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Efficacy of Morphological Characters for Varietal Identification of Chilli

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The present study was aimed to identify the chilli varieties through its morphological characters identification. Tamil Nadu Agriculture University (TNAU) released chilli varieties viz., CO1, CO2, K1, K2, KKM1, PKM1, PMK1, PLR1, CCH1(hybrid), CA97 (male) and Sln1 (female) were used. The experiment was carried out during the period from August 2011 to February 2012. There are 33 morphological characters (plant height, leaf density, flower position etc.,) were studied in identification. Among the above, only 8 qualitative morphological characters (Intensity of anthocyanin coloration of nodes, stem pubescence, plant growth habit, leaf color, leaf pubescence, flower position, anther colour and calyx annular constriction) and 3 qualitative characters (plant height, leaf length and leaf width) were found as the important morphological characters for identification. Other characters (Seedling: Anthocyanin colouration of hypocotyl, hypocotyl pubescence, Stem colour, Plant: Anthocyanin etc.,) were of secondary importance for identification of varieties. Some of the characters were recorded in quantitatively and the cluster was formed from the recorded quantitative data, based on similarity in the characters the varieties were grouped into three main clusters at 76% similarity level. In cluster one PMK1, PLR1 and CO2 were diverged from other genotypes at 87.5% similarity. The rest of eight genotypes formed a second cluster and third cluster showing the 80% similarity level and thus useful for varietal identification.

Introduction

Chilli (*Capsicum* spp.) is an important vegetable cum spice crop grown in the tropical, subtropical as well as temperate regions. India is the largest producer of chillies in the world. Its production level hovers around 1.1 million tonnes annually. India also has the maximum area dedicated to the production of this crop. The major regions where chilli is cultivated in India are Karnataka, Maharashtra, Uttar Pradesh, Punjab, Tamil Nadu, Rajasthan, Orissa, West Bengal and Madhya Pradesh. (Kumar *et al.*, 2011). Most of the chill varieties are local cultivars or landraces. 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 (Hasan *et al.*, 2014).

The varietal identification and parietal purity assessment is an important parameter for the released cultivars. Cultivars are commonly

identified on the basis of morphological differences of seed, seedling and mature plant.

Morphological evaluation of pepper germplasm accessions have been studied for most plant and fruit traits (Qaryouti *et al.*, 2003). It has been reported the variation in cotyledon color, number of stems, stem color, stem pubescence, leaf properties, number of flowers, flower color, anthocyanin in fruit, anther color, stigma position, immature fruit color and number of fruit in chilli (Wang and Bosland, 2006). Most of the varieties or cultivars within a species can be distinguished at the fruiting stage by the shape and size of the fruits. With the introduction of Indian legislation Protection of Plant Varieties and Farmers Rights Act (PPV and FRA, 2001), the release of new crop varieties is possible only if it is distinct (D) from other varieties, uniform (U) in their characteristics and generally stable (S) over the years (DUS). Farmers and seed growers need an assurance that they are being supplied with correct seed material with known identity of a specific variety and assured quality. Thus, there is an urgent need to search for rapid and reliable methods of varietal identification. Morphological characters of both qualitative and quantitative have long been used to identify species and to discriminate between varieties. Characterization of varieties based on morphological characters are carried out with the specific characters in the field during seedling, vegetative etc., But it is expensive and time consuming process and the purity of seed will be known only after the seed developed into plant. Keeping this in view the present investigation was carried out to differentiate eleven chilli varieties based on morphological characters.

Materials and Methods

Plant materials: Total eight chilli varieties (CO1, CO2, K1, K2, KKM1, PKM1, PMK1 and PLR1) and one hybrid (CCH1) and its parents of CA97 (male) and Sln1 (female) were obtained from TNAU, and the research work carried at the Agricultural College and Research Institute, Madurai during August 2011 and 2012.

Field experiments: The six weeks old seedlings were transplanted using 60.0 cm x 45.0 cm plant to plant and row to row on the basis of a randomized complete block design. NPK fertilizers at rate of 90:60:60 kg/ ha were applied. There are 33 morphological characters such as genotype on anthocyanin colouration of hypocotyl, Hypocotyl pubescence, Cotyledonous leaf colour, Cotyledonous leaf shape, Stem colour, anthocyanin coloration of nodes, intensity of anthocyanin coloration of nodes, Nodal anthocyanin, Stem pubescence etc., were recorded on five randomly selected plants.

Cluster analysis: The quantitative morphological traits observed subjected to cluster analysis. The genetic association between genotypes was evaluated by calculating the similarity matrix coefficient for pairwise comparisons based on the morphological characters. Pair wise similarity matrices were generated by Jaccard's coefficient of similarity (Jaccard, 1908) by using SIMQUAL format of NTSYS-PC (Rohlf, 2002). A dendrogarm was constructed by using the unweighted pair group method on arithmetic average (UPGMA) with SHAN module.

Results and Discussion

Morphological characters: Table 1 shows the 33 morphological characters of 11 chilli genotypes. Among the above, only 8 morphological characters like intensity of anthocyanin coloration of nodes, plant growth habit, leaf colour, leaf pubescence, flower position, Anther colour and calyx annular constriction were useful in the varietal

identification (Table 2). The intensity of anthocyanin colouration of nodes categorized the genotypes into two groups as medium and strong. PLR1 had strong pigmentation and medium in rest of the other genotypes. The stem pubescence was found to be sparse in four genotypes *viz*., K2, CCH1, CA97 and Sln1. The pubescence was found to be intermediate for K1, PKM1, PMK1, KKM1 whereas the rest of genotypes *viz*., CO1, CO2 and PLR1 had dense pubescence. The eleven genotypes were grouped as prostate, intermediate and erect. None of the genotypes fell under prostrate type. While, CO1, KKM1, CCH1, CA97 and Sln1 fell under intermediate category. Whereas K1, K2, PLR1, PKM1, PMK1 and CO2 came under erect group. Leaf colour of all the genotypes was light green, green and dark green. CO1, CCH1, CA97 and Sln1 were dark green. While other genotypes *viz*., CO2, K1, K2, KKM1, PLR1, PKM1 and PMK1 fell under light green. When considering leaf pubescence, K2, CCH1, CA97 and Sln1 has sparse pubescence, K1, PLR1, PKM1, PMK1 and KKM1 came under intermediate pubescence whereas CO1 and CO2 was dense pubescence. The eleven genotypes were grouped as pendant, intermediate and erect based on flower position. K1, K2, KKM1, PLR1, PKM1 and PMK1 were grouped as intermediate type. CO1, CO2, CCH1, CA97 and Sln1 were grouped as erect type. In the case of anther colour, eleven chilli genotypes were grouped as white, yellow, pale blue, blue and purple. CO1, K1, K2 and PMK1 were fall under pale blue colour. CO2, PLR1, PKM1 and KKM1 were categorized under blue. Other genotypes such as CCH1, CA97 and Sln 1 came under purple colour. The calyx annular constriction was absent in K1, PKM1 and KKM1. CO2, K2, PLR1, PMK1, CCH1, CA97 and Sln1 were present.

Table 3 shows the qualitative characters different chilli verities. Based on plant height, genotypes were grouped into very short (<25 cm), short (25-45 cm), medium (45-65 cm), long (65-85 cm) and extra-long (>85 cm). CO1, CO2, PLR1, PMK1, CCH1, CA97 and Sln1 fell under medium category and KKM1, K1, K2 and PKM1 had long category. Based on leaf length, genotypes were grouped as short (<10 cm), medium (10-15 cm) and long (>15 cm) categories. Among eleven genotypes, CO1, CA97, Sln1 and CCH1 were categorized under short. The genotypes *viz*., CO2, K1, K2, PLR1, PKM1, PMK1 and KKM1 fell under medium. The leaf width was found to be short (<3 cm) in three genotypes *viz*., CO1, CA97, Sln1 and CCH1. The leaf width was found to be medium (3-5 cm) for CO2, K1, K2, PLR1, PKM1, PMK1 and KKM1. The morphological traits were helpful for easy separation of varieties and hybrid among the genotypes studied.

Cluster analysis: The similarity and dissimilarity occur in the morphological characters among different chilli varieties were given in table 1. Among the 33 morphological characters, 3 quantitative characters such as plant leaf length, width and plant height were taken for the cluster analysis. The dendrogram (Fig.1) depicted PMK1, PLR1 and CO2 varieties possess medium leaf length (10-15 cm), width (3 - 5 cm) and medium plant height (45-65 cm) were diverged under the cluster I. K1, K2, PKM1 and KKM1 varieties possess medium leaf length (10-15 cm), width (3 - 5 cm) and long plant height (66 - 85 cm) were fall in the cluster II. CO1, CCH1, CA97 and Sln1 varieties possess short leaf length (< 10 cm), short leaf width (< 3 cm) and medium plant height (46 -65 cm) were diverged under cluster III.

In chilli intensity of anthocyanin colouration of nodes categorized the genotypes into two groups as medium and strong. PLR 1 had strong pigmentation and it was medium in CO1, CO2, K1, K2, PKM1, PMK1, PLR1, KKM1, CCH1, CA97 and Sln1 genotypes.

Similar results have also been reported by Ravi (2000). Paul *et al.,* (2010) observed the anthocyanin colouration was present in all accessions of tomato a few days after transplanting. However, the pigmentation disappeared in the later stage of crop growth. Similarly, our study was showed anthocyanin coloration of nodes disappeared in the later stage of crop growth in all the eleven chilli genotypes. The stem pigmentation is one of the conspicuous characteristics in varietal identification. Stem pigmentation is under genetic control and it may also be affected by light intensity and temperature prevailing during the crop growth, thus resulting in variation in the degree of pigmentation in chilli genotypes.

The stem pubescence was found to be sparse in four genotypes *viz*., K2, CCH1, CA97 and Sln1. The pubescence was found to be intermediate for K1, PKM1, PMK1 and KKM1 whereas the rest of genotypes *viz*., CO1, CO2 and PLR1 had dense pubescence. Manju and Sreelathakumary, (2004) reported that most of the chilli accessions had sparse stem pubescence. Similar observations were made by Payakhapaab *et al.,* (2012) and Manjunath Reddy (2005) in cotton genotypes. This character was highly useful for identification of genotypes.

The plant height is one of the important characteristics, which help in differentiating the genotypes as short, medium and tall. Based on plant height, CO1, CO2, PLR, PMK1, CCH1, CA97 and Sln1 fall under medium category (45-65 cm), KKM1,K1, K2 and PKM1 had long category (65-85 cm). Jain *et al.,* (2002) in mungbean and Mate and Shelar, (2006) in sorghum varieties reported that plant height characteristics can be used for differentiation genotypes.

Plant growth habit is an important in terms of crop management because it can help in terms of defining the area for each plant. The eleven chilli genotypes were grouped as prostate, intermediate and erect. None of the genotypes fell under prostrate type. While, CO1, KKM1, CCH1, CA97 and Sln1 fell under intermediate category. Whereas K1, K2, PLR1, PKM1, PMK1 and CO2 came under erect group. The decrease in branch number would lead to erect plant growth and decreased fruit diameter and fruit weight. Sudre *et al.,* (2010) reported that most of the chilli accessions were classified as intermediate with regard to the trait growth habit.

The present investigation, Pantone colour matching system classified leaf colour of all the genotypes were light green, green and dark green. CO1, CCH1, CA97 and Sln1 were dark green with pantone number (PMS 363). While other genotypes *viz*., CO2, K1, K2, KKM1, PLR1, PKM1 and PMK1 fell under light green with pantone number (PMS 362). Similar results were reported earlier Arunkumar *et al.,* (2004) in pearl millet.

In case of leaf pubescence, K2, CCH1, CA97 and Sln1 had sparse pubescence, K1, PLR1, PKM1, PMK1 and KKM1 came under intermediate pubescence whereas CO1 and CO2 possessed dense pubescence. Sripunitha (2012) also used this trait to classify ten and fifteen varieties. Based on leaf length, genotypes CO1, CA97, Sln1 and CCH1were categorized under short (<10 cm). The genotypes *viz*., CO2, K1, K2, PLR1, PKM1, PMK1 and KKM1 fell under medium category (10-15 cm). Similar variations and grouping of genotypes in these leaf characters were reported earlier by Prakash and Singhal (1997) in pea varieties. The leaf width was found to be short (3 cm) in three genotypes viz., CO1, CA97, Sln1 and CCH1 and medium (3-5 cm) for CO2, K1, K2, PLR1, PKM1, PMK1, KKM1 and CCH1. Eevera (2003) used this trait to identify the 26 rice cultivars.

On the basis of flower position, the eleven chilli genotypes were grouped as pendant, intermediate and erect based on flower position. K1, K2, KKM1, PLR1, PKM1 and PMK1 were grouped as intermediate type. CO1, CO2, CCH1, CA97 and Sln 1 were grouped as erect type. Similar variations were observed by Sonia Sood *et al.,* (2011) in capsicum genotypes. Based on characterization by flower morphology, anther colour was pale blue in CO1, K1, K2 and PMK1 and also CO2, PLR1, PKM1 and KKM1 were categorized under blue. Other genotypes such as CCH1, CA97 and Sln1 came under purple. Flower morphology, including flower color, calyx constriction and the number of flowers per axil, is most used in taxonomic descriptions (Moscone *et al.,* 2007 and Ince *et al.,* 2009). In chilli genotypes, calyx annular constriction was absent in K1, PKM1 and KKM1 while it was present in CO2, K2, PLR1, PMK1, CCH1, CA 97 and Sln1. Similar results were observed by Sudre *et al.,* (2010).

Table.1 Morphological characterization of chilli genotypes based on DUS guidelines

S.No	Characters	States	Varieties	Score
1	Seedling:Anthocyanin colouration of hypocotyl	Absent	–	1
		Present	CO1, CO2, K1, K2, PLR1, PKM1, PMK1, KKM1, CCH1, CA97 and Sln1	9
2	Hypocotyl pubescence	Sparse	CO1, CO2, K1, K2, PLR1, PKM1, PMK1, KKM1, CCH1, CA97 and Sln1	3
		Intermediate	–	5
		Dense	–	7
3	Cotyledonous leaf colour	Light green	CO1, CO2, K1, K2, PLR1, PKM1, PMK1, KKM1, CCH1, CA97 and Sln1	1
		Green	–	2
		Dark green	–	3
4	Cotyledonous leaf shape	Deltoid	–	1
		Ovate	–	2
		Lanceolate	CO1, CO2, K1, K2, PLR1, PKM1, PMK1, KKM1, CCH1, CA97 and Sln1	3
5	Stem colour	Green	–	1
		Green with purple	CO1, CO2, K1, K2, PLR1, PKM1, PMK1, KKM1, CCH1, CA97 and Sln1	2
		Purple	–	3
6	Plant:Anthocyanin coloration of nodes	Absent	–	1
		Present	CO1, CO2, K1, K2, PLR1, PKM1, PMK1, KKM1, CCH1, CA97 and Sln1	9
7	Stem: Intensity of anthocyanin coloration of nodes	Very weak	–	1
		Weak	–	3
		Medium	CO1, CO2, K1, K2, PKM1, PMK1, KKM1, CCH1, CA97 and Sln1	5
		Strong	PLR1	7
		Very strong	–	9
8	Nodal anthocyanin colour	Green	–	1
		Light purple	–	3
		Purple	CO1, CO2, K1, K2, PLR1, PKM1, PMK1, KKM1, CCH1, CA97 and Sln1	5
		Dark purple	–	7
9	Stem pubescence	Sparse	K2, CCH1, CA97 and Sln1	3
		Intermediate	K1, PKM1, PMK1 and KKM1	5
		Dense	CO1, CO2 and PLR1	7
10	Plant height (cm)	Very short (<25 cm)	–	1
		Short (25-45 cm)	–	3
		Medium (46-65 cm)	CO1, CO2, PLR1,PMK1,CCH1,CA97 and Sln1	5

		Long (66-85 cm)	K1, KKM1, PKM1 and K2	7
		Very long (>85 cm)		9
11	Plant growth habit	Prostrate	–	3
		Intermediate	CO1, KKM1, CCH1, CA97 and Sln1	5
		Erect	K1, K2, CO2, PLR1, PKM1and PMK1	7
12	Branching habit	Sparse	–	3
		Intermediate	CO1, CO2, K1, K2, PLR1, PKM1, PMK1, KKM1, CCH1, CA97 and Sln1	5
		Dense	–	7
13	Leaf density	Sparse	–	3
		Intermediate	CO1, CO2, K1, K2, PLR1, PKM1, PMK1, KKM1, CCH1, CA97 and Sln1	5
		Dense	–	7
14	Leaf colour	Light green	–	1
		Green	CO2, K1, K2, PLR1, PKM1, PMK1 and KKM1	2
		Dark green	CO1, CCH1, CA97 and Sln1	3
15	Leaf shape	Deltoid	–	1
		Ovate	–	2
		Lanceolate	CO1, CO2, K1, K2, PLR1, PKM1, PMK1, KKM1, CCH1, CA97 and Sln1	3
16	Leaf profile in cross section	Strongly concave	–	1
		Moderately concave	–	3
		Flat	CO1, CO2, K1, K2, PLR1, PKM1, PMK1, KKM1, CCH1, CA7 and Sln1	5
		Moderately convex	–	7
		Strongly convex	–	9
17	Lamina margin	Entire	CO1, CO2, K1, K2, PLR1, PKM1, PMK1, KKM1, CCH1, CA97 and Sln1	1
		Undulate	–	2
		Ciliate	–	3
18	Leaf pubescence	Sparse	K2, CCH1, CA97 and Sln1	3
		Intermediate	K1, PKM1, PMK1, PLR1 and KKM1	5
		Dense	CO1 and CO2	7
19	Leaf length (cm)	Short (<10 cm)	CO1, CA97, Sln1 and CCH1	3
		Medium (10-15 cm)	CO2, K1,K2, PLR1, PKM1, PMK1, KKM1	5
		Long (>15 cm)	–	7
20	Leaf width (cm)	Short (<3cm)	CO1, CA97, Sln1 and CCH1	3
		Medium (3-5 cm)	CO2, K1, K2, PLR1, PKM1, PMK1, KKM1	5
		Long (>5 cm)	–	7
21	Days to 50% flowering	Early (<65 days)	–	3
		Medium (65-80 days)	CO1, CO2, K1, K2, PLR1, PKM1, PMK1, KKM1, CCH1, CA97 and Sln1	5
		Late (>80 days)	–	7
22	Number of flowers per axil	One	–	1
		Two	–	2
		Three or more	CO1, CO2, K1, K2, PLR1, PKM1, PMK1, KKM1, CCH1, CA97 and Sln1	3
23	Flower position	Pendant	–	3

		Intermediate	K1, K2, PLR1, PKM1, PMK1 and KKM1	5
		Erect	CO1, CO2, CCH1, CA97 and Sln 1	7
24	Corolla colour	White	CO1, CO2, K1, K2, PLR1, PKM1, PMK1, KKM1, CCH1, CA97 and Sln1	1
		Light yellow	–	2
		Yellow	–	3
		Yellow green	–	4
25	Corolla shape	Rotate	CO1, CO2, K1, K2, PLR1, PKM1, PMK1, KKM1, CCH1, CA97 and Sln1	1
		Campanulate	–	2
26	Corolla length (cm)	Short (<1.5 cm)	–	1
		Medium (1.5 -2.5 cm)	CO1,CO2, K1, K2, PLR1, PKM1, PMK1, KKM1, CCH1,CA97 and Sln1	2
		High (>2.5 cm)	–	3
27	Anther colour	White	–	1
		Yellow	–	2
		Pale blue	CO1, K1, K2 and PMK1	3
		Blue	CO2, PLR1, PKM1 and KKM1	4
		Purple	CCH1,CA97 and Sln1	5
28	Filament colour	White	CO1, CO2, K1, K2, PLR1, PKM1, PMK1, KKM1, CCH1, CA97 and Sln1	1
		Yellow	–	2
		Green	–	3
		Blue	–	4
		Light purple	–	5
		Purple	–	6
29	Pubescence of style	Absent	CO1, CO2, K1, K2, PLR1, PKM1, PMK1, KKM1, CCH1, CA97 and Sln1	1
		Present	–	9
30	Calyx pigmentation	Absent	CO1, CO2, K1, K2, PLR1, PKM1, PMK1, KKM1,CCH1, CA97 and Sln1	1
		Present	–	9
31	Calyx margin	Entire	–	1
		Intermediate	–	2
		Dentate	CO1, CO2, K1, K2, PLR1, PKM1, PMK1, KKM1, CCH1, CA97 and Sln1	3
32	Calyx annular constriction	Absent	K1, PKM1 and KKM1	1
		Present	CO1, CO2, K2, PMK1, PLR1, CCH1, CA97 and Sln1	9
33	Peduncle: Abscission layer	Absent	CO1, CO2, K1, K2, PLR1, PKM1, PMK1, KKM1, CCH1, CA97 and Sln1	1
		Present	–	9

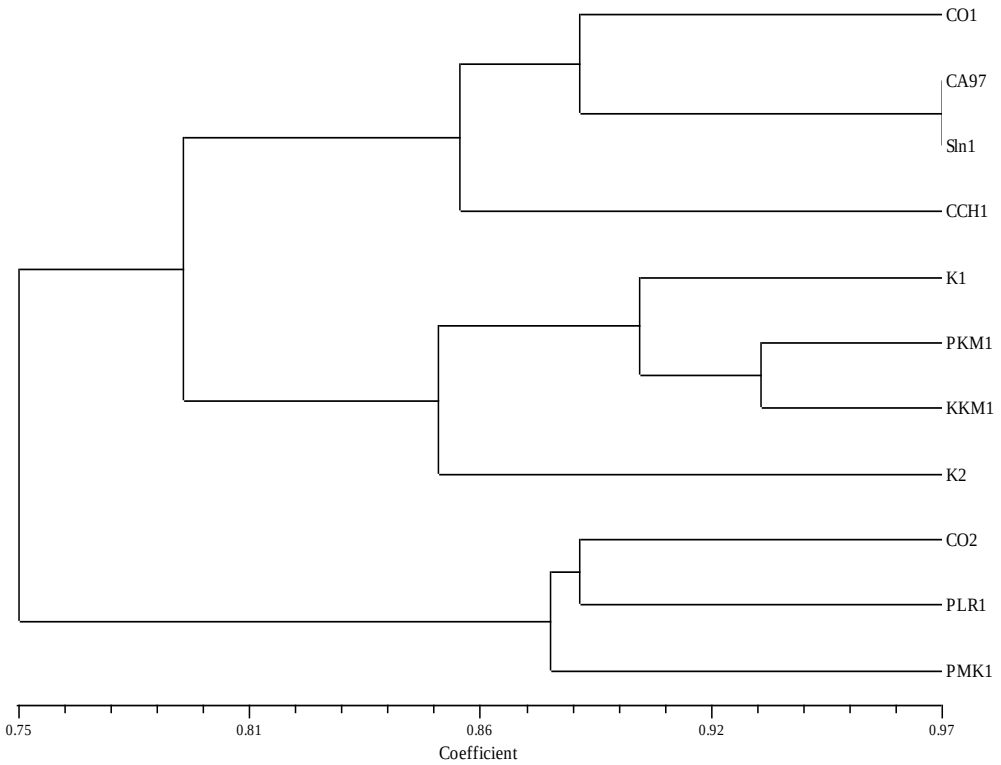
Table.2 Qualitative morphological characters for Chilli variety

Genotypes	Stem intensity of anthocyanin coloration of nodes	Stem Pubescence,	Plant growth habit	Leaf Color	Leaf Pubescence	Flower Position	Anther Colour	Calyx annular constriction
CO1	Medium	Dense	Intermediate	Dark Green	Dense	Erect	Pale Blue	Present
CO2	Medium	Dense	Erect	Light Green	Dense	Erect	Blue	Present
K1	Medium	Intermediate	Erect	Light Green	Intermediate	Intermediate	Pale Blue	Absent
K2	Medium	Sparse	Erect	Light Green	Sparse	Intermediate	Pale Blue	Present
KKM1	Medium	Intermediate	Intermediate	Light Green	Intermediate	Intermediate	Blue	Absent
PKM1	Medium	Intermediate	Erect	Light Green	Intermediate	Intermediate	Blue	Absent
PMK1	Medium	Intermediate	Erect	Light Green	Intermediate	Intermediate	Pale Blue	Present
PLR1	Strong	Dense	Erect	Light Green	Intermediate	Intermediate	Blue	Present
CCH1	Medium	Sparse	Intermediate	Dark Green	Sparse	Erect	Purple	Present
CA97	Medium	Sparse	Intermediate	Dark Green	Sparse	Erect	Purple	Present
Sln1	Medium	Sparse	Intermediate	Dark Green	Sparse	Erect	Purple	Present

Table.3 Quantitative morphological characters for Chilli variety

Genotypes	Plant height(cm)	Leaf length(cm)	Leaf width(cm)
CO1	63	7.50	2.10
CO2	65	11.20	3.40
K1	97	11.50	3.80
K2	98	11.30	3.10
KKM1	78	12.40	3.40
PKM1	63	11.70	3.70
PMK1	65	12.50	3.60
PLR1	68	13.50	3.20
CCH1	60	7.80	2.30
CA97	58	7.60	1.80
Sln1	59	7.70	1.90

Fig.1 Dendrogram representing the grouping of eleven chilli genotypes formed through UPGMA based on morphological markers



Cluster analysis showed that the eleven genotypes were grouped into two major clusters at 76% similarity level. The similarity matrix coefficient ranged from 76% to 97% with an average of 87%. In cluster 1, three genotypes were formed a separate and sub clusters with the similarity coefficient ranged from 87.5% to 97.0% in the dendrogram (Fig. 1). At the 87.5% and 85.5 % similarity level PMK1, PLR1 and CO2 diverged from other genotypes. The rest of the eight genotypes were formed a second cluster and third clusters with similarity coefficient ranged from 80% to 97%. The female (Sln1) and male (CA97) parents of CCH1 hybrid were tied i.e. these genotypes placed at same level of 97% similarity. The female had high similarity coefficient with the rest of the genotypes studied (87.1%,75.75%, 77.1%, 80%, 67.1%, 80%, 70%, 75.1%, 87.1% and 97% similarity with CO1, CO2, K1, K2, PLR1, PKM1, PMK1, KKM1, CCH1 and CA97 respectively). The dendrogram result revealed that genotypes hybrid and its parental lines were grouped as one cluster and other varieties were grouped as the second and third clusters. The above mentioned morphological characters were useful for the identification of genotypes at vegetative and flowering stage itself. Hence, this study was useful for the characterization and identification of among chilli genotypes before the fruiting stage defeating the need to wait till maturity as chilli possesses duration of more than one hundred twenty days.

In conclusion, from this study, it is concluded that the 11 chilli genotypes can be effectively distinguished by its' morphological characters. Out of 33 morphological characters, only 8 qualitative morphological characters viz., intensity of anthocyanin

coloration of nodes, stem pubescence, plant growth habit, leaf color, leaf pubescence, flower position, anther colour and calyx annular constriction and 3 quantitative characters viz., leaf length, width and plant height were found as the important morphological characters for its varietal identification. This study provides an idea to conduct DUS testing for chilli genotypes, which is lacking in The National Test Guidelines. Further studies are warranted to fruits and seeds morphological characters.

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