam (2011) Selection of parents in chilli (*Capsicum annuum* L.). *Int. J. Sustain. Crop Prod.* 6(1), 63-75.

Based on the degree of divergence among geontypes, the 20 accessions, CCA 1, CCA 2, CCA 3, CCA 4, CCA 5, CCA 6, CCA 7, BARI Morich 1, CCA 9, CCA 10, CCA 11, CCA 12, CCA 13, CCA 14, CCA 15, CCA 16, CCA 17, CCA 18, CCA 19, CCA 20 could be grouped into six clusters. Cluster I consisted of solitary individual genotype, cluster II and cluster III of three accessions, cluster IV of two genotypes cluster V of maximum seven genotypes while cluster VI consists of four genotypes. The highest intracluster divergence (1.7153) for cluster VI was invariably smaller than the lowest intercluster divergence between cluster III and cluster VI (3.247), thus authenticating the clustering pattern formed in this study. The intracluster divergence ranged from 0.00 and 0.07288 to 1.7153, whereas the intercluster divergence ranged from 3.247 to 12.677 between clusters III and VI and clusters I and V respectively. The four characteristics that played the greatest role in differentiation were yield per plant, plant height, days to 50% flowering and fruits per plant. In the present study, the clustering pattern did not follow their geoclimatic zonal distribution and taxonomic labels, suggesting that factors other than regional boundaries and taxonomic characters are also responsible for divergence. Six different homozygous divergent parents CCA 2, CCA 5, BARI Morich 1, CCA 11, CCA 15, CCA 19 were selected from six different clusters using ranking among genotypes within cluster. The divergence of the selected parents was also estimated by developing dendogram using 11 different characters. The minimum similarity was 17.52% among accession CCA 5 and CCA 11 and maximum similarity was less than 50% among accession BARI Morich 1 and CCA 19 indicating the adequate divergence. The genotypes differed significantly for all the traits and considerable amount of variation is observed in selected six parents.

Key words: *parent selection, multivariate analysis, dendogram, chilli*

INTRODUCTION

Chilli (*Capsicum annuum* L.) is grown worldwide both as a spice and as a vegetable crop and world's second most important solanaceous vegetable after tomato. Landraces are variable plant populations adapted to local agro climatic conditions, which are locally named, selected and maintained by the traditional farmers to meet their social, economic, cultural and ecological needs (Teshome *et al.* 1997). The chilli landraces of Bangladesh are heterogeneous and serve as a reservoir of genetic variability for the plant breeder. These landraces have survived hundreds of years through human selection and natural selection to the local environment. The chilli landraces have been selected by each farmer for agronomic and horticultural traits important to them (e.g., heat level, fruit size and color, early maturity) and as a result of natural selection, are well adapted to the specific environment. The landraces in general have acquired genes for resistance to diseases and pests that could be of benefit to plant breeders. The landraces of Bangladesh are grown in different confined areas and genetically distinct from each other. City morich, Bindu, Balijuri, Diapara, Jagri, Kolabari, Abhaguz, Bogra local, Hathazari local, Halda, Comilla local, Chittagong, Naga, Bain, Kantai, Mota-morich, Lomba-morich, Ausa marich, Akashi, Matal, Kala morich, Ausadhebra, Shamali, Shikharpuri, Dhani morich, Surjamukhi etc. are the local chilli landraces of Bangladesh (Ahmed 1982; Rashid 1999; Khaleque 1992). A rich diversity of chilli exists due to varied geo climatic regions of Bangladesh. It is widely cultivated through out the year in Bangladesh. Genetic resources play a pivotal role in its economical utilization and desirable traits improvements. Genetic divergence existing in the population helps in the selection of suitable parents for utilization in chilli crop breeding programs.

Different chilli germplasms were introduced at different times, cultivated for centuries and adapted to varied agro-ecological zones of Bangladesh. Such situations contributed for the evolvement of local Bangladeshi genotypes with different fruit types and pungency levels. Hot pepper genotypes have been introduced from all over the world and local collections were made in the entire country. The introduced genotypes have diverse origin and contain many useful traits that are essential for the variety development and addressing the critical varietal problem of the development sector.

The selection of genotypes to serve as parents is one of the most important steps in any crossing program for plant breeding. Selection of parents depends on specific objectives of the research program and their performance in F_1 and F_2 segregating generations. Potentiality of the parents must be evaluated before selecting parents. Various statistical analyses are available to select suitable parents. Experience of the breeder is one of the important factors in this matter. The study of genetic divergence through multivariate analysis is frequently applied in parent selection by researchers involved in breeding programs of several crops, leading to a reduction in the number of crosses (Guerra *et al.* 1999). The use of multivariate genetic divergence technique is very important when there are a high number of parents to be studied and the amount of necessary crosses is impracticable. Considering the importance of chilli and in view of the above-mentioned constraints, the present study was undertaken aiming at to select suitable parents for crossing.

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MATERIALS AND METHOD

Materials

Twenty chilli genotypes (listed in Table I) were taken for preliminary evaluation and selection for detailed genetically as well as others studies on yield and yield related characters. These genotypes, selfed for several generations, were supplied by Lal Teer Seed Limited (Formerly East West Seed (Bangladesh) Limited).

Method

The twenty different genotypes were grown in Research and Development Farm of Lal Teer Seed Limited, Basan (North 23.9763^{o} and East 090.3539^{o}), Gazipur during 2006-2007 starting from October, 2006. The experiment was laid out in randomized complete block design with three replications.

The seeds of the 20 different chilli germplasm were sown in Seedling Tray. The media in the seedling tray have been prepared by using coconut coir, ash and decomposed cow dung at a ratio of 50%, 25% and 25% respectively. The media were boiled by steam for two hours. After cooling the media, the seeds were sown on 17 October, 2006. The seedlings at the age of 4 to 5 leaves were suitable for transplanting and this took 35-45 days after sowing.

The transplantation of seedlings was done on December 5, 2006. Raised beds were prepared for transplanting. The width of raised bed was 1.5 meter. Plant to Plant distance was 50 cm and row to row distance was 70 cm. Bed to bed distance is 1.0 meter that was used as drain. Cow dung, Urea, TSP, MP, Gypsum and Zinc Oxide were applied @ 15 tons, 200 kg, 300 kg, 200 kg, 110 kg and 5 Kg per hectare respectively. The entire amount of cow dung, TSP, Zinc Oxide, Gypsum and one-third of the urea and MP is applied at the time of final land preparation while the rest of the urea and MP is applied at two equal installments, 25 and 50 days after transplanting (Rashid and Singh, 2000).

At the time of transplanting, Dursbarn 20 EC and Ridomil MZ 68 WP were used at the rate of 5 ml/L and 3g/L respectively for soil treatment. Irrigation was given as and when necessary. Weeding was done after every 20 days of transplanting.

The diversity between accessions was assessed by multivariate statistics. Non-hierarchical pre determined cluster analysis was done using Genstat 5 Release 4.1 (Fourth Edition). The Mahalanobis distance (D^2) (Mahalanobis, 1936) was applied to measure the genetic divergence between the accessions. A canonical variate analysis was carried out to confirm the D^2 analysis as well as to provide a graphic representation of the divergence of the accessions. A similarity dendrogram was plotted using the Minitab 15.1.0.0.

RESULTS AND DISCUSSION

Analysis of variances for yield and different yield contributing traits showed that the genotypes differed significantly for the traits (Table 1). This indicated that the materials were genotypically divergent. Based on the degree of divergence (Mahalanobis' D^2 statistics) among genotypes, the 20 accessions were grouped into six clusters (Table 2). Cluster I consisted of solitary individual genotype, cluster II and cluster III of three accessions, cluster IV of two genotypes, cluster V of maximum seven genotypes while cluster VI consisted of four genotypes. The highest intracluster divergence (1.7153) for cluster VI was invariably smaller than the lowest intercluster divergence between cluster III and cluster VI (3.247), thus authenticating the clustering pattern formed in this study. The intracluster divergence ranged from 0.00 and 0.07288 to 1.7153, whereas the intercluster divergence ranged from 3.247 to 12.677 between clusters III and VI and clusters I and V, as depicted in the figure 1. Senapati *et al.* (2003) also evaluated 20 diverse chilli genotypes for 11 characters. Based on D^2 values, they grouped the genotypes into six groups. Cluster with one genotype in chilli was observed by Senapati *et al.* (2003), Thul *et al.* (2009), Smitha and Basavaraja (2006) and Vani *et al.* (2007).

Both the conglomeration technique based on Mahalanobis generalized distance and the analysis of the canonic variables was used for the quantification of the genetic divergence among the parents. In the latter, the genetic divergence was assessed by the graphic scattering of the scores for the studied genotypes on Cartesian axes. Generally, researchers have opted for graphic representation when the first two canonic variables accounted more than 70% of total available variability (Cruz 1990). The phenotypic divergence was also confirmed through canonical variate analysis and in terms of spatial distribution. Since the proportionate contribution by the first three canonical roots, $\lambda 1$ (55.12%), $\lambda 2$ (21.86%) and $\lambda 3$ (13.46%) were more than 90%, therefore the three dimensional representation was adequate for the present study. The distribution of each individual against $\lambda 1$, $\lambda 2$ and $\lambda 3$ coordinating axes is presented in Figure 2. The figure apparently represents the six different clusters and it shows that the cluster I consists of single genotype and no other genotype is present around it with close vicinity.

Table 3 represents the cluster mean. Cluster I had the highest value for fruit length, fruit width, fruit weight, number of seeds per fruit, days to fruit maturity (green), days to fruit maturity (ripe) and yield per plant and lowest value for number of fruits per plant and plant canopy width. Lowest value for number of seeds per fruits, plant height, plant canopy width and medium fruit length, fruit width, fruit weight, number of fruits per plant and yield per plant were observed in cluster II. Lowest value for yield per plant, number of seeds per plant and highest plant height were observed in cluster III. Cluster IV had highest value for days to 50% flowering and lowest value for fruit width and yield per plant. Maximum number of fruits per plant and plant height and minimum fruit length, fruit weight, days to fruit maturity (green) and days to fruit maturity (ripe) were observed in cluster V. Cluster VI had lowest days to 50% flowering, fruit length, medium number of fruits per plant and low yield per plant. From the observations, it was apparent that there was a considerable degree of divergence at intercluster level.

The four characteristics that played the greatest role in differentiation were yield per plant, plant height, days to 50% flowering and fruits per plant. This was confirmed by relative character contribution percentage (RCC %) towards genetic diversity and rank distribution. The contribution of individual characters to the divergence had been worked out in terms of number of times it appeared first. Yield per plant was the highest contributor towards the phenotypic diversity (44.21%); followed by plant height (15.26%) days to 50% flowering (15.26%) which ranked second and number of fruits per plant (10.53%) ranked third. The least contributing characteristics towards divergence were fruit length that ranked ninth position (Table 4).

The relative character contribution (%) value of this character is zero. This is because, the character, fruit length did not stand first in any combination during ranking but this might be least variability of this character. Kumar *et al.* (1998) evaluated chickpea and reported that days to 50% flowering, days to maturity, biological yield/plant and harvest index did not stand first in any ranking and contribution towards divergence was zero. Contribution of traits towards divergence was cross checked by first two principal components and this method confirmed that yield per plant contributed highest towards divergence (Table 5). However, there was difference between the two results as fruit length contributed higher to divergence that was minimum as estimated by previous method. Difference arises due to difference in mode of calculation of the two methods.

Different quantitative traits contributed to the total divergence but the magnitude of contribution of different traits towards divergence was not same. Yield per plant, fruit weight, number of fruits per plant, fruit length fruit diameter, Plant height had maximum contribution towards divergence in chilli (Vani *et al.* 2007; Karad *et al.* 2002; Senapati *et al.* 2003; Varalakshmi and Babu, 1991; Thul *et al.* 2009; Roy and Sarma, 1996).

Based on relative magnitude of D^2 values, 20 accessions were grouped into six clusters. The collections were from different regions and some of the accessions from different localities grouped into same cluster. The clustering pattern did not follow their geoclimatic zonal distribution and taxonomic labels, suggesting that factors other than regional boundaries and taxonomic characters were also responsible for divergence. Thul *et al.* (2009), Gogate *et al.* (2006) and Varalakshmi and Babu (1991) studied on diversity on chilli in different seasons and area and reported that all of them found no parallelism or association between geographical distribution of materials and their phenotypic diversity.

A high degree of similarity could be expected, using the multivariate statistic as a basis, among the genotypes belonging to the same group (Destro 1991). The genotypes grouped together are less divergent than the ones that fall into different clusters (Chaudhary *et al.* 1975). Selecting one variety from each group and testing them through a diallel analysis may prove to be highly fruitful for evaluation and their breeding potentiality (Singh and Chaudhary, 1985).

Genotypes within the same cluster are more similar than genotypes with other clusters. Homozygosity of the genotypes studied within cluster was not at same level. However, homozygous parents are needed for diallel cross and generation mean analysis (Singh and Chaudhury, 1985; Singh and Narayanan, 2000). A strong relationship exists between heterozygosity and phenotypic variability (Knowles and Mitton, 1980). Homozygous parents are less variable than heterozygous parents. To select homozygous parents from each cluster, ranking was done within each cluster. Parents having lowest phenotypic intra variability were given lowest rank and parents having highest phenotypic intra variability were given highest rank. Phenotypic variability was shown in Table 6. From six different clusters six parents was selected based on lowest ranking value within each cluster. CCA 11 was selected from cluster I, which had only one accession. Cluster II had three accessions from which BARI Morich 1 was selected due lowest ranking (12) within cluster. CCA 2 was the lowest ranked accession in cluster III and it was selected. In cluster IV, the lowest rank accession was CCA 15, which was selected. The lowest ranking accession was CCA 5, which was selected from cluster V. Finally, CCA 19, the lowest ranking accession, was selected as parent for 6X6 diallel cross from cluster VI (Table 7).

The divergence of the selected parents was also estimated by developing dendogram using 11 different characters (Figure 3). The minimum similarity was 17.52% between accession CCA 5 and CCA 11 and maximum similarity was less than 50% between accession BARI Morich 1 and CCA 19 indicating the adequate divergence.

Table 8 represent the salient features of the selected six parents. Among the selected six different parents, CCA 2 had the lowest value of fruit length, fruit weight and yield per plant and highest value of days to 50%

flowering and plant height. Lowest values of number of seeds per fruit, days to fruit maturity (green) and days to fruit maturity (ripe) and more than medium values of number of fruits per plant and yield per plant were observed in CCA 5. BARI Morich 1 had the lowest value of days to 50% flowering, plant height and plant canopy width and values of number of fruits plant and yield per plant were close to highest values. Highest value of fruit length, fruit width, fruit weight, number of seeds per fruit and days to fruit maturity (green and ripe), lowest value of fruit number per plant and more than medium value for yield per plant were recorded in CCA 11. Lowest value of fruit width and weight and medium value for yield per plant and close to highest value for number of fruits per plant were observed in CCA 15. CCA 19 was the highest yield producing parent and highest value of fruit number per plant and plant canopy width were observed in it. This indicates the well distribution of divergence among the selected six different parents.

Table I. List of chilli accessions

Entry	Accession	Place of Collection
01	CCA 1	Bangladesh
02	CCA 2	Bangladesh
03	CCA 3	Bangladesh
04	CCA 4	Bangladesh
05	CCA 5	Bangladesh
06	CCA 6	Bangladesh
07	CCA 7	India
08	BARI Morich 1 (Bangla lonka)	Bangladesh (Only released variety of BARI)
09	CCA 9	Bangladesh
10	CCA 10	Bangladesh
11	CCA 11	Thailand
12	CCA 12	Taiwan
13	CCA 13	Thailand
14	CCA 14	Bangladesh
15	CCA 15	Bangladesh
16	CCA 16	Bangladesh
17	CCA 17	Bangladesh
18	CCA 18	Bangladesh
19	CCA 19	Bangladesh
20	CCA 20	Bangladesh

Table 1. Analysis of variance for yield and yield contributing characters in a collection of chilli genotypes

	df	Days to 50% flowering	Fruit length (cm)	Fruit width (mm)	Fruit weight (g)	Number of seeds per fruit	Number of fruits per plant	Days to fruit maturity (green)	Days to fruit maturity (ripe)	Plant height (cm)	Plant canopy width (cm)	Yield per plant (g)
Accession	19	604.11**	7.25**	3.85**	3.31**	272.52**	7396.79**	25.63**	41.66**	139.05**	64.38**	52348.2**
Replication	2	169.87**	0.03	1.89*	0.26**	6.68	2444.11	9.44*	16.74	92.59*	34.28*	17357.3
Error	38	27.78	0.11	0.48	0.02	12.29	95.26	1.50	4.49	42.35	16.97	674.64
Total (corrected)	59	218.19	2.40	1.61	1.09	95.90	21.88	6.53	12.76	337.35	77.11	1914.16
CV		6.8	5.6	7.7	6.5	9.7	7.3	3.6	4.2	9.3	7.6	9.6

*P<0.05, ** P<0.01 respectively

Table 2. Intra (Bold) and inter cluster Mahalanobis distance (D^2 value) among six clusters of chilli

Cluster	I	II	III	IV	V	VI	Frequency	Accessions included in cluster
I	**0.00**	86.03 (9.275)	121.75 (11.034)	111.07 (10.539)	160.71 (12.677)	127.17 (11.277)	1	CCA 11
II		**1.47 (1.2105)**	19.72 (4.441)	26.03 (5.102)	21.73 (4.662)	22.56 (4.75)	3	CCA 7, BARI Morich 1, CCA 9
III			**0.01 (0.07288)**	25.38 (5.038)	15.11 (3.887)	10.54 (3.247)	3	CCA 2, CCA 12, CCA 20
IV				**2.10 (1.4494)**	34.54 (5.877)	36.26 (6.022)	2	CCA 4, CCA 15
V					**1.21 (1.1016)**	26.52 (5.15)	7	CCA 1,CCA 3, CCA 5, CCA 6, CCA 13, CCA 16, CCA 17
VI						**2.94 (1.7153)**	4	CCA 10, CCA 14, CCA 18, CCA 19

D values are in parenthesis

Table 3. Cluster means for yield and yield contributing characters in a collection of chilli genotypes

Cluster	Days to 50% flowering	Fruit length (cm)	Fruit width (mm)	Fruit weight (g)	Number of seeds per fruit	Number of fruits per plant	Days to fruit maturity (green)	Days to fruit maturity (ripe)	Plant height (cm)	Plant canopy width (cm)	Yield per plant (g)
I	74.00	8.70	11.19	5.54	46.80	85.09	40.17	58.28	61.98	50.71	483.15
II	73.44	6.91	9.49	2.74	30.38	130.13	34.68	50.67	54.61	50.60	335.08
III	73.11	6.31	9.02	1.86	30.50	118.79	34.54	50.30	78.00	58.38	221.32
IV	93.83	6.59	8.25	1.75	34.18	124.96	34.18	53.22	68.94	54.76	221.29
V	81.24	5.13	8.82	1.59	37.82	160.00	32.78	48.56	74.89	53.71	262.93
VI	69.17	5.21	8.88	1.79	40.88	120.27	34.32	53.35	69.60	53.85	242.47

Table 4. Contribution of traits towards diversity in chilli

Sl. No.	Character	Relative Character Contribution (%)	Rank
1	Days to 50% flowering	15.26	2
2	Fruit length	0	9
3	Fruit width	1.05	7
4	Fruit weight	0.53	8
5	Number of seeds per fruit	8.95	4
6	Number of fruits per plant	10.53	3
7	Days to fruit maturity (green)	0.53	8
8	Days to fruit maturity (ripe)	2.11	5
9	Plant height	15.26	2
10	Plant canopy width	1.58	6
11	Yield per plant	44.21	1

Table 5. Relative contributions of the eleven characters to the total divergence based on the first two principal components in chilli

Sl. No.	Character	Principal component	
		Eigen vector I	Eigen vector II
1	Days to 50% flowering	-0.0182	-0.0476
2	Fruit length	0.0067	0.0157
3	Fruit width	0.0004	0.0012
4	Fruit weight	0.0047	0.0182
5	Number of seeds per fruit	-0.0022	-0.0289
6	Number of fruits per plant	0.2165	-0.9736
7	Days to fruit maturity (green)	0.0105	0.0256
8	Days to fruit maturity (ripe)	0.0107	0.0307
9	Plant height	-0.0329	-0.0218
10	Plant canopy width	0.0058	-0.0259
11	Yield per plant	0.9754	0.2138

Table 6. Variance of yield and yield contributing characters in a collection of chilli genotypes

Cluster	Accession	Days to 50% flowering	Fruit length (cm)	Fruit width (mm)	Fruit weight (g)	Number of seeds per fruit	Number of fruits per plant	Days to fruit maturity (green)	Days to fruit maturity (ripe)	Plant height (cm)	Plant canopy width (cm)	Yield per plant (g)
I	CCA 11	11	4.000	0.027	1.087	0.037	74.234	377.527	1.978	6.295	64.477	65.889
II	CCA 7	7	16.333	0.422	1.390	0.174	125.609	1011.178	3.633	50.954	109.145	118.965
	BARI morich 1	8	9.333	0.027	0.949	0.018	81.099	423.098	3.021	7.826	44.321	76.302
	CCA 9	9	25.333	0.388	1.780	0.102	141.926	510.671	3.826	4.746	193.478	77.617
III	CCA 2	2	14.333	0.050	0.976	0.036	54.510	470.948	4.723	11.954	94.561	72.164
	CCA 12	12	37.000	0.273	2.169	0.092	113.403	1502.185	4.303	6.737	133.604	83.636
	CCA 20	20	19.000	0.248	1.116	0.111	46.924	976.976	3.913	7.241	118.363	131.276
IV	CCA 4	4	37.333	0.368	1.492	0.080	85.513	1048.395	5.637	5.804	165.236	79.319
	CCA 15	15	10.333	0.024	0.774	0.036	92.079	320.361	1.531	4.997	51.677	57.003
V	CCA 1	1	151.000	0.292	2.336	0.068	257.333	749.292	4.616	5.371	144.927	91.449
	CCA 3	3	52.000	0.289	1.973	0.072	189.909	1237.826	10.464	3.492	104.587	82.986
	CCA 5	5	13.000	0.026	1.051	0.031	157.651	415.853	5.490	4.102	91.065	69.696
	CCA 6	6	16.333	0.235	1.368	0.089	60.437	1002.466	4.999	8.896	312.012	111.517
	CCA 13	13	16.333	0.373	1.178	0.064	90.759	1371.860	2.809	7.100	135.021	88.441
	CCA 16	16	19.000	0.116	1.205	0.088	83.610	1084.991	3.431	8.420	83.863	105.373
	CCA 17	17	50.333	0.152	1.154	0.100	115.370	1017.519	2.639	8.162	121.212	99.014
VI	CCA 10	10	20.333	0.069	1.314	0.061	51.030	1217.499	3.964	32.145	235.615	186.810
	CCA 14	14	21.000	0.255	1.152	0.074	177.292	931.609	2.645	15.507	138.079	108.317
	CCA 18	18	156.000	0.183	1.386	0.099	106.478	510.309	3.018	8.198	126.157	82.778
	CCA 19	19	9.333	0.032	0.744	0.012	123.109	297.616	1.489	10.831	80.759	57.835

Table 7. Rank distribution of accessions within cluster based on variance

Cluster	Accession	Days to 50% flowering	Fruit length (cm)	Fruit width (mm)	Fruit weight (g)	Number of seeds per fruit	Number of fruits per plant	Days to fruit maturity (green)	Days to fruit maturity (ripe)	Plant height (cm)	Plant canopy width (cm)	Yield per plant (g)	Rank Total
I	CCA 11	1	1	1	1	1	1	1	1	1	1	1	11
II	CCA 7	2	3	2	3	2	3	2	3	2	3	2	27
	BARI Morich 1	1	1	1	1	1	1	1	2	1	1	1	12
	CCA 9	3	2	3	2	3	2	3	1	3	2	3	27
III	CCA 2	1	1	1	1	2	1	3	3	1	1	1	16
	CCA 12	3	3	3	2	3	3	2	1	3	2	2	27
	CCA 20	2	2	2	3	1	2	1	2	2	3	3	23
IV	CCA 4	2	2	2	2	1	2	2	2	2	2	2	21
	CCA 15	1	1	1	1	2	1	1	1	1	1	1	12
V	CCA 1	6	6	7	3	7	2	4	3	6	4	7	55
	CCA 3	5	5	6	4	6	6	7	1	3	2	5	50
	CCA 5	1	1	1	1	5	1	6	2	2	1	1	22
	CCA 6	2	4	5	6	1	3	5	7	7	7	4	51
	CCA 13	2	7	3	2	3	7	2	4	5	3	2	40
	CCA 16	3	2	4	5	2	5	3	6	1	6	6	43
	CCA 17	4	3	2	7	4	4	1	5	4	5	3	42
VI	CCA 10	2	2	3	2	1	4	4	4	4	4	4	34
	CCA 14	3	4	2	3	4	3	2	3	3	3	3	33
	CCA 18	4	3	4	4	2	2	3	1	2	2	2	29
	CCA 19	1	1	1	1	3	1	1	2	1	1	1	14

Table 8. Mean Performance of yield and yield contributing characters of selected six parents

Sl no.	Accession	Days to 50% flowering	Fruit length (cm)	Fruit width (mm)	Fruit weight (g)	Number of seeds per fruit	Number of fruits per plant	Days to fruit maturity (green)	Days to fruit maturity (ripe)	Plant height (cm)	Plant canopy width (cm)	Yield per plant (g)
1	CCA 2	86±2.08	5.56±0.03	9.3±0.19	1.88±0.03	26.80±2.29	113.31±3.72	39.97±0.43	54.67±0.37	78.25±1.74	54.82±1.52	219.69±5.13
2	CCA 5	75±1.86	6.78±0.03	9.3±0.16	2.78±0.03	26.73±1.75	165.80±3.27	31.60±0.23	48.03±0.41	76.15±1.31	55.34±1.38	449.80±5.22
3	BARI Morich 1	71±4.16	6.65±0.10	9.4±0.26	2.99±0.05	34.73±2.52	170.36±6.42	37.99±0.59	55.03±0.34	47.48±1.87	49.32±1.66	506.75±8.91
4	CCA 11	74±2.33	8.70±0.12	11.2±0.22	5.54±0.08	46.80±2.05	85.09±5.81	40.17±0.35	58.28±1.30	61.98±1.91	50.71±1.99	483.15±8.37
5	CCA 15	85±2.33	7.64±0.11	7.8±0.20	1.80±0.05	33.30±1.74	173.45±6.76	35.23±0.31	57.22±0.49	66.32±2.12	54.77±1.72	305.89±6.96
6	CCA 19	73±7.21	7.10±0.08	9.9±0.21	2.80±0.06	34.83±1.88	194.24±4.12	39.03±0.32	56.73±0.52	68.40±2.05	64.31±1.66	547.01±6.73

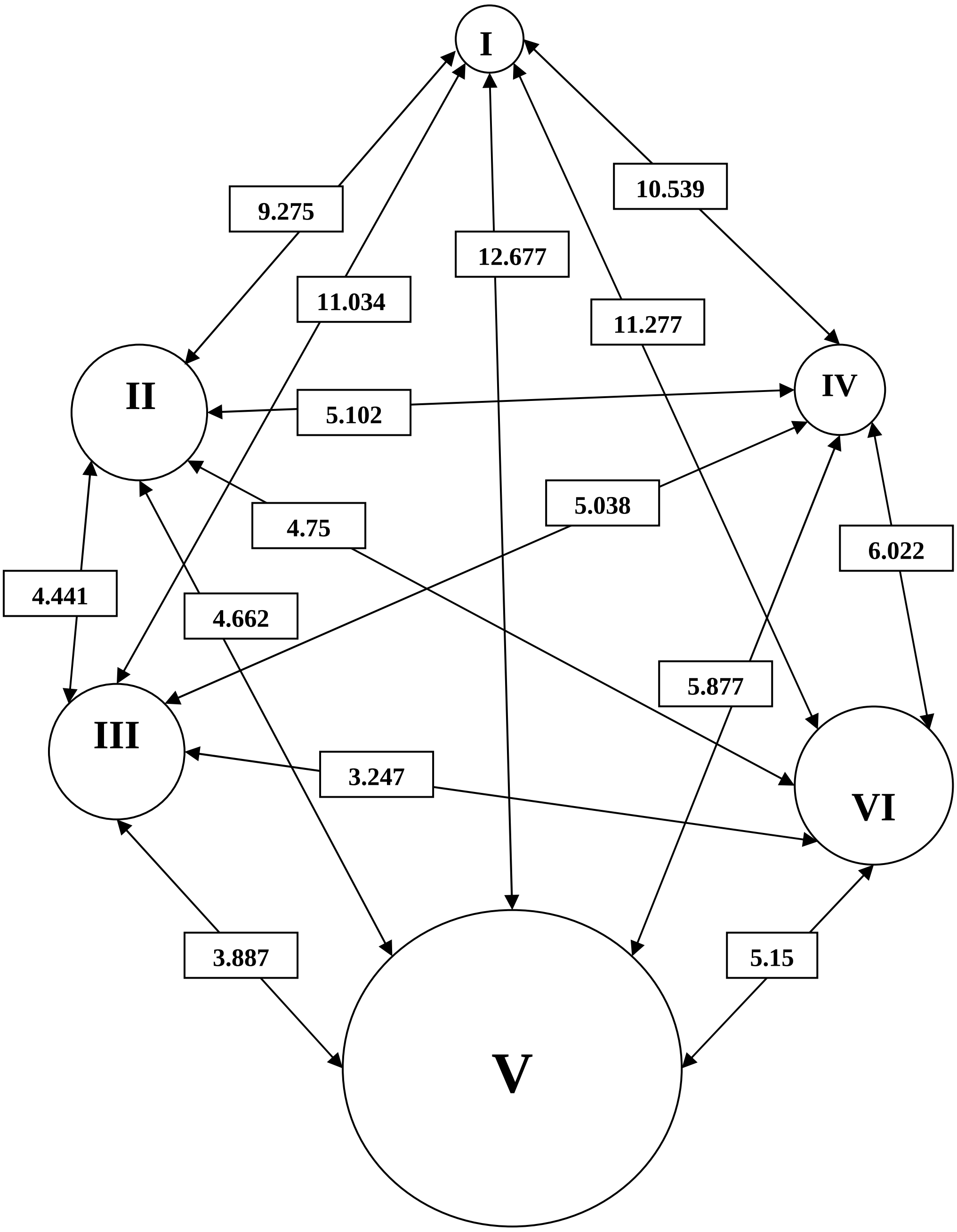

Figure 1. Cluster divergence among six clusters of chilli based on D-values

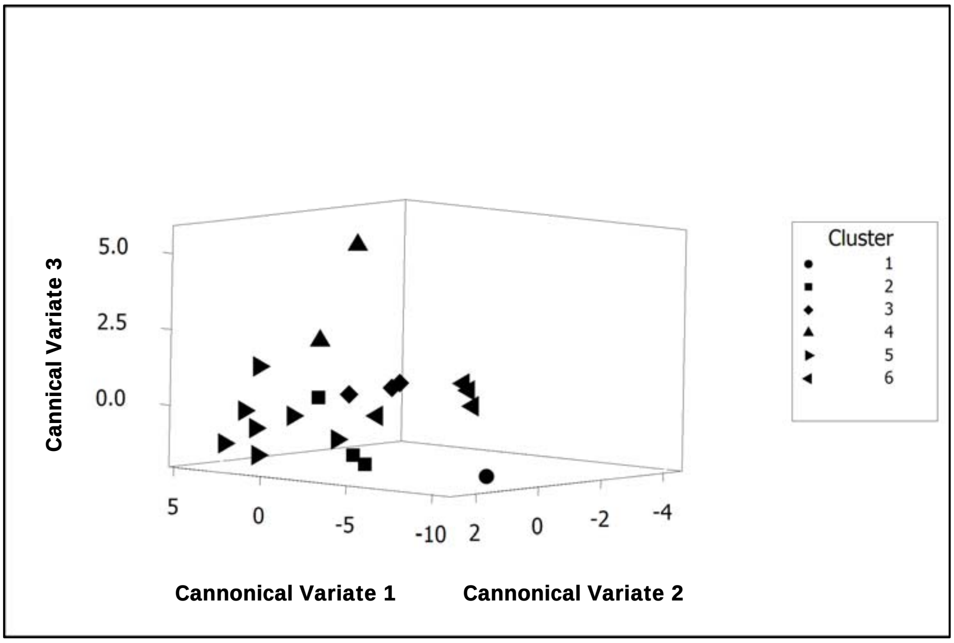

Figure 2. 3D spatial distribution of 20 accessions of chilli in six different clusters

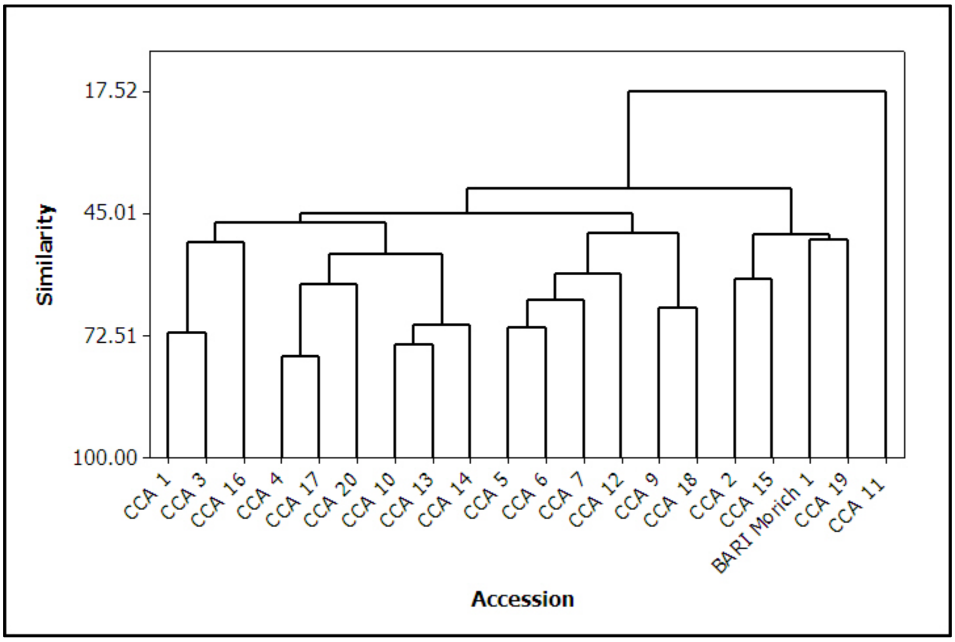

Figure 3. Dendrogram showing the similarity among the 20 accessions

CONCLUSION

In conclusion, parent selection is an important step in any breeding program. In the present study, out of 20, 6 different accessions were selected using statistical tools, cluster analysis and ranking. Cluster analysis developed uniform group and ranking helped in selection parent from each uniform group. The dissimilarity among the six selected parents was 50%-82%, which was quite high. Utilizing this dissimilarity, genetic potentiality of the selected parents could be evaluated by combining ability and generation mean analyses.

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