Electronic Journal of Plant Breeding, 8(2): 660-667 (June 2017)
ISSN 0975-928X
DOI: 10.5958/0975-928X.2017.00100.4

Research Note

Taxonomic diversity of cultivated *Capsicum* genotypes of India

Sharmila Dutta Deka
Principal Scientist, Department of Genetics and Plant Breeding, Assam Agricultural University, Jorhat, Assam,
E-mail: sharmila9368@gmail.com

(Received: 15 Nov 2016; Revised: 24 May 2017; Accepted: 30 May 2017)

Abstract
Germplasm characterization is an important link between the conservation and utilization of plant genetic resources. Genetic diversity within and between crops is a major requirement for plant breeders. For description of plant genetic recourses the choice of characteristics is crucial. In the present study 60 cultivated *Capsicum annum* varieties collected from different parts of India and their divergence and similarities were recorded for 35taxonomic traits. Variability for the 35 morpho physiological traits was evident .Traits suitable for identification and grouping of the Capsicum genotypes has been identified. Traits with variable phenotypic classes giving stable expression were -seedling- anthocyanin coloration of hypocotyl, plant shortened internodes (in upper part), anthocianin coloration of the nodes, varieties with shortened internodes, leaf shape and blistering, anthocianin coloration of anther, fruit color before maturity, fruit shape in longitudinal section, fruit attitude, peduncle attitude, shape of apex of the fruit and fruit colour at maturity.

Key words
Capsicum, taxonomy, characterization, diversity, morphological grouping

Chilli (*Capsicum annuum* L.) is a member of the *Solanaceae* family, originated from South and Central America. It is one of the most important spice crop worldwide, with a global production 30.71 lakh tonnes and 20.378 lakh ha area harvested, in 2010-11. In India chilli ranked first in spice crops in terms of production (12.23 lakh tonnes) and area harvested (7.92 lakh ha), in the year 2010-11 (FAOSTAT, 2011). Chilli is grown for its pungent fruits, which are used both green, ripe and dry form.

The genus *Capsicum consists* of about 25 wild and 5 domesticated species (IBPGR 1995; Bosland and Votava, 2000). The five domesticated species of this family are *Capsicum annuum, C. frutescens, C. chinense*, *C. baccatum* and *C. pubescens* (Pickersgill, 1997). Three of the species, *C. annuum*, *C. chinense* and *C. frutescens*, form an overlapping complex with a common ancestral gene pool (Pickersgill *et al.* 1979). Species derived from this gene pool are based largely on flower color, calyx constriction, and the number of flowers per node. Nevertheless, unambiguous species designation, among *C. annuum*, *C. frutescens*, and *C. chinense* using morphological descriptors is difficult since many exceptions to general taxonomic identification exist (Pickersgill *et al.* 1979).

The plant varieties must fulfill the distinctiveness, uniformity and stability (DUS) criteria for protection under the Act and hence, there is a need to characterize varieties according to standard test guidelines. Variety characterization and identification serves important goals, such as mitigating legal claims and confirming intellectual property rights and maintenance of genetic purity. The morphological markers are the most common and considered as the first step in description and classification of germplasm .Use of morphological descriptors in sequential fashion is useful and convenient to discriminate the different varieties. Among morphological characters, Martinello *et al* (2001) observed a better discrimination power of the quantitative morphological characters compared to qualitative characters in okra genotypes but in major studies qualitative monogenic traits are found to be more reliable as they are least influenced by environmental factors.

Diversity in plant genetic resources provides opportunity for plant breeders to develop new and improved cultivars with desirable characteristics. Since plant breeding and cultivar development are integral components of improving food production, therefore, availability of and access to diverse genetic sources will ensure that the global food production network becomes more sustainable.

The cultivated pepper is known to possess very little genetic diversity. However, some authors have pointed out that it does not seem to be as narrow as for some other crops (Heiser, 1985). The present investigation was undertaken with the objective to study the plant taxonomy of cultivated *Capsicum annum* varieties collected from different parts of India and their divergence and similarities for taxonomic traits.

.

The experimental material consisted of 60 land races of *Capsicum annum* collected from different parts of India and given accession number as SSTC-1 to SSTC-60 .The genotypes were raised during *kharif* seasons of 2008 and 2009 at the Center for Protected Cultivation and Technology IARI. The material was replicated thrice and all the agronomic practices were followed to raise a good crop.

DOI: 10.5958/0975-928X.2017.00100.4

Plant Taxonomic Traits: The plant morphology was studied with 35 taxonomic traits. Ten competitive plants were randomly selected from each genotype in each replication to record the data following UPOVE Test Guidelines (2006) (Table 1). The scores or weightage as recommended for each of the qualitative character in the *Capsicum* descriptors and actual numerical data for the quantitative characters were used for morphological study.

Morphological characters for identification and grouping: Grouping of genotypes was done following UPOVE test guideline using five plant morphological traits. One seedling trait- seedling-anthocyanin coloration of hypocotyl, one plant character-plant shortened internodes (in upper part) and three fruit related characters are fruit color (before maturity), fruit shape in longitudinal section, and fruit color (at maturity) were included for the for the purpose.

Data analysis: The observations for 35 traits were subjected pooled analysis of variance for quantitative traits using statistical software followed by mean comparison. The overall diversity within the phenotypic classes was presented in the form of *Pie* diagram.

Tested 60 land races of *Capsicum annuum* were significantly different ($P<0.05$) for quantitative characteristics such as time of flowering, time of maturity, plant height, length of internodes, leaf length, leaf breath, fruit length, fruit diameter and ratio of length/diameter of fruit (Table 2). The flowering time ranged from 35 to 64 days in SSTC-22 and SSTC-32 respectively, time of maturity is longest in SSTC- 16 with 136 days and lowest in SSTC 22 with 68 days. The time of maturity varies from 83 to 136 days in SSTC-22 and SSTC-16 respectively. Length of internodes was found from 7 cm to as long as 27 cm in SSTC-7. Shortest fruit length was 4.55 cm observed in SSTC-48 and longest 11.81 cm was observed in SSTC-30. In different studies fruit length and fruit girth showed positive and significant association showing more length and girth of fruit increases weight of fruit thus total fruit yield per plant. Significant association of plant height with yield was also reported (Ukkund *et al.,* 2007). They also reported higher total yield per plant that is due to the more number of branches per plant that increases number of fruits per plant (Ukkund *et al.*, 2007). Singh *et al*. (2014) reported there was positive and significant genotypic and phenotypic correlation coefficient of fruit girth with fruit weight. The correlation of fruit length, fruit girth, fruit weight, number of fruits per plant, 1000-seed weight and green fruit yield with dry fruit yield.

Two phenotypic classes were observed for seedling anthocyanin coloration of hypocotyls. It was present in SSTC6, SSTC 7, SSTC16 and SSTC 22 rest of the genotypes are without colour. Only one genotype was found with shortened internodes in upper part SSTC22, whereas variation was observed for varieties with shortened internodes only, here two phenotypic classes were observed. 10 genotypes produced more than three internodes, and rests of the genotypes are with one to three internodes.

Variability for fruit related characters were evident in the present study. Three phenotypic classes were observed for fruit colour before maturity. It was predominantly green with two purple genotypes SSTC 8 and SSTC 16. Three with yellow fruit colour are SSTC20, SSTC43 and SSTC 45. At ripening two accessions with dark purple colour fruits turned red. Two accessions SSTC7 and SSTC42 was orange colour, SSTC20 and SSTC43 produced yellow fruit colour and only genotype SSTC 43 produced brown fruit colour at maturity. Rest of the genotypes produced red fruit colour at maturity. Sweet peppers are very often used as a bulking agent in ready-made meals and take-away food, because they are cheap, have a strong flavour, and are colourful (Janick & Paull, 2009). Therefore economic importance of fruit colour and shape is considered as major quality component. The present study identifies many genotypes with economic importance for frit related characters. Out of which with yellow fruit colour SSTC20, SSTC43, SSTC 45, orange SSTC7 and SSTC42 with brown fruit colour at maturity can be utilized in sweet pepper breeding programmes.

Highest phenotypic classes were observed in fruit shape in longitudinal section. Sixty accessions were divided into six phenotypic classes. Five genotypes are with circular fruits, five genotypes with cordate, 25 genotypes are trapezoidal, seven genotypes with moderately triangular, 17 genotypes narrowly triangular and one genotype SSTC 9 with unique horn shaped fruit. Total variability for grouping of characters according to UPOVE test guideline is presented in percent in the fig. 1. Variation for different qualitative traits which are found stable over two growing seasons are given in fig. 2.

Present study is in accordance to many finding related to characterization of *Capsicum* germplasm. Cultivated *Capsicum annuum* var. *annuum* is found to be very diverse regionally and worldwide (DeWitt and Bosland, 1996) having a wealth of innumerable strains, landraces and varieties. There is extensive diversity in fruit shape, size, wall thickness and fleshiness, colour and pungency (IPGRI *et al*., 1995), determined by genetic and environmental factors. Among the innumerable varieties of *capsicum annuum*, the diversification of shapes of the pod (fruit) is striking which is evident in the present study also.

DOI: 10.5958/0975-928X.2017.00100.4

The length of the pod varies considerably which can be used as a morphological marker for grouping of the varieties. Fruit colour before and after maturity can also be successfully utilized as a morphological indicator for grouping of the varieties. Fruit colours range from green, yellow, orange and red to purple, brown, black, and white as reported by many scientists (Bosland and Vatova, 2000). Some of the genetics of fruit colour and shape are becoming well understood (Huh *et al*., 2001).

The major challenge of characterization of genotypes with morphological markers is effect of environment on expression of characters. In the present study few qualitative traits has been identifies which are stable in their expression behavior over two consecutive growing seasons .Therefore these characters are least affected by environment. These are - seedling- anthocyanin coloration of hypocotyl, plant shortened internodes (in upper part) fruit color (before maturity), fruit shape in longitudinal section, fruit color (at maturity), fruit shape in longitudinal section, fruit attitude, peduncle attitude, anthocianin coloration of anther, shape of apex of the fruit. These traits can be successfully used in identification and grouping of the *Capsicum* genotypes. Anthocianin colouration of the plant parts plays an important role in identification of plant varieties. The result is in accordance Dutta Deka *et al*. (2010). They found that expression of anthocianin colouration of the anthers is found to be dominant morphological marker for identification varietal identity of *Capsicum* spp. Padma *et al.* (2017) has also reported the importance of anthocyanin colouration of the nodes along with other characters as a diagnostic character for chilli germplasm.

In nature plants generally occur in groups, called populations. These populations can comprise of many different genotypes. Maintaining heterogeneity is a common strategy of those populations to survive varying conditions. It is not only applied by wild populations but also by landraces. Landraces, also called farmers' varieties, are generally heterogeneous populations of crop plants grown by traditional farmers. The heterogeneity within landraces buffers for the differences in growing conditions within farmers fields and between growing seasons (Hardon *et al* 1994). The genotype along with environmental conditions determines plants adaptive behavior which reflects in the present study with the variation for different traits in different degrees. The distinguishing fruit morphological features observed in these investigations are of systematic value because they are have discriminatory features among the different genotypes. Furthermore, the use of fruit features in morphology studies is an important taxonomic tool at the levels of family, genus, species, and variety.

Acknowledgement

The Author acknowledged with thanks for financial support provided by Indian Agricultural Research Institute (IARI) to carry out the project. Author also acknowledged with thanks the guidance of Dr. Malavika Dadlani Rtd. Professor .and Head Division of Seed Science IARI, New Delhi for carrying out the research.

References

Bosland, P.W., and Votava, E.J. 2000. Peppers: Vegetable and Spice Capsicums. Crop Production Science in Horticulture 12. CAB International Publishing, Wallingford, England, UK. 204 pp.

DeWitt, D., and Bosland, P.W. 1996. Peppers of the world: an identification guide. Ten Speed press, Bekerley California. 219 pp.

Dutta Deka, S., Dadlani, M., Talukdar, A. and Sing, B. 2011. Determination of Hybrid Seed Purity in Capsicum using PCR based Markers. *Seed Res.*, **39**(2): 130-137

Hardon, J.J., Vosman, B.and van Hintum, Th.J.L. 1994. Identifying genetic resources and their origin: The capabilities and limitations of Modern biochemical and legal systems; Commission on plant genetic resources; First Extraordinary Session;Rome, 7 - 11 November

Heiser Jr.C.B. 1985. How many kinds of peppers are there? Pp. 142-154 *in* C.B. Heiser Jr., Of Plants andPeople. University of Oklahoma Press, Norman and London

Huh, J.H., Kang, B.C., Nahm, S.H., Kim, S., Ha, K.S., Lee, M.H. and Kim, B.D. 2001. A candidate gene approach identified phytoene synthase as the locus for mature fruit color in red pepper(*Capsicum* spp.). *Theor. Appl. Genet.*, **102**: 524-530.

IPGRI, AVRDC and CATIE. 1995. Descriptors for Capsicum (*Capsicum* spp.). International Plant Genetic Resources Institute, Rome, Italy; Asian Vegetable Research and Development Center, Taipei,Taiwan; and Centro Agronómico Tropical de Investigación y Enseñanza, Turrialba, Costa Rica. pp. 54

J. Padma, Anbu, S. and Sivasubramaniam, K. 2017 Efficacy of Morphological Characters for Varietal Identification of Chilli *Int. J. Curr. Microbiol. App. Sci.*, **6**(2): 690-700

Janick J. and Paull, R.E. 2008. The Encyclopaedia of Fruit & Nuts, CAB International, Wallingford, UK,

Martinello, G.E., Leal, N.R., Amaral, Jr, A.T., Pereira, M.G. and Daher, R.F. 2001. Comparison of morphological characteristics and RADP for estimating genetic diversity in *Abelmoschus* spp. *Acta Hort.* (ISHS) **546**: 101-104.

Pickersgill, B., Heiser, C.B. and McNeill, J. 1979. Numerical taxonomic studies on variation and domestication in some species of *Capsicum*. *In*: Hawkes JG, Lester RN, Skelding AD (eds) The biology and taxonomy of the *Solanaceae*. Academic Press Inc, New York, pp 679-700

Pickersgill, B. 1997. Genetic resources and breeding of *Capsicum* spp. *Euphytica*, **96**: 129-133.

Pradeep kumar Singh, Amit Kumar and Ishtiyaqahad. 2014. Correlation and path coefficient analysis in

DOI: 10.5958/0975-928X.2017.00100.4

yield contributing characters in chilli, *Capsicum annum* L. *Int. J. Farm Sci.*, **4**(4): 104-111

Ukkund Krishna, C., Patil, M.P., Madalageri, M.B., Mulage, R. and Jagadeesh, C. 2007. Character association and path analysis studies in green chilli for yield and yield attributes (*Capsicum annum* L). *Karnataka J. Agric. Sci.*, **20**(1): 99-101.

UPOV Code: CAPSI_ANN Sweet Pepper, Hot Pepper, Paprika, Chili, 2006-04-05 TG/76/8

DOI: 10.5958/0975-928X.2017.00100.4

Table 1. Tested Morphological Characters

S. No.	Traits	Scale
1	Seedling: anthocyanin coloration of hypocotyls	Absent (1), present (9)
2	Plant: shortened internode (in upper part)	Absent (1), present (9)
3	Varieties with shortened internodes only	None (1), one to three (2), more than three (3)
4	Plant: anthocyanin coloration of nodes	Absent (1), present (9)
5	Leaf: intensity of green color	Light (1), medium (3), dark (5)
6	Leaf: shape	Lanceolate (1), ovate (2), broad elliptic(3)
7	Peduncle: attitude	Erect (1), semi-drooping (2), drooping (3)
8	Flower: anthocyanin coloration in anther	Absent (1), present (9)
9	Fruit anthocianin coloration	Erect (1), horizontal (2), drooping (3)
10	Fruit attitude	Erect (1), horizontal (2), drooping (3)
11	Fruit: color (before maturity)	Greenish white (1), yellow (2), green (3), purple (4)
12	Fruit shape in longitudinal section	Oblate (1), circular (2), cordate (3), square (4), rectangular (5), trapezoidal (6), moderately triangular (7), narrowly triangular (8), horn shaped (9)
13	Fruit: texture of surface	Smooth or very slightly wrinkled (1), slightly wrinkled (2), strongly wrinkled (3)
14	Fruit: color (at maturity)	Yellow (1), orange (2), red (3) brown
15	Fruit: shape of apex Fruit	Very acute (1), moderately acute (2), rounded (3) moderately depressed (4), very depressed (5)
16	Plant: habit	Upright (1), semi-upright (2), prostrate (3)
	a. Length of internodes	Very short (1), short (3), medium (5), long (7), very long (9)
17	Stem: intensity of anthocyanin coloration of nodes	Very weak (1), weak (3), medium (5), strong (7), very strong (9)
18	Stem: hairiness of nodes	Absent or very weak (1), weak (3), medium (5), strong (7), very strong (9)
19	Plant: height	Very short (1), short (3), medium (5), tall (7), very tall (9)
20	Leaf: length of blade	Very short (1), short (3), medium (5), long (7), very long (9)
21	Leaf: width of blade	Very narrow (1), narrow (3), medium (5), broad (7)
22	Leaf: undulation of margin	Absent or very weak (1), weak (3), medium (5), strong
23	Leaf: blistering	Very weak (1), weak (3), medium (5), strong (7)
24	Leaf: profile in cross section	Strongly concave (1), moderately concave (3), flat (5), moderately convex (7), strongly convex (9)
25	Leaf: glossiness	Very weak (1), weak (3), medium (5), strong (7), very strong (9)
26	Fruit: length Fruit	Very short (1), short (3), medium (5), long (7), very long (9)
27	Fruit: diameter Fruit	Very narrow (1), narrow (3), medium (5), broad large (7), very broad (9)
28	Fruit: ratio length/diameter	Very small (1), small (3), medium (5), large (7), very large (9)
29	Fruit: sinuation of pericarp at basal part	Absent or very weak (1), weak (3), medium (5), strong (7), very strong (9)
30	Fruit sinuation of pericarp excluding basal part	Absent (1), weak (3), medium (5), strong (7), very strong (9)
31	Fruit: glossiness Fruit	Very weak (1),weak (3), medium (5), strong (7), very strong (9)
32	Fruit: number of locules:	Predominantly two (1), predominantly three (2), equally three and four (3), predominantly four and more(4)
33	Fruit: depth of interloculary grooves	Absent or very shallow (1), shallow (3), medium (5), deep (7)
34	Time of beginning of flowering (first flower on second flowering node)	Early (3), medium (5), late (7)
35	Time of maturity	very early (1), early (3), medium (5), late (7), very late (9)

Electronic Journal of Plant Breeding, 8(2): 660-667 (June 2017)
ISSN 0975-928X
DOI: 10.5958/0975-928X.2017.00100.4

Table 2. Variability in quantitative characters

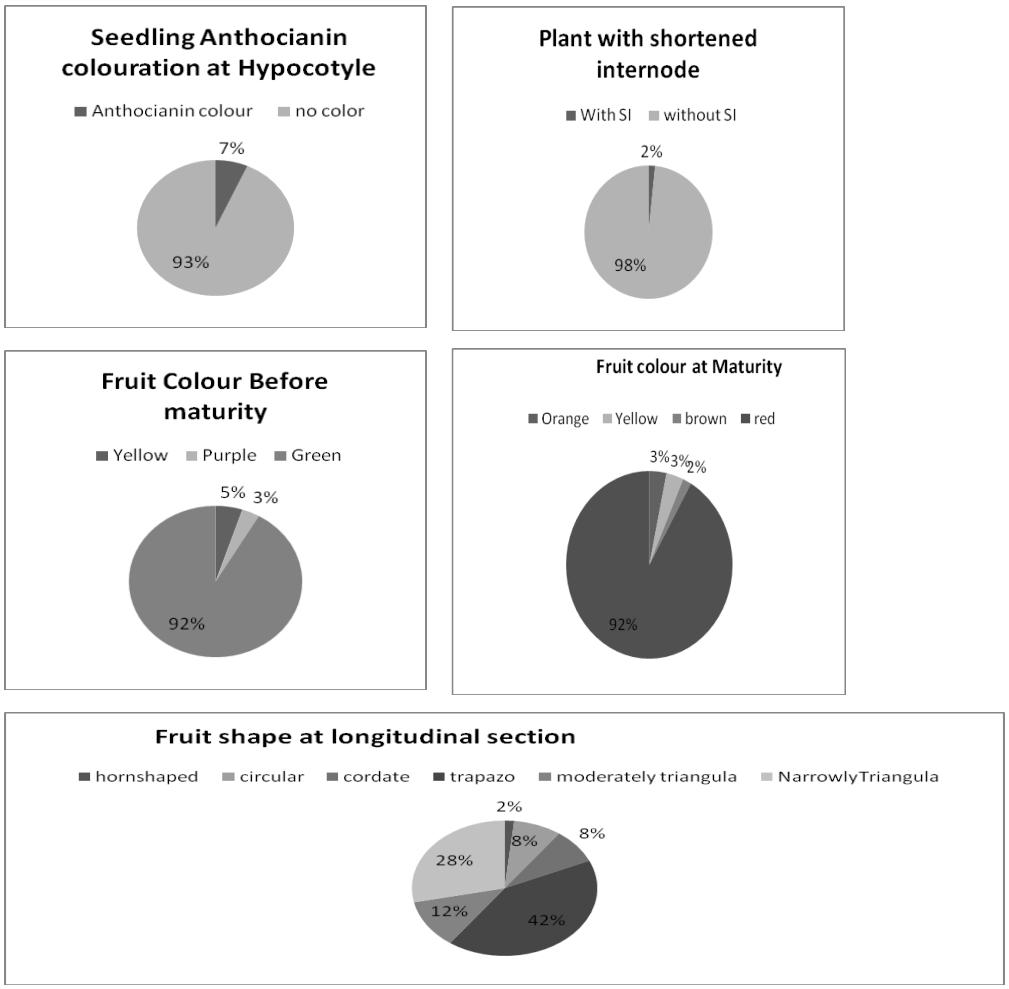
Genotype/ Character	Time of Flowering (days)	Time of Maturity (days)	Internodes (cm)	Plant height (cm)	Leaf length (cm)	Leaf Width (cm)	Fruit length (cm)	Fruit diameter (cm)	FR L/B
SSTC1	46.33	117.00	8.45	78.5	10.27	7.53	6.24	4.43	1.43
SSTC2	39.00	94.17	8.72	75.5	9.53	6.11	9.44	4.59	2.03
SSTC3	45.67	92.50	8.26	84.5	8.00	3.38	8.86	3.39	2.62
SSTC4	46.83	111.00	7.25	84.5	8.72	4.33	7.63	2.87	2.65
SSTC5	56.67	124.50	13.45	78.2	8.89	4.44	5.68	2.96	1.89
SSTC6	51.00	119.00	19.26	78.3	12.54	8.17	8.29	3.32	2.45
SSTC7	46.33	107.00	27.5	98.5	8.20	3.60	5.63	4.47	1.27
SSTC8	61.00	130.67	25.4	98.7	8.95	4.43	10.23	4.40	2.33
SSTC9	61.67	134.50	14.25	97.5	8.47	4.44	7.55	2.72	2.29
SSTC10	56.00	122.50	14.82	105.5	8.18	3.62	6.67	3.22	2.01
SSTC11	39.17	93.33	25.78	106.8	9.04	5.15	6.00	4.58	1.31
SSTC12	49.00	111.00	25.48	68.5	7.49	3.42	9.46	3.58	2.62
SSTC13	56.00	122.17	24.36	67.5	8.54	3.40	6.47	3.58	1.82
SSTC14	54.67	124.00	27.5	69.4	8.46	4.31	8.57	5.08	1.68
SSTC15	60.00	131.00	14.26	74.5	7.16	2.52	7.57	2.95	2.62
SSTC16	63.67	136.50	14.52	75.2	8.60	3.28	9.88	4.58	2.15
SSTC17	51.00	112.33	16.25	74.9	6.42	3.56	5.52	4.63	1.19
SSTC18	54.50	117.33	8.76	68.5	6.39	3.57	7.50	4.66	1.61
SSTC19	54.50	115.00	8.54	106.3	9.27	4.46	8.42	3.00	2.84
SSTC20	46.17	105.17	9.25	102.5	10.42	5.84	10.94	5.33	2.02
SSTC21	47.67	95.00	18.45	86.2	9.50	4.63	7.06	4.72	1.54
SSTC22	35.67	83.33	18.48	82.5	11.11	5.29	7.44	2.84	2.63
SSTC23	53.00	93.83	18.25	95.4	12.60	4.62	6.71	4.65	1.43
SSTC24	35.90	91.33	14.52	95.4	13.44	4.72	8.59	4.79	1.81
SSTC25	53.00	112.00	24.52	67.5	8.51	3.69	9.04	3.01	3.06
SSTC26	57.33	122.00	22.48	62.5	8.54	4.32	6.59	2.74	2.42
SSTC27	56.50	126.50	24.62	62.4	9.67	4.15	5.70	3.67	1.54
SSTC28	56.00	126.00	21.35	64.7	8.01	4.50	9.66	4.58	2.12
SSTC29	50.33	111.33	18.52	78.5	7.77	4.62	7.59	4.37	1.73
SSTC30	57.17	121.83	17.56	75.4	8.28	4.49	11.81	4.43	2.69
SSTC31	58.00	134.50	16.54	72.5	12.43	5.05	6.48	4.50	1.44
SSTC32	64.00	133.50	17.25	64.2	7.63	4.36	6.22	4.37	1.46
SSTC33	47.17	113.67	21.35	64.5	8.36	4.63	5.65	2.72	2.13
SSTC34	51.00	112.67	19.45	68.7	9.32	4.34	8.54	2.77	3.12
SSTC35	48.00	130.50	21.25	67.5	8.01	3.97	9.51	4.73	2.01
SSTC36	47.00	116.00	14.45	77.9	8.70	3.62	5.40	4.64	1.17
SSTC37	53.00	119.50	16.52	77.5	9.36	4.59	8.75	2.96	2.99
SSTC38	55.33	123.83	14.25	74.5	14.14	5.31	4.67	3.05	1.58
SSTC39	47.50	116.33	12.62	74.6	8.11	5.17	6.43	3.39	1.90
SSTC40	48.17	117.83	18.25	69.5	8.64	4.29	7.36	4.80	1.54
SSTC41	52.83	121.67	18.23	65.4	11.13	8.64	5.54	4.65	1.19
SSTC42	45.50	114.00	18.62	68.5	8.04	4.39	8.59	2.86	3.01
SSTC43	46.67	119.17	22.23	66.2	9.70	4.21	10.94	2.81	3.86
SSTC44	46.33	121.50	20.23	64.5	11.42	8.46	9.72	3.28	2.84
SSTC45	45.17	124.33	19.25	66.2	10.66	7.71	7.34	4.68	1.58
SSTC46	48.67	118.17	18.52	67.5	11.08	7.26	7.43	4.73	1.56
SSTC47	51.00	121.00	19.52	74.5	11.42	6.51	7.79	4.52	1.71
SSTC48	53.00	121.17	20.13	74.6	10.92	3.94	4.46	5.28	0.84
SSTC49	47.67	117.00	18.54	77.2	9.51	4.35	6.63	5.38	1.23

DOI: 10.5958/0975-928X.2017.00100.4

Table 2. Contd.,

Genotype/ Character	Time of Flowering (days)	Time of Maturity (days)	Internodes (cm)	Plant height (cm)	Leaf length (cm)	Leaf Width (cm)	Fruit length (cm)	Fruit diameter (cm)	FR L/B
SSTC50	52.00	131.00	19.25	76.5	10.94	7.50	5.78	5.41	1.07
SSTC51	54.33	133.50	21.23	88.2	10.57	3.57	7.72	5.49	1.41
SSTC52	45.67	121.33	20.31	84.5	11.53	4.03	8.37	4.72	1.79
SSTC53	52.83	126.50	14.54	86.3	10.65	3.71	8.87	5.29	1.68
SSTC54	52.67	123.83	14.54	87.4	9.42	4.31	9.50	4.70	2.02
SSTC55	47.33	118.67	13.56	84.3	9.35	4.30	8.70	4.40	1.96
SSTC56	48.33	119.17	14.25	96.5	11.46	5.69	7.48	4.56	1.63
SSTC57	52.67	122.33	9.25	107.5	9.84	4.13	8.55	5.34	1.61
SSTC58	51.00	125.33	8.69	102.3	9.33	6.73	9.58	5.44	1.76
SSTC59	51.00	124.17	10.25	94.2	10.93	7.70	8.66	4.72	1.85
SSTC60	48.00	119.83	10.23	84.2	11.09	7.57	6.54	5.41	1.21
Mean	50.89	117.76	17.06	79.87	9.58	4.91	7.73	4.16	1.95
CD (5%)	1.26	1.64	0.25	1.60	0.41	0.17	0.24	0.22	0.19

Fig. 1. Diversity in five Plant Morphological Grouping traits



DOI: 10.5958/0975-928X.2017.00100.4

Fig. 2. Diversity in stable qualitative traits