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Morphological characterization of bell pepper (*Capsicum annuum* var. *grossum*) genotypes and their application for distinctness, uniformity and stability testing

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ABSTRACT

A study was carried out during 2004–05 on morphological characterization of bell pepper (*Capsicum annuum* L. var. *grossum* Sendt.) and to establish distinctness of the candidate variety from all other varieties. A total of 25 lines of bell pepper were grouped for several agromorphological descriptors. All the genotypes were intermediate/compact in growth habit except genotype 'Mid Way' (prostate) and 'SKAU-SP 614', 'SKAU-SP 609', 'SKAU-SP 633-1', 'SKAU-SP 609-1', 'Rajer collection', 'EC 464107' and 'EC 464115' (erect). Wide diversity (31 to 70 cm) has been observed in plant height. All the genotypes have erect flower position except 'SKAU-SP 633-1', 'Kandaghat selection' (intermediate) and 'Rajer collection' (pendent). The blocky fruit shape, which is most desirable for Indian market was observed in genotypes 'Nishat 1', 'SKAU-SP 614', 'SKAU-SP 616-1', 'SKAU-SP 633-1', 'SKAU-SP 82-1', 'SKAU-SP 648', 'SKAU-SP 601', 'SKAU-SP 609-1', 'Capsicum 143570', 'HC 201', 'Kandaghat selection', 'EC 464107', 'UHF 494', 'California Wonder', 'Mid Way', 'Local Belgam', 'EC 464119' and 'EC 464115'. Almost all the varieties are in green group for fruit colour except 'Russian Yellow' and 'EC 464115' which are in yellow group.

Key words: Bell pepper, *Capsicum annuum* var. *grossum*, Characterization, Genotypes

Capsicum annuum L. var. *grossum* Sendt., popularly known as bell pepper or Shimla *mirch* or sweet pepper is looked as luxury vegetable in the world. It is considered to be a crop of temperate zone, however, it is also being raised in subtropical regions of the country (Singh *et a*l. 1993). This crop is vulnerable to environmental adversities and is therefore, cultivated under poly tunnels or glasshouses in European countries. In India, bell pepper was first introduced by the British in the 19 the century in Shimla hills. The crop is now commercially grown in Himachal Pradesh, Jammu and Kashmir, Andhra Pradesh, Uttranchal and Darjeeling district of West Bengal during summer months and as autumn crop in Maharastra, Karnataka, Tamil Nadu and Bihar with an area of more than 5 500 ha and production of 51 000 metric tonnes, including chillies (FAO 2007). In crop improvement programmes, efforts are being made to develop high-yielding, disease-resistant and stable cultivars. Morphological descriptions of many cultivars are in vague. Further, characterization of bell pepper varieties/genotypes is also required for their protection under Plant Variety Protection (PVP) legislation, because varietal testing for distinctness, uniformity and stability (DUS) is the basis for grant of protection of new plant varieties under the protection of Plant Varieties and Farmer's Right Act, 2001 (PVR & FR Act 2001). The act has provision to compare the candidate variety with the varieties of common knowledge on a set of relevant characteristics prescribed in the 'Minimal Descriptors of Vegetable Crops' for bell pepper (Srivastava *et al.* 2001). Therefore, the present study was undertaken to characterize 25 cultivars/lines of bell pepper on the basis of qualitative morphological characters and to establish distinctness of the candidate variety from all other varieties and also among extant varieties developed in India.

MATERIALS AND METHODS

A total of 25 capsicum genotypes, viz 'Nishat 1', 'SKAU-SP 616-1', 'SKAU-SP 614', 'SKAU-SP 609', 'SKAU-SP 633-1', 'SKAU-SP 82-1', 'SKAU-SP 648', 'SKAU-SP 601', 'SKAU-SP 613-1', 'SKAU-SP 625-4', 'SKAU-SP 609-1', 'Capsicum 143570', 'Capsicum 203602', 'Russian Yellow', 'HC 201', 'EC 218688', 'California Wonder', 'Mid Way', 'Local Belgam', 'UHF 494', 'Kandaghat selection', 'Rajer collection', 'EC 464107', 'EC 464115' and 'EC 464119' were

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Table 1 Characterization of bell pepper genotypes based on morphological characters

Genotype	Plant character					Leaf character				Flower character						Fruit character				
	Plant growth habit	Branching habit	Stem shape	Stem pubescence	Tillering	Leaf colour	Leaf shape	Leaf margin	Leaf pubescence	Flower position	Corolla colour	Stigma exsertion	Calyx pigmentation	Calyx margin constriction	Calyx annular	Fruit shape	Blossom end at fruit shape	Fruit shape pedicle attachment	Blossom end fruit appendage	Fruit surface
'Nishat 1'	5	5	3	3	3	3	2	1	3	7	1	7	0	3	0	5	3	5	0	2
'SKAU-SP 616-1'	5	5	2	3	3	3	2	1	3	7	1	7	0	3	0	5	3	5	0	2
'SKAU-SP 614'	7	5	3	3	3	4	3	1	3	7	1	5	0	3	0	5	3	5	0	1
'SKAU-SP 609'	7	5	2	3	3	3	2	1	3	7	1	7	0	3	0	3	2	4	0	2
'SKAU-SP 633-1'	7	5	2	3	3	3	2	1	3	5	1	5	0	2	0	5	3	5	0	2
'SKAU-SP 82-1'	5	7	2	3	3	3	2	1	3	7	1	5	0	2	0	5	3	4	0	2
'SKAU-SP 648'	5	5	2	3	3	3	2	1	3	7	1	7	0	2	0	5	3	4	0	2
'SKAU-SP 601'	5	5	2	3	3	3	2	1	3	7	1	5	0	3	0	5	3	5	0	1
'SKAU-SP 613-1'	5	5	2	3	3	3	2	1	3	7	1	3	0	2	0	3	1	3	0	1
'SKAU-SP 625-4'	5	5	2	3	3	3	2	1	3	7	1	3	0	2	0	3	2	5	0	1
'SKAU-SP 609-1'	7	5	2	3	3	3	2	1	3	7	1	5	0	2	0	5	3	4	0	2
'Capsicum 143570'	5	5	2	3	3	3	2	1	3	7	1	5	0	2	0	5	3	3	0	1
'Capsicum 203602'	5	5	2	3	3	3	2	1	3	7	1	7	0	2	0	2	3	3	0	2
'HC 201'	7	5	2	3	3	3	2	1	3	7	1	5	0	2	0	5	3	4	0	1
'EC 218688'	5	5	2	3	3	3	2	1	3	7	1	5	0	3	0	3	2	3	0	1
'Russian Yellow'	5	3	2	3	3	3	2	1	3	7	1	3	0	3	0	3	2	4	0	1
'Mid Way'	3	7	2	3	5	3	2	1	3	7	1	7	0	2	0	5	4	5	0	2
'Local Belgam'	5	7	2	3	5	3	3	1	3	7	1	7	0	3	0	5	3	4	0	2
'EC 464119'	5	7	2	3	3	3	2	1	3	7	1	7	0	3	0	5	3	3	0	2
'Rajer collection'	7	5	2	3	3	3	2	1	3	3	1	7	0	3	0	3	2	3	0	2
'Kandaghat selection'	5	5	2	3	3	3	2	1	3	5	1	5	0	3	0	5	4	5	0	1
'EC 464107'	7	5	2	3	3	3	2	1	3	7	1	7	0	2	0	5	4	4	0	2
'EC 464115'	7	5	2	3	3	3	3	1	3	7	1	5	0	2	0	5	3	3	0	2
'UHF 494'	5	5	2	3	3	3	2	1	3	7	1	7	0	2	0	5	3	5	0	2
'California Wonder'	5	7	2	3	5	3	3	1	3	7	1	5	0	2	0	5	4	4	0	2
Status of characteristics according to minimal descriptors of vegetable crops	3. prostate 5.compact 7.erect	3.Sparse 5.intermediate 7.Dense	2.angled 3.flattened	3.sparse	3. sparse 5.intermediate	3 green 4.dark green	2.ovate 3.lanceolate	1.entire	3. sparse	3.pendant 5.intermediate 7.erect	1.white	3.inserted 5.same level7.exserted	0.calyx pigmentation	2.intermediate 3.dentate	0. absent	2.almost round 3.companulate 5.blocky	1.pointed 2.blunt 3.sunken 4.sunken and pointed	3.truncate 4.cordate 5.lobate	0.absent	1.smooth 2.semi-wrinkled

evaluated at experimental farm of Department of Vegetable Science and Floriculture of the university in a randomized block design with three replications over two years (2004 and 2005). Each plot consisted of three m × 2.25 m with inter- and intra-plant distance of 60 and 45 cm, respectively. Cultivars were evaluated for 21 descriptors, viz plant growth habit, branching habit, stem shape, stem pubescence, tillering, leaf colour, leaf shape, leaf margin, leaf pubescence, flower position, corolla colour, stigma exsertion, calyx pigmentation, calyx margin, calyx annular constriction, fruit shape, blossom end fruit shape, fruit shape at pedicel attachment, blossom end fruit appendage, fruit surface and fruit colour with different character states.

The observations were recorded on 10 plants in each replication at specified stages of crop growth period when the characters under study had full expression. The time of flowering was observed at 50% plants with atleast one open flower. Fifteen characters, viz growth habit, branching habit, stem pubescence, stem types, tillering, leaf colour, leaf shape, leaf margin, leaf pubescence, flower position, corolla colour, stigma exsertion, calyx pigmentation, calyx margin, calyx annular constriction were observed at 50% flowering. Similarly, fruit shape at pedicel attachment, blossom end fruit shape, blossom end appendage, fruit surface and fruit colour were observed at horticultural maturity (harvest maturity). Further, one attribute, viz plant height was observed at final picking of bell pepper fruits.

RESULTS AND DISCUSSION

Among the 25 bell pepper genotypes, considerable variation was observed for all the important attributes under study except for stem pubescence, leaf margin, leaf pubescence, corolla colour, calyx annular constriction and blossom end fruit appendage. The characterization of bell pepper genotypes/ varieties under study is presented in Tables 1, 2; frequency distribution of each descriptor of genotypes along with example lines is depicted in Table 3.

In the present study, all the genotypes were intermediate/ compact in growth habit except genotype 'Mid Way' (prostate) and 'SKAU-SP 614', 'SKAU-SP 609', 'SKAU-SP 633-1', 'SKAU-SP 609-1', 'Rajer collection', 'EC 464107' and 'EC 464115' (erect). Genotypes were also classified on the basis of branching habit. The branching habit was intermediate in all the varieties except 'Russian Yellow' (sparse) and 'SKAU-SP 82-1', 'California Wonder', 'Mid Way', 'Local Belgam', 'EC 464115' (dense). Since, bell pepper is grown in the mid hills of Himachal Pradesh during rainy season, a plant type combining indeterminate growth habit, high harvest index and genotypes of longer duration are required. The taller plants are preferred to prevent diseases and ensures fruiting over a longer period. On the basis of evaluation of two years, the utilization of 'Rajer collection' and 'SKAU-SP 609', the potential donors for plant height was suggested to develop suitable cultivars for rainy season and to take the advantage of off-season marketing for a longer period. Khurana *et al*. (2003) suggested that early maturing genotypes were lower in yield in rainy season. 'EC 464115', 'SKAU-SP 616-1', 'EC 464119', 'SKAU-SP 609', 'EC 218688', 'Kandaghat selection' and 'SKAU-SP 633-1' are some of the genotypes present for such situations.

Further, 23 genotypes showed angled stem shape and two genotypes, viz 'Nishat 1' and 'SKAU-SP 614' depicted flattened stem shape. Intermediate tillering was shown by 'California Wonder', 'Mid Way' and 'Local Belgam' while the remaining genotypes showed sparse tillering. Dark-green leaf colour was shown by 'SKAU-SP 614'. All the genotypes had ovate leaf shape except the genotypes, like 'SKAU-SP 614', 'California Wonder', 'Local Belgam' and 'EC 464115' which showed lanceolate leaf shape.

On the basis of flower position, capsicum genotypes have been grouped into three categories, viz erect, intermediate and pendent. In the present study, 22 genotypes were having erect flower position, 2 ('SKAU-SP 633-1' and 'Kandaghat selection') have intermediate and 1('Rajer collection') have pendent flower position. Eleven cultivars, viz 'Nishat 1', 'SKAU-SP 616-1', 'SKAU-SP 609', 'SKAU-SP 648', 'Capsicum 203602', 'Rajer collection', 'EC 464107', 'UHF 494', 'Mid Way', 'Local Belgam' and 'EC 464119' exhibited

Table 2 Fruit colour of 25 capsicum genotypes grown at Palampur

Genotype	Fruit colour*
'Nishat 1'	Medium green (GG 135A)
'SKAU-SP 616-1'	Dark green (GG 136A)
'SKAU-SP 614'	Medium green (GG 135A)
'SKAU-SP 609'	Medium green (GG 136A)
'SKAU-SP 633-1'	Dark green (GG 136A)
'SKAU-SP 82-1'	Medium green (GG 136B)
'SKAU-SP 648'	Dark green (GG 135B)
'SKAU-SP 601'	Dark green (GG 136A)
'SKAU-SP 613-1'	Light green (GG 132A)
'SKAU-SP 625-4'	Dark green (GG 135A)
'SKAU-SP 609-1'	Medium green (GG 143B)
'Capsicum 143570'	Light green (GG 132A)
'Capsicum 203602'	Medium green (GG 135B)
'Russian Yellow'	Yellow (YGG 145 C)
'HC 201'	Medium green (GG 135A)
'EC 218688'	Dark green (GG 135B)
'California Wonder'	Dark green(GG 135A)
'Mid Way'	Dark green (GG 135A)
'Local Belgam'	Dark green(GG 135B)
'UHF 494'	Dark green (GG 135A)
'Kandaghat selection'	Dark green (GG 135B)
'Rajer collection'	Medium green (GG 136A)
'EC 464107'	Dark green (GG 143A)
'EC 464115'	Pale yellow (YGG 145B)
'EC 464119'	Dark green (GG 135B)

*From Royal horticultural Society (RHS) colour charts
GG, Green group; YG; yellow group

Table 3 Frequency distribution and example varieties of some important attributes of 25 genotypes of bell pepper

Plant descriptor	Range in expression	No. of genotype	Genotype
Plant characters			
Plant growth habit	Prostrate	1	'Mid Way'
	Erect	8	'SKAU-SP 614', 'SKAU-SP 609', 'SKAU-SP 633-1', 'SKAU-SP 609-1', 'HC 201', 'Rajer collection', 'EC-464107','EC-464-115'
	Intermediate (compact)	16	'Nishat 1', 'SKAU-SP 616-1', 'SKAU-SP 82-1', 'SKAU-SP 648', 'SKAU-SP 601', 'SKAU-SP 613-1', 'SKAU-SP 625-4', 'Capsicum 143570', 'Local Belgam', 'Capsicum 203602', 'EC 218688', 'Russian Yellow', 'California Wonder', 'EC 464119', 'Kandaghat selection', 'UHF 494'
Branching habit	Sparse	1	'Russian Yellow'
	Intermediate	19	'Nishat 1', 'SKAU-SP 616-1', 'SKAU-SP 614', 'SKAU-SP 609', 'SKAU-SP 633-1', 'SKAU-SP 648', 'SKAU-SP 601', 'SKAU-SP 613-1', 'SKAU-SP 625-4','SKAU-SP 609-1', 'Capsicum 143570', 'Capsicum 203602', 'HC 201', 'EC 218688', 'Rajer collection', 'EC 464107', 'EC 464115', 'Kandaghat selection', 'UHF-494'
Stem shape	Dense	5	'SKAU-SP 82-1', 'California Wonder', 'Mid Way', 'Local Belgam', 'EC-464119'
	Angled	23	'SKAU-SP 616-1', 'SKAU-SP 633-1', 'SKAU-SP 609', 'SKAU-SP 82-1', 'SKAU-SP 648', 'SKAU-SP 601', 'SKAU-SP 613-1', 'SKAU-SP 625-4', 'SKAU-SP 609-1', 'Capsicum 143570', 'Capsicum 203602', 'HC 201', 'EC 218688', 'Rajer collection', 'Kandaghat selection', 'EC 464107', 'UHF 494', 'Russian Yellow', 'California Wonder', 'Mid Way', 'Local Belgam', 'EC 464119', 'EC 464115'
Stem pubescence	Flattened	2	'Nishat 1', 'SKAU-SP 614'
	Sparse	25	'Nishat 1', 'SKAU-SP 614', 'SKAU-SP 616-1', 'SKAU-SP 633-1', 'SKAU-SP 609', 'SKAU-SP 82-1', 'SKAU-SP 648', 'SKAU-SP 601', 'SKAU-SP 613-1', 'SKAU-SP 625-4', 'SKAU-SP 609-1', 'Capsicum 143570', 'Capsicum 203602', 'HC 201', 'EC 218688', 'Rajer collection', 'Kandaghat selection', 'EC 464107', 'UHF 494', 'Russian Yellow', 'California Wonder', 'Mid Way', 'Local Belgam', 'EC 464119', 'EC 464115'
Tillering	Sparse	22	'Nishat 1', 'SKAU-SP 614', 'SKAU-SP 616-1', 'SKAU-SP 633-1', 'SKAU-SP 609', 'SKAU-SP 82-1', 'SKAU-SP 648', 'SKAU-SP 601', 'SKAU-SP 613-1', 'SKAU-SP 625-4', 'SKAU-SP 609-1', 'Capsicum 143570', 'Capsicum 203602', 'HC 201', 'EC-218688', 'Rajer collection', 'Kandaghat selection', 'EC 464107', 'UHF 494', 'Russian Yellow', 'EC 464119', 'EC 464115'
Leaf characters	Intermediate	3	'California Wonder', 'Mid Way', 'Local Belgam'
Leaf colour			
	Green	24	'Nishat 1', 'SKAU-SP 616-1', 'SKAU-SP 633-1', 'SKAU-SP 609', 'SKAU-SP 82-1', 'SKAU-SP 648', 'SKAU-SP 601', 'SKAU-SP 613-1', 'SKAU-SP 625-4', 'SKAU-SP 609-1', 'Capsicum 143570', 'Capsicum 203602', 'HC 201', 'EC 218688', 'Rajer collection', 'Kandaghat selection', 'EC 464107', 'UHF 494', 'Russian Yellow', 'EC 464119', 'EC 464115', 'California Wonder', 'Mid Way', 'Local Belgam'
Leaf shape	Dark green	1	'SKAU-SP 614'
	Ovate	21	'Nishat 1', 'SKAU-SP 616-1', 'SKAU-SP 633-1', 'SKAU-SP 609', 'SKAU-SP 82-1', 'SKAU-SP 648', 'SKAU-SP 601', 'SKAU-SP 613-1', 'SKAU-SP 625-4', 'SKAU-SP 609-1', 'Capsicum 143570', 'Capsicum 203602', 'HC 201', 'EC 218688', 'Rajer collection', 'Kandaghat selection', 'EC 464107', 'UHF 494', 'Russian Yellow', 'EC 464119', 'Mid Way'
	Lanceolate	4	'SKAU-SP 614', 'California Wonder', 'Local Belgam', 'EC 464115'

(Contd...)

Plant descriptor	Range in expression	No. of genotype	Genotype
Leaf margin	Entire	25	'Nishat 1', 'SKAU-SP 614', 'SKAU-SP 616-1', 'SKAU-SP 633-1', 'SKAU-SP 609', 'SKAU-SP 82-1', 'SKAU-SP 648', 'SKAU-SP 601', 'SKAU-SP 613-1', 'SKAU-SP 625-4', 'SKAU-SP 609-1', 'Capsicum 143570', 'Capsicum 203602', 'HC 201', 'EC 218688', 'Rajer collection', 'Kandaghat selection', 'EC 464107', 'UHF 494', 'Russian Yellow', 'California Wonder', 'Mid Way', 'Local Belgam', 'EC 464119', 'EC 464115'
Leaf pubescence	Sparse	25	'Nishat 1', 'SKAU-SP 614', 'SKAU-SP 616-1', 'SKAU-SP 633-1', 'SKAU-SP 609', 'SKAU-SP 82-1', 'SKAU-SP 648', 'SKAU-SP 601', 'SKAU-SP 613-1', 'SKAU-SP 625-4', 'SKAU-SP 609-1', 'Capsicum 143570', 'Capsicum 203602', 'HC 201', 'EC 218688', 'Rajer collection', 'Kandaghat selection', 'EC 464107', 'UHF 494', 'Russian Yellow', 'California Wonder', 'Mid Way', 'Local Contd Contd Table 3Belgam', 'EC 464119', 'EC 464115'
Flower characters			
Flower position	Erect	22	'Nishat 1', 'SKAU-SP 614', 'SKAU-SP 616-1', 'SKAU-SP 609', 'SKAU-SP 82-1', 'SKAU-SP 648', 'SKAU-SP 601', 'SKAU-SP 613-1', 'SKAU-SP 625-4', 'SKAU-SP 609-1', 'Capsicum 143570', 'Capsicum 203602', 'HC 201', 'EC 218688', 'Rajer collection', 'EC 464107', 'UHF 494', 'Russian Yellow', 'California Wonder', 'Mid Way', 'Local Belgam', 'EC 464119', 'EC 464115'
Corolla Colour	Intermediate	2	'SKAU-SP 633-1', 'Kandaghat selection'
	Pendent	1	'Rajer collection'
	White	25	'Nishat 1', 'SKAU-SP 614', 'SKAU-SP 616-1', 'SKAU-SP 633-1', 'SKAU-SP 609', 'SKAU-SP 82-1', 'SKAU-SP 648', 'SKAU-SP 601', 'SKAU-SP 613-1', 'SKAU-SP 625-4', 'SKAU-SP 609-1', 'Capsicum 143570', 'Capsicum 203602', 'HC 201', 'EC 218688', 'Rajer collection', 'Kandaghat selection', 'EC 464107', 'UHF 494', 'Russian Yellow', 'California Wonder', 'Mid Way', 'Local Belgam', 'EC 464119', 'EC 464115'
Stigma exsertion	Exserted	11	'Nishat 1', 'SKAU-SP 616-1', 'SKAU-SP 609', 'SKAU-SP 648', 'Capsicum 203602', 'Rajer collection', 'EC 464107', 'UHF 494', 'Mid Way', 'Local Belgam', 'EC 464119'.
	Same level	11	'SKAU-SP 614', 'SKAU-SP 633-1', 'SKAU-SP 82-1', 'SKAU-SP 601', 'SKAU-SP 609-1', 'Capsicum 143570', 'HC 201', 'EC 218688', 'California Wonder',' Kandaghat selection', 'EC 464115'
Calyx pigmentation	Inserted	3	'SKAU-SP 613-1','SKAU-SP 625-4', 'Russian Yellow'
	Absent	25	'Nishat 1', 'SKAU-SP 614', 'SKAU-SP 616-1', 'SKAU-SP 633-1', 'SKAU-SP 609', 'SKAU-SP 82-1', 'SKAU-SP 648', 'SKAU-SP 601', 'SKAU-SP 613-1', 'SKAU-SP 625-4', 'SKAU-SP 609-1', 'Capsicum 143570', 'Capsicum 203602', 'HC 201', 'EC 218688', 'Rajer collection', 'Kandaghat selection', 'EC464107', 'UHF 494', 'Russian Yellow', 'California Wonder', 'Mid Way', 'Local Belgam', 'EC 464119', 'EC 464115'
Calyx margin	Dentate	12	'Nishat 1', 'SKAU-SP 614', 'SKAU-SP 616-1', 'SKAU-SP 609', 'SKAU-SP 601', 'EC 218688', 'Rajer collection', 'Kandaghat selection', 'UHF 494', 'Russian Yellow', 'Local Belgam', 'EC 464119'
	Intermediate	13	'SKAU-SP 633-1', 'SKAU-SP 82-1', 'SKAU- Contd Table 3SP 648', 'SKAU-SP 613-1', 'SKAU-SP 625-4', 'SKAU-SP 609-1', 'EC-464115', 'Capsicum 143570', 'Capsicum 203602', 'HC 201', 'California Wonder', 'Mid Way', 'EC 464107'
Calyx annular constriction	Absent	25	'Nishat 1', 'SKAU-SP 614', 'SKAU-SP 616-1', 'SKAU-SP 633-1', 'SKAU-SP 609', 'SKAU-SP 82-1', 'SKAU-SP 648', 'SKAU-SP 601', 'SKAU-SP 613-1', 'SKAU-SP 625-4', 'SKAU-SP 609-1', 'Capsicum

(Contd...)

(Concluded Table 3)

Plant descriptor	Range in expression	No. of genotype	Genotype
			143570', 'Capsicum 203602', 'HC 201', 'EC 218688', 'Rajer collection', 'Kandaghat selection', 'EC 464107', 'UHF 494', 'Russian Yellow', 'California Wonder', 'Mid Way', 'Local Belgam', 'EC 464119', 'EC 464115'
Fruit characters			
Fruit shape	Blocky	18	'Nishat 1', 'SKAU-SP 614', 'SKAU-SP 616-1', 'SKAU-SP 633-1', 'SKAU-SP 82-1', 'SKAU-SP 648', 'SKAU-SP 601', 'SKAU-SP 609-1', 'Capsicum 143570', 'HC 201', 'Kandaghat selection', 'EC 464107', 'UHF 494', 'California Wonder', 'Mid Way', 'Local Belgam', 'EC 464119', 'EC 464115'
Blossom end fruit shape	Companulate	3	'SKAU-SP 609', 'SKAU-SP 613-1', 'SKAU-SP 625-4'
	Triangular	3	'EC 218688', 'Russian Yellow', 'Rajer collection'
	Almost round	1	'Capsicum-203602'
	Sunken	15	'Nishat 1', 'SKAU-SP 614', 'SKAU-SP 616-1', 'SKAU-SP 633-1', 'SKAU-SP 82-1', 'SKAU-SP 648', 'SKAU-SP 601', 'SKAU-SP 609-1', 'Capsicum 143570', 'Capsicum 203602', 'HC 201', 'UHF 494', 'Local Belgam', 'EC 464119', 'EC 464115'
Fruit shape at pedicel attachment	Blunt	5	'SKAU-SP 609', 'SKAU-SP 625-4', 'EC 218688', 'Russian Yellow', 'Rajer collection'
	Pointed	1	'SKAU-SP 613-1'
	Sunken and pointed	4	'California Wonder', 'Mid Way', 'Kandaghat selection', 'EC 464107'
	Lobate	9	'Nishat 1', 'SKAU-SP 614', 'SKAU-SP 616-1', 'SKAU-SP 633-1', 'SKAU-SP 601', 'SKAU-SP 625-4', 'Kandaghat selection', 'UHF 494', 'Mid Way'
Blossom end fruit appendage	Cordate	9	'SKAU-SP 609', 'SKAU-SP 82-1', 'SKAU-SP 648', 'SKAU-SP 609-1', 'HC 201', 'Russian Yellow', 'California Wonder', 'Local Belgam', 'EC 464107'
	Truncate	7	'SKAU-SP 613-1', 'Capsicum 143570', 'Capsicum 203602', 'EC 218688', 'EC 464119', 'Rajer collection', 'EC-464115'
	Absent	25	'Nishat 1', 'SKAU-SP 614', 'SKAU-SP 616-1', 'SKAU-SP 633-1', 'SKAU-SP 609', 'SKAU-SP 82-1', 'SKAU-SP 648', 'SKAU-SP 601', 'SKAU-SP 613-1', 'SKAU-SP 625-4', 'SKAU-SP 609-1', 'Capsicum 143570', 'Capsicum 203602', 'HC 201', 'EC 218688', 'Rajer Collection', 'Kandaghat Selection', 'EC 464107', 'UHF 494', 'Russian Yellow', 'California Wonder', 'Mid Way', 'Local Belgam', 'EC 464119', 'EC 464115'
Fruit surface	Semi-wrinkled	16	'Nishat 1', 'SKAU-SP 616-1', 'SKAU-SP 633-1','SKAU-SP 609','SKAU-SP 82-1', 'SKAU-SP 648','SKAU-SP 609-1','Capsicum 203602', 'Rajer collection', 'EC 464107', 'UHF 494', 'California Wonder', 'Mid Way', 'Local Belgam', 'EC 464119', 'EC 464115'
	Smooth	9	'SKAU-SP 614', 'SKAU-SP 601', 'SKAU-SP 613-1', 'SKAU-SP 625-4', 'Capsicum 143570', 'HC 201', 'Russian Yellow', 'Kandaghat selection', 'EC 218688'
Fruit colour	Dark-green	13	'SKAU-SP 616-1', 'SKAU-SP 633-1', 'SKAU-SP 648', 'SKAU-SP 601', 'SKAU-SP 625-4', 'EC 218688', 'California Wonder', 'Mid Way', 'Local Belgam', 'EC 464119', 'Kandaghat selection', 'EC 464107', 'UHF 494'.
	Medium-green	8	'Nishat 1', 'SKAU-SP 614', 'SKAU-SP 609', 'SKAU-SP 82-1', 'SKAU-SP 609-1', 'Capsicum 203602', 'HC 201', 'Rajer collection'
	Light-green	2	'SKAU-SP 613-1', 'Capsicum 143570'
	Yellow	1	'Russian Yellow'
	Pale-yellow	1	'EC 464115'

exerted stigma while other genotypes, like 'SKAU-SP 614', 'SKAU-SP 633-1', 'SKAU-SP 82-1', 'SKAU-SP 601', 'SKAU-SP 609-1', 'Capsicum 143570', 'HC 201', 'EC 218688', 'California Wonder', 'Kandaghat selection', 'EC 464115' depicted stigma exsertion at same level and the remaining three, viz 'SKAU-SP 613-1', 'SKAU-SP 625-4' and 'Russian Yellow' showed inserted stigma exsertion. In the present study, 12 genotypes ('Nishat 1', 'SKAU-SP 614', 'SKAU-SP 616-1', 'SKAU-SP 609', 'SKAU-SP 601', 'EC 218688', 'Rajer collection', 'Kandaghat selection', 'UHF 494', 'Russian Yellow', 'Local Belgam' and 'EC 464119') depicted dentate calyx margin and others were intermediate.

Four type of fruit shape (blocky, companulate, triangular and almost round) are present in capsicum genotypes. In the present study, all the cultivars were blocky, except 'SKAU-SP 609', 'SKAU-SP 613-1', 'SKAU-SP 625-4' (companulate), 'EC 218688', 'Russian Yellow', 'Rajer collection' (triangular) and 'Capsicum 203602' (almost round). Genotypes were also classified on the basis of blossom end fruit shape. The shape was sunken for 15 genotypes, blunt for 5('SKAU-SP 609', 'SKAU-SP 625-4', 'EC 218688', 'Russian Yellow', 'Rajer collection'), pointed for 1('SKAU-SP 613-1') and sunken pointed for 4 ('California Wonder', 'Mid Way', 'Kandaghat selection', 'EC 464107') genotypes. Lobate fruit shape at pedicel attachment was shown by 'Nishat 1', 'SKAU-SP 614', 'SKAU-616-1', 'SKAU-SP 633-1', 'SKAU-SP 601', 'SKAU-SP 625-4', 'Kandaghat selection', 'UHF 494' and 'Mid Way' where as cordate fruit shape was depicted in 9 genotypes 'SKAU-SP 609', 'SKAU-SP 82-1', 'SKAU-SP 648', 'SKAU-SP 609-1', 'HC 201', 'Russian Yellow', 'California Wonder', 'Local Belgam' and 'EC 464107' while truncate fruit shape at pedicel attachment was observed in 7 genotypes, viz 'SKAU-SP 615', 'Capsicum 143570', 'Capsicum 203602', 'EC 218688', 'EC 464119', 'Rajer collection' and 'EC 464115'. Fruit surface is also an important attribute and genotypes 'SKAU-SP 614', 'SKAU-SP 601', 'SKAU-SP 613-1', 'SKAU-SP 625-4', 'Capsicum 143570', 'HC 201', 'Russian Yellow', 'Kandaghat selection', 'EC 218688' showed smooth surface. Further, fruit colour also exhibited much variability. In the present study, 13 varieties ('SKAU-SP 616-1', 'SKAU-SP 633-1', 'SKAU-SP 648', 'SKAU-SP 601', 'SKAU-SP 625-4', 'EC 218688', 'California Wonder', 'Mid Way', 'Local Belgam', 'EC 464119', 'Kandaghat selection', 'EC 464107', 'UHF 494') showed dark green colour while 8 genotypes ('Nishat 1', 'SKAU-SP 614', 'SKAU-SP 609', 'SKAU-SP 82-1', 'SKAU-SP 609-1', 'Capsicum 203602', 'HC 201', 'Rajer collection') depicted medium green fruit colour. The genotypes 'SKAU-SP 613-1' and 'Capsicum 143570' showed light-green fruit colour, 'Russian Yellow' depicted yellow fruit colour, whereas 'EC 464115' was pale-yellow.

The fruit/plant was significantly correlated with yield / plant (Sreelathakumary and Rajamony 2002). The fruits can be increased by increasing the plant height and branches/ plant. Plant height and primary branches generally has positive correlation with yield/plant. Branches/plant, a direct component-contributing towards fruit yield, was maximum in 'Kandaghat selection'. Further, an increase in branch number would lead to compact plant type and decreased fruit diameter and fruit weight (Sarma and Roy 1995). Since, bell pepper is grown in the mid hills of Himachal Pradesh during rainy season this suggested that there is a need to develop taller plants to prevent diseases, having three to four branches, more fruits/plant with average fruit weight of 30–50 g. Further, it is also suggested that plants that produce more leaf area along with bigger fruit size would also be desirable. In the present study, genotypes 'SKAU-SP 633-1', 'SKAU-SP 648', 'SKAU-SP 601', 'SKAU-SP 625-4' and 'EC 464107' showed dark green fruit colour, desirable for Indian market along with higher yield. Genotype 'EC 464115' was high yielder, among the yellow green group. Adetula and Olakojo (2006) observed significant differences among the genotypes for fruit colour at maturity and fruit position.

On the basis of present preliminary characterization, these lines are grouped into different categories for each character and may be used as reference genotypes.

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