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THE DUS CHARACTERIZATION IN BELL PEPPER (*Capsicum annuum* L.)

D Arti*, D K Mehta and A Sharma

Department of Vegetable Science
Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan - 173 230, Himachal Pradesh

Sweet pepper (Capsicum annuum) is a popular fresh vegetable in the world, because of the combination of colour, taste, and nutritional value The Capsicum genus consists of about 30 wild species and 5 domesticated species: *Capsicum annuum, C. baccatum, C. chinense, C. frutescense C. pubescens* (Dewitt and Bosland, 1996; Sikora and Nowaczyk, 2014). Regarding the fertilization system, domesticated

Presence of variability in a base population is important for any improvement programme. Collection, conservation and maintenance of genotypes are important to develop new varieties. Morphological descriptions of cultivars have proved reliable and provided the basis of assurance to farmers and merchants that they are being offered specific varieties or classes of product to certain minimum standards of quality and purity. Nowadays many tools are available to study relationships among cultivars including various types of molecular markers, however, morphological characterization is the first step in description and classification. 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 database of bell pepper varieties generated may be useful for the selection of suitable varieties to be compared against the candidate varieties developed in India as and when required.

Experimental site

The experiment was conducted at the Research Farm of the Department of Vegetable Science, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan (HP) in a randomized complete block design with three replications in 2021. The climate of the Experimental Research Farm is sub-humid, sub-temperate with cool winters. Generally, May and June are the hottest months and December and January are the coldest ones. It experiences 1100-1300 mm rainfall annually, most of which occurs during the South-West monsoon (June-August).

Plant materials, design and layout of the experiment

Twenty-three promising lines and four varieties were evaluated for morphological characters. Thirty days old seedlings were transplanted in the main field following a randomized complete block design (RCBD) with three replications. Each plot was made of 3.0 m × 1.8 m area with a spacing of 60 cm × 45 cm, which accommodates 20 plants per plot.

Data collection

The observations were recorded on ten plants in each replication at specified stages of the crop growth period when the characters under study had full expression. Twenty characters *viz*., branching habit, stem pubescence, leaf colour, leaf shape, leaf margin, leaf pubescence, flower position, corolla colour, anther colour, filament colour, stigma exsertion, calyx pigmentation, calyx margin, calyx annular, stem colour, nodal anthocyanin, number of flowers per axil, corolla shape, anthocyanin colouration of nodes, intensity of anthocyanin colour of nodes were observed at 50 per cent flowering. Plant growth habit and plant height was observed when 50 per cent of the plants bear ripe fruits. Similarly, fruit shape at pedicel attachment, blossom end fruit shape, blossom end appendage and fruit surface were observed at horticultural maturity (harvest maturity) whereas leaf density was observed at healthy, mature plants.

Physio-morphological traits

Three types of plant growth habits were observed among the genotypes. Intermediate plant growth habit was found to be dominated among the genotypes (59.36 %) followed by prostrate (25.93 %) and erect (14.81). Two types of plant height were observed in this study. Of which, 66.67 % genotypes had medium plant height followed by short height genotypes (33.33 %). Among 27 genotypes, 15 genotypes exhibited intermediate type of branching habit while 6 had sparse and rest of the genotypes had dense branching

*Corresponding author : divyaarti091993@gmail.com
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habit. All the genotypes had sparse stem pubescence. Two types of stem colour were observed among the genotypes. Twenty-five genotypes had green stem colour whereas 2 genotypes exhibited green with purple stripes (UHF CAP-3 and Arka Basant). A wide variation was observed in nodal anthocyanin among different genotypes. Sixteen genotypes showed light purple nodal anthocyanin (59.26 %), 7 genotypes had green nodal anthocyanin (25.93 %) whereas 3 genotypes had purple and Arka Basant had dark purple nodal anthocyanin. In 20 genotypes anthocyanin colouration of nodes was absent and rest of the genotypes had anthocyanin colouration. Intensity of anthocyanin colour of nodes exhibited either medium or strong (Table 3). Twenty-five genotypes had medium intensity and rest of the 2 genotypes had strong anthocyanin intensity. Three types of leaf colour were observed among the 27 genotypes i.e. dark green, green and light green. 17 genotypes had green leaf colour whereas 5 genotypes had dark green and rest of the 5 genotypes had light green. Three types of leaf shape were observed among the genotypes. Ovate type of leaf shape was observed in 12 genotypes whereas 9 genotypes had deltoid and rest 6 genotypes had lanceolate leaf shape (Fig. 1). There was no variation among the 27 genotypes for leaf margin because all the genotypes had an entire leaf margin.

There was no variation observed in the leaf pubescence because all of the genotypes had sparse pubescence. Leaf density varied to sparse, intermediate and dense. Intermediate leaf density was found to be dominated among the genotypes (62.96 %) followed

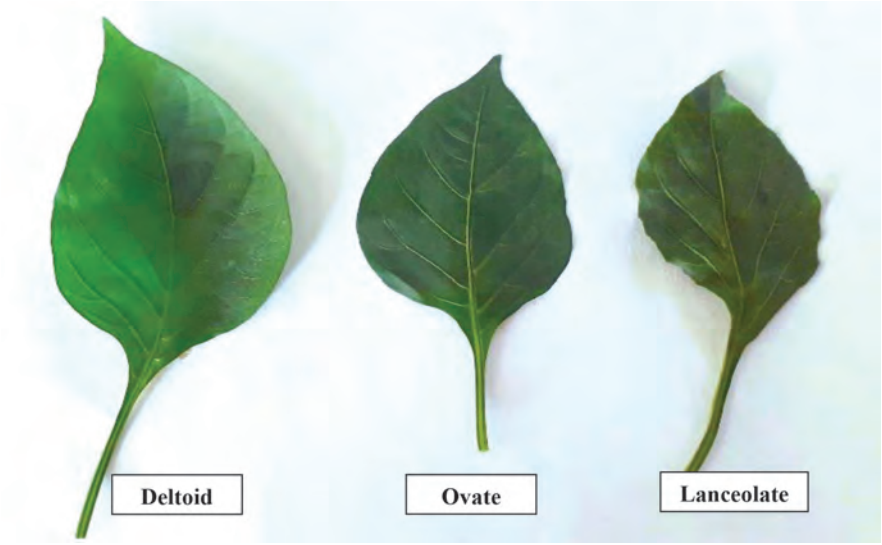

Fig. 1. Leaf shape of bell pepper

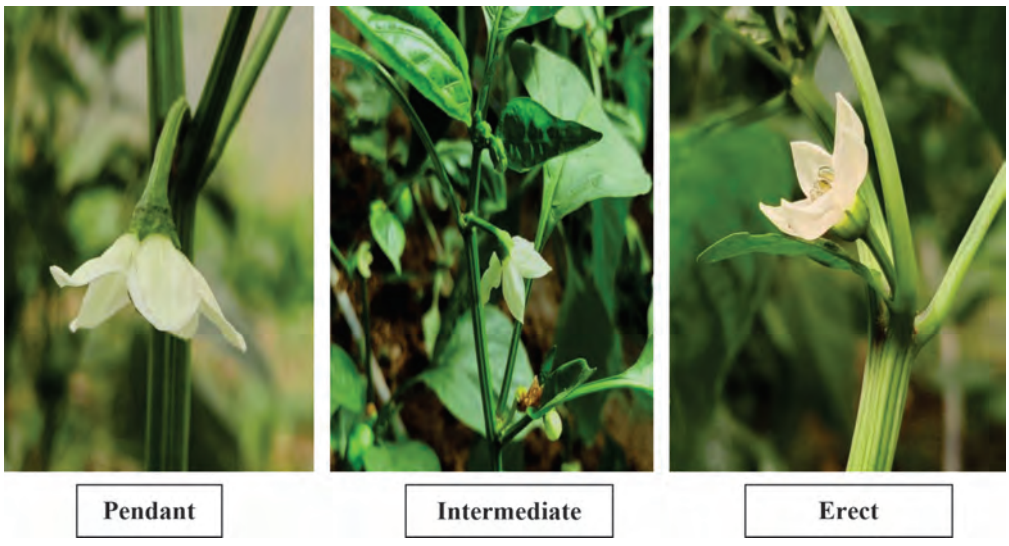

Fig. 2. Flower position of bell pepper

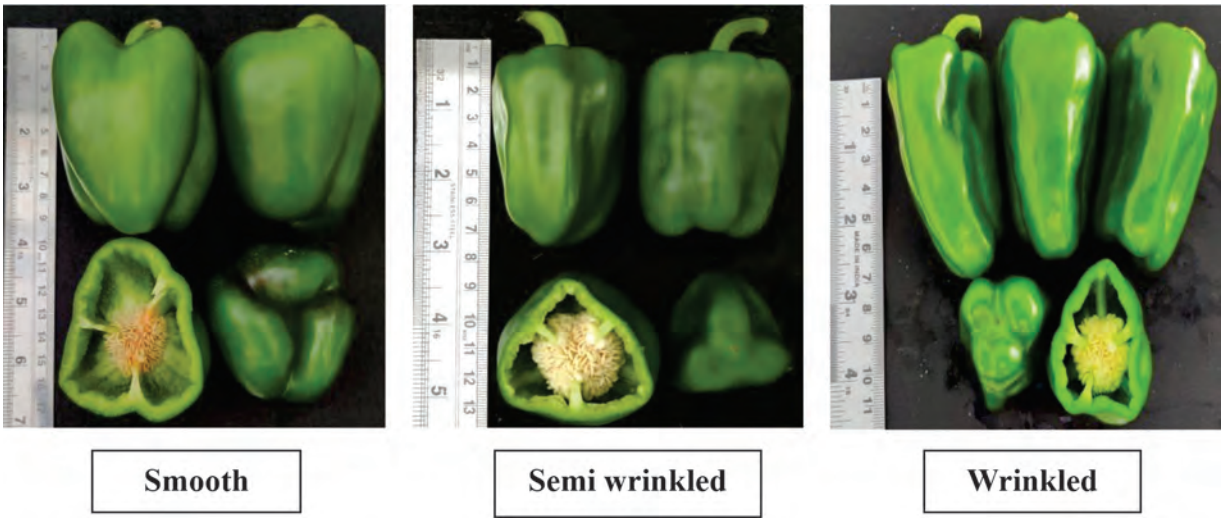

Fig. 3. Fruit surface of bell pepper

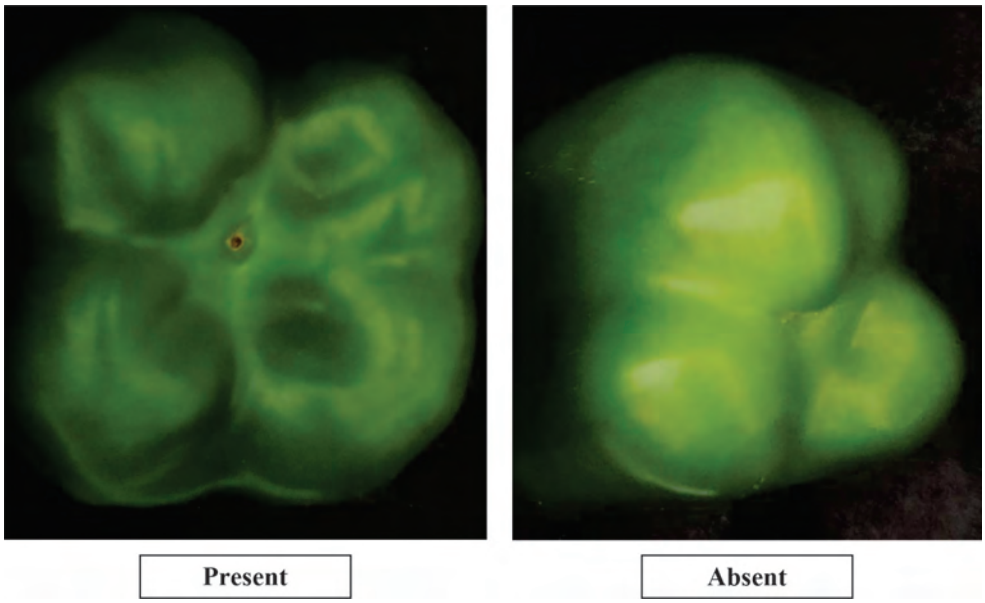

Fig. 4. Blossom end fruit appendages

by sparse (22.22%) and dense (14.82%). Number of flowers per axil varied from one, two and other. Fourteen genotypes had other numbers of flowers per axil whereas 12 genotypes had one flower per axil and UHF CAP-3 had two flowers per axil. Three types of flower positions viz: erect, intermediate and pendant were observed among genotypes (Fig 2). Intermediate flower position was found to be dominant among the genotypes (51.85 %) followed by pendant (25.93 %) and erect (22.22 %). Three types of stigma positions were observed in 27 genotypes i.e. inserted, exserted and at same level. Stigma position is an important character influencing pollination behaviour of the crop. Twelve genotypes showed exserted stigma (44.44 %) whereas ten genotypes showed stigma at same level (37.04 %) and rest of the genotypes showed inserted stigma (18.52 %). There was no calyx pigmentation in all the studied genotypes. Among 27 genotypes, 14 genotypes had intermediate calyx margin whereas, 12 genotypes had dentate calyx margin and UHF CAP-29 had entire calyx margin. Calyx annular were absent in all the genotypes under this study. Anther colour would be helpful in grouping of genotypes Three types of anther colour were reported i.e. yellow, purple and pale blue. Pale blue colour was observed in 23 genotypes whereas, 2 genotypes had yellow and rest of the 2 genotypes had purple colour of anther. White colour of filament was recorded in all the genotypes under

Table 1. Data of morphological traits scored in the twenty-seven genotypes according to the PPV&FR for the conduct of tests for Distinctness, Uniformity and Stability on bell pepper

Descriptor	Acronym	Score scale
Plant growth habit	PGH	3, Prostrate; 5, Intermediate; 7, Erect
Plant height	PH	1, Very short; 3, short; 5, medium; 7, tall; 9, very tall
Branching habit	BrH	3, Sparse; 5, Intermediate; 7, Dense
Stem pubescence	SP	3, Sparse; 5, Intermediate; 7, Dense
Stem colour	SC	1, Green; 2, Green with purple stripes; 3, Purple; 4,Other
Nodal anthocyanin	NA	1, Green; 3, Light Purple; 5, Purple; 7, Dark Purple
Anthocyanin colouration of nodes	ACrN	1, Absent; 9, Present
Intensity of anthocyanin colour of nodes	InACN	1, Very weak; 3, Weak; 5, Medium; 7, Strong; 9, Very strong
Leaf color	LC	1, Yellow; 2, Light Green; 3, Green; 4, Dark Green; 5, Light Purple; 6, Purple; 7, Variegated; 8, Other
Leaf shape	LS	1, Deltoid; 2, Ovate; 3, Lanceolate
Leaf margin	LM	1, Entire; 2, Undulate; 3, Ciliate
Leaf pubescene	LP	3, Sparse; 5, Intermediate; 7, Dense
Leaf density	LD	3, Sparse; 5, Intermediate; 7, Dense
Flower position	FP	3, Pendant; 5, Intermediate; 7, Erect
Stigma exsertion	SE	3, Inserted; 5, Same level; 7, Exserted
Calyx pigmentation	CP	0, Absent; 1, Present
Calyx margin	CM	1, Entire; 2, Intermediate; 3, Dentate; 4, Other
Calyx annular	CA	0, Absent; 1, Present
Anther colour	AC	1, White; 2, Yellow; 3, Pale blue; 4, Blue; 5, Purple; 6, Other
Filament colour	FC	1, White; 2, Yellow; 3, Green; 4, Blue; 5, Light Purple; 6, Purple; 7, Other
Number of flowers per axil	NFA	1, One; 2, Two; 3, Three or more; 4, Many flowers in bunches but each in individual axil (fasciculate growth); 5, Other (i.e. cultivars with two flowers in the first axil and with one only in the other)
Corolla shape	CS	1, Rotate; 2, Campanulate; 3, Other
Fruit shape	FrS	1, Oblate; 2, Circular; 3, Cordate; 4, Square; 5, Rectangular; 6, Trapezoidal; 7, Moderately triangular; 8, Narrowly triangular; 9, Hornshaped
Fruit surface	FrSr	1, Smooth; 2, Semi wrinkled; 3, Wrinkled
Fruit shape at pedicle attachment	FrSPAt	1, Acute; 2, Obtuse; 3, Truncate; 4, Cordate; 5, Lobate
Blossom end fruit appendages	BEFrA	0, Absent; 1, Present
Fruit shape at blossom end	FrSBE	1, Pointed; 2, Blunt; 3, Sunken; 4, Sunken and pointed; 5, Other

study. There was no variation among the 27 genotypes for corolla shape because all the genotypes produced campanulate shape corolla. Fruit shape varied from square, trapezoidal, rectangular, cordate. Square fruit shape was reported in 18 genotypes whereas, 7 genotypes had rectangular fruit shape, UHF CAP-31 had trapezoidal and Solan Bharpur reported cordate fruit shape. Three main types of fruit surface i.e. smooth, semi-wrinkled and wrinkle were recorded in this experiment (Fig 3). Thirteen genotypes showed semi-wrinkled fruit surface whereas eleven showed smooth surface. Rest of the genotypes showed wrinkled fruit surface (Table 3). Variation was observed among the 27 genotypes in fruit shape at pedicle attachment. Lobate shape at pedicle attachment predominated among the genotypes studied. 23 genotypes had no blossom end fruit appendages whereas, rest of the genotypes had blossom end appendages. Three main types; sunken, pointed and sunken and pointed fruit shape at blossom end were observed in this experiment. Sunken shape at blossom end was dominated in 23 genotypes whereas 3 showed pointed shape. Rest of the genotypes

Table 2. Morphological characterization in bell pepper (*Capsicum annuum* L.) genotypes

Genotypes	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
UHF CAP-1	7	5	3	3	1	3	9	7	4	2	1	3	3	5	3	0	3	0	2	1	1	2	4	3	5	0	3
UHF CAP-2	5	3	5	3	1	1	9	5	3	1	1	3	7	5	7	0	2	0	2	1	1	2	5	3	4	0	3
UHF CAP-3	3	5	7	3	2	5	9	5	3	3	1	3	7	7	7	0	3	0	5	1	2	2	4	3	4	0	3
UHF CAP-4	5	5	5	3	1	1	9	5	2	1	1	3	5	5	7	0	3	0	3	1	5	2	4	2	4	1	3
UHF CAP-13	3	5	7	3	1	1	1	5	3	1	1	3	7	5	7	0	2	0	3	1	1	2	5	1	5	1	3
UHF CAP-20	3	5	7	3	1	3	9	5	3	2	1	3	7	5	5	0	2	0	3	1	5	2	4	1	5	0	4
UHF CAP-21	3	3	5	3	1	1	9	5	2	3	1	3	5	5	5	0	2	0	5	1	1	2	4	1	3	0	3
UHF CAP-22	5	5	5	3	1	3	9	5	3	2	1	3	5	5	5	0	2	0	3	1	5	2	5	1	5	0	3
UHF CAP-23	5	5	5	3	1	1	9	5	3	2	1	3	5	7	7	0	3	0	3	1	5	2	4	2	4	0	3
UHF CAP-24	5	5	3	3	1	3	9	5	3	2	1	3	5	7	7	0	3	0	3	1	1	2	4	2	4	0	3
UHF CAP-25	5	5	5	3	1	1	9	5	3	1	1	3	3	5	5	0	2	0	3	1	5	2	4	1	4	0	3
UHF CAP-26	7	5	5	3	1	3	9	5	3	1	1	3	3	5	3	0	2	0	3	1	5	2	5	1	3	0	3
UHF CAP-27	5	5	5	3	1	3	9	5	3	2	1	3	5	3	3	0	3	0	3	1	1	2	4	1	5	0	1
UHF CAP-29	5	3	3	3	1	3	9	5	3	2	1	3	3	3	5	0	1	0	3	1	5	2	4	2	5	0	1
UHF CAP-30	5	3	3	3	1	3	9	5	3	3	1	3	3	3	7	0	3	0	3	1	5	2	5	2	5	0	3
UHF CAP-31	5	5	5	3	1	5	9	5	3	3	1	3	5	3	5	0	2	0	3	1	1	2	6	2	5	0	1
UHF CAP-32	5	5	3	3	1	5	9	7	4	1	1	3	5	5	5	0	3	0	3	1	5	2	4	1	5	0	3
UHF CAP-33	7	5	3	3	1	3	9	5	3	2	1	3	3	5	3	0	3	0	3	1	5	2	5	1	5	0	3
Arka Basant	5	3	5	3	2	7	9	5	2	2	1	3	5	7	5	0	3	0	3	1	5	2	5	2	5	1	1
Solan Bharpur	3	3	5	3	1	3	9	5	4	3	1	3	5	5	5	0	2	0	3	1	5	2	3	2	5	1	3
California Wonder	5	5	5	3	1	1	9	5	3	1	1	3	5	7	7	0	2	0	3	1	5	2	4	1	3	0	3
Yolo Wonder	5	3	5	3	1	3	1	5	3	2	1	3	5	7	7	0	2	0	3	1	5	2	4	1	4	0	3
IIHR-35	3	3	7	3	1	3	9	5	4	1	1	3	5	5	7	0	3	0	3	1	1	2	4	2	5	0	1
IIHR-36	3	5	7	3	1	3	9	5	4	1	1	3	5	3	7	0	3	0	3	1	1	2	4	2	5	0	1
IIHR-37	5	5	7	3	1	3	9	5	3	2	1	3	5	3	3	0	2	0	3	1	1	2	4	2	4	0	1
IIHR-38	7	5	5	3	1	3	9	5	5	2	1	3	5	5	7	0	2	0	3	1	1	2	4	2	5	0	1
IIHR-39	5	3	5	3	1	3	9	5	5	3	1	3	5	3	5	0	2	0	3	1	1	2	4	2	4	0	1

Descriptors: 1:Plant growth habit, 2: Plant height, 3: Branching habit, 4: Stem pubescence, 5: Stem colour, 6: Nodal anthocyanin, 7: Anthocyanin colouration of nodes, 8: Intensity of anthocyanin colour of nodes, 9: Leaf color, 10: Leaf shape, 11: Leaf margin, 12: Leaf pubescence, 13: Leaf density, 14: Flower position, 15: Stigma exsertion, 16: Calyx pigmentation, 17: Calyx margin, 18: Calyx annular, 19: Anther colour, 20: Filament colour, 21: Number of flowers per axil, 22: Corolla shape, 23: Fruit shape, 24: Fruit surface 25: Fruit shape at pedicle attachment, 26: Blossom end fruit appendages, 27: Fruit shape at blossom end

Table 3. Frequency distribution and example varieties of some important attributes of twenty-seven genotypes of bell pepper

Plant descriptor	Range in expression	Number of genotypes	Frequency	Genotypes
Plant growth habit	Erect	4	14.81	UHF CAP-1, UHF CAP-26, UHF CAP-33, IIHR-38
	Intermediate	16	59.36	UHF CAP-2, UHF CAP-4, UHF CAP-22, UHF CAP-23, UHF CAP-24, UHF CAP-25, UHF CAP-27, UHF CAP-29, UHF CAP-30, UHF CAP-31, UHF CAP-32, Arka Basant, California Wonder, Yolo Wonder, IIHR-37, IIHR-39
	Prostrate	7	25.93	UHF CAP-3, UHF CAP-13, UHF CAP-20, UHF CAP-21, Solan Bharpur, IIHR-35, IIHR-36
Plant height	Short	9	33.33	UHF CAP-2, UHF CAP-21, UHF CAP-29, UHF CAP-30, Arka Basant, Solan Bharpur, Yolo Wonder, IIHR-35, IIHR-39
	Medium	18	66.67	UHF CAP-1, UHF CAP-3, UHF CAP-4, UHF CAP-13, UHF CAP-20, UHF CAP-22, UHF CAP-23, UHF CAP-24, UHF CAP-25, UHF CAP-26, UHF CAP-27, UHF CAP-29, UHF CAP-31, UHF CAP-32, California Wonder, IIHR-36, IIHR-37, IIHR-38
Branching habit	Sparse	6	22.22	UHF CAP-1, UHF CAP-24, UHF CAP-29, UHF CAP-30, UHF CAP-32, UHF CAP-33
	Intermediate	15	55.56	UHF CAP-2, UHF CAP-4, UHF CAP-21, UHF CAP-22, UHF CAP-23, UHF CAP-25, UHF CAP-26, UHF CAP-27, UHF CAP-31, Arka Basant, Solan Bharpur, California Wonder, Yolo Wonder, IIHR-38, IIHR-39
	Dense	6	22.22	UHF CAP-3, UHF CAP-13, UHF CAP-20, IIHR-35, IIHR-36, IIHR-37
Stem pubescence	Sparse	27	100	UHF CAP-1, UHF CAP-2, UHF CAP-3, UHF CAP-4, UHF CAP-13, UHF CAP-20, UHF CAP-21, UHF CAP-22, UHF CAP-23, UHF CAP-24, UHF CAP-25, UHF CAP-26, UHF CAP-27, UHF CAP-29, UHF CAP-30, UHF CAP-31, UHF CAP-32, UHF CAP-33, Arka Basant, Solan Bharpur, California Wonder, Yolo Wonder, IIHR-35, IIHR-36, IIHR-37, IIHR-38, IIHR-39
Stem colour	Green	25	92.60	UHF CAP-1, UHF CAP-2, UHF CAP-4, UHF CAP-13, UHF CAP-20, UHF CAP-21, UHF CAP-22, UHF CAP-23, UHF CAP-24, UHF CAP-25, UHF CAP-26,UHF CAP-29 ,UHF CAP-30, UHF CAP-31, UHF CAP-32, UHF CAP-33, Solan Bharpur, California Wonder, Yolo Wonder, UHF CAP-27, IIHR-35, IIHR-36, IIHR-37, IIHR-38, IIHR-39
	Green with purple stripes	2	7.40	UHF CAP-3, Arka Basant
Nodal anthocyanin	Green	7	25.93	UHF CAP-2, CAP-4, UHF CAP-13, UHF CAP-21, UHF CAP-23, UHF CAP-25, California Wonder
	Light purple	16	59.26	UHF CAP-1, UHF CAP-20, UHF CAP-22, UHF CAP-24, UHF CAP-25, UHF CAP-26, UHF CAP-27, UHF CAP-29, UHF CAP-33, Solan Bharpur, Yolo Wonder, IIHR-35, IIHR-36, IIHR-37, IIHR-38, IIHR-39
	Purple	3	11.11	UHF CAP-3, UHF CAP-31, UHF CAP-32
	Dark purple	1	3.70	Arka Basant
Anthocyanin colouration of nodes	Absent	20	74.07	UHF CAP-1, UHF CAP-2, UHF CAP-3, UHF CAP-4, UHF CAP-20, UHF CAP-21, UHF CAP-22, UHF CAP-23, UHF CAP-24, UHF CAP-25, UHF CAP-26, UHF CAP-29, UHF CAP-30, UHF CAP-31, UHF CAP-32, UHF CAP-33, Arka Basant, Solan Bharpur, California Wonder, Yolo Wonder
	Present	7	25.93	UHF CAP-13, UHF CAP-27, IIHR-35, IIHR-36, IIHR-37, IIHR-38, IIHR-39

Plant descriptor	Range in expression	Number of genotypes	Frequency	Genotypes
Intensity of anthocyanin colour of nodes	Medium	25	92.59	UHF CAP-2, UHF CAP-3, UHF CAP-4, UHF CAP-13, UHF CAP-20, UHF CAP-21, UHF CAP-22, UHF CAP-23, UHF CAP-24, UHF CAP-25, UHF CAP-26, UHF CAP-27, UHF CAP-29, UHF CAP-30, UHF CAP-31, UHF CAP-33, Arka Basant, Solan Bharpur, California Wonder, Yolo Wonder, IIHR-35, IIHR-36, IIHR-37, IIHR-38, IIHR-39
	Strong	2	7.41	UHF CAP-1, UHF CAP-32
Leaf color	Dark green	5	18.52	UHF CAP-1, UHF CAP-32, Solan Bharpur, IIHR-35, IIHR-36
	Green	17	62.96	UHF CAP-2, UHF CAP-3, UHF CAP-13, UHF CAP-20, UHF CAP-22, UHF CAP-23, UHF CAP-24, UHF CAP-25, UHF CAP-26, UHF CAP-27, UHF CAP-29, UHF CAP-30, UHF CAP-31, UHF CAP-33, California Wonder, Yolo Wonder, IIHR-37
	Light green	5	18.52	UHF CAP-4, UHF CAP-21, Arka Basant, IIHR-38, IIHR-39
Leaf shape	Deltoid	9	33.33	UHF CAP-2, UHF CAP-4, UHF CAP-13, UHF CAP-25, UHF CAP-26, UHF CAP-32, California Wonder, IIHR-35, IIHR-36
	Ovate	12	44.44	UHF CAP-1, UHF CAP-20, UHF CAP-22, UHF CAP-23, UHF CAP-24, UHF CAP-27, UHF CAP-29, UHF CAP-33, Arka Basant, Yolo Wonder, IIHR-37, IIHR-38
	Lanceolate	6	22.22	UHF CAP-3, UHF CAP-21, UHF CAP-30, UHF CAP-31, Solan Bharpur, IIHR-39
Leaf margin	Entire	27	100	UHF CAP-1, UHF CAP-2, UHF CAP-3, UHF CAP-4, UHF CAP-13, UHF CAP-20, UHF CAP-21, UHF CAP-22, UHF CAP-23, UHF CAP-24, UHF CAP-25, UHF CAP-26, UHF CAP-27, UHF CAP-29, UHF CAP-30, UHF CAP-31, UHF CAP-32, UHF CAP-33, Arka Basant, Solan Bharpur, California Wonder, Yolo Wonder, IIHR-35, IIHR-36, IIHR-37, IIHR-38, IIHR-39
Leaf pubescence	Sparse	27	100	UHF CAP-1, UHF CAP-2, UHF CAP-3, UHF CAP-4, UHF CAP-13, UHF CAP-20, UHF CAP-21, UHF CAP-22, UHF CAP-23, UHF CAP-24, UHF CAP-25, UHF CAP-26, UHF CAP-27, UHF CAP-29, UHF CAP-30, UHF CAP-31, UHF CAP-32, UHF CAP-33, Arka Basant, Solan Bharpur, California Wonder, Yolo Wonder, IIHR-35, IIHR-36, IIHR-37, IIHR-38, IIHR-39
Leaf density	Sparse	6	22.22	UHF CAP-1, UHF CAP-25, UHF CAP-26, UHF CAP-29, UHF CAP-30, UHF CAP-33
	Intermediate	17	62.96	UHF CAP-4, UHF CAP-21, UHF CAP-22, UHF CAP-23, UHF CAP-24, UHF CAP-27, UHF CAP-31, UHF CAP-32, Arka Basant, Solan Bharpur, California Wonder, Yolo Wonder, IIHR-35, IIHR-36, IIHR-37, IIHR-38, IIHR-39
	Dense	4	14.82	UHF CAP-2, UHF CAP-3, UHF CAP-13, UHF CAP-20
Number of flowers per axil	One	12	44.44	UHF CAP-1, UHF CAP-2, UHF CAP-13, UHF CAP-21, UHF CAP-24, UHF CAP-27, UHF CAP-31, IIHR-35, IIHR-36, IIHR-37, IIHR-38, IIHR-39
	Two	1	3.70	UHF CAP-3
	Other	14	51.85	UHF CAP-4, UHF CAP-20, UHF CAP-22, UHF CAP-23, UHF CAP-25, UHF CAP-26, UHF CAP-29, UHF CAP-30, UHF CAP-32, UHF CAP-33, Arka Basant, Solan Bharpur, California Wonder, Yolo Wonder
Flower position	Erect	6	22.22	UHF CAP-3, UHF CAP-23, UHF CAP-24, Arka Basant, California Wonder, Yolo Wonder
	Intermediate	14	51.85	UHF CAP-1, UHF CAP-2, UHF CAP-4, UHF CAP-13, UHF CAP-20, UHF CAP-21, UHF CAP-22, UHF CAP-25, UHF CAP-26, UHF CAP-32, UHF CAP-33, Solan Bharpur, IIHR-35, IIHR-38
	Pendant	7	25.93	UHF CAP-27, UHF CAP-29, UHF CAP-30, UHF CAP-31, IIHR-36, IIHR-37, IIHR-39

Plant descriptor	Range in expression	Number of genotypes	Frequency	Genotypes
Stigma exsertion	Inserted	5	18.52	UHF CAP-1, UHF CAP-26, UHF CAP-27, UHF CAP-33, IIHR-37
	Exserted	12	44.44	UHF CAP-2, UHF CAP-3, UHF CAP-4, UHF CAP-13, UHF CAP-23, UHF CAP-24, UHF CAP-30, California Wonder, Yolo Wonder, IIHR-35, IIHR-36, IIHR-38
	Same level	10	37.04	UHF CAP-20, UHF CAP-21, UHF CAP-22, UHF CAP-25, UHF CAP-29, UHF CAP-31, UHF CAP-32, Arka Basant, Solan Bharpur, IIHR-39
Calyx pigmentation	Absent	27	100	UHF CAP-1, UHF CAP-2, UHF CAP-3, UHF CAP-4, UHF CAP-13, UHF CAP-20, UHF CAP-21, UHF CAP-22, UHF CAP-23, UHF CAP-24, UHF CAP-25, UHF CAP-26, UHF CAP-27, UHF CAP-29, UHF CAP-30, UHF CAP-31, UHF CAP-32, UHF CAP-33, Arka Basant, Solan Bharpur, California Wonder, Yolo Wonder, IIHR-35, IIHR-36, IIHR-37, IIHR-38, IIHR-39
Calyx margin	Entire	1	3.71	UHF CAP-29
	Intermediate	14	51.85	UHF CAP-2, UHF CAP-13, UHF CAP-20, UHF CAP-21, UHF CAP-22, UHF CAP-25, UHF CAP-26, UHF CAP-31, Solan Bharpur, California Wonder, Yolo Wonder, IIHR-37, IIHR-38, IIHR-39
	Dentate	12	44.44	UHF CAP-1, UHF CAP-3, UHF CAP-4, UHF CAP-23, UHF CAP-24, UHF CAP-27, UHF CAP-30, UHF CAP-32, UHF CAP-33, Arka Basant, IIHR-35, IIHR-36
Calyx annular	Absent	27	100	UHF CAP-1, UHF CAP-2, UHF CAP-3, UHF CAP-4, UHF CAP-13, UHF CAP-20, UHF CAP-21, UHF CAP-22, UHF CAP-23, UHF CAP-24, UHF CAP-25, UHF CAP-26, UHF CAP-27, UHF CAP-29, UHF CAP-30, UHF CAP-31, UHF CAP-32, UHF CAP-33, Arka Basant, Solan Bharpur, California Wonder, Yolo Wonder, IIHR-35, IIHR-36, IIHR-37, IIHR-38, IIHR-39
Anther colour	Yellow	2	7.41	UHF CAP-1, UHF CAP-2
	Purple	2	7.41	UHF CAP-3, UHF CAP-21
	Pale blue	23	85.18	UHF CAP-4, UHF CAP-13, UHF CAP-20, UHF CAP-22, UHF CAP-23, UHF CAP-24, UHF CAP-25, UHF CAP-26, UHF CAP-27, UHF CAP-29, UHF CAP-30, UHF CAP-31, UHF CAP-32, UHF CAP-33, Arka Basant, Solan Bharpur, California Wonder, Yolo Wonder, IIHR-35, IIHR-36, IIHR-37, IIHR-38, IIHR-39
Filament colour	White	27	100	UHF CAP-1, UHF CAP-2, UHF CAP-3, UHF CAP-4, UHF CAP-13, UHF CAP-20, UHF CAP-21, UHF CAP-22, UHF CAP-23, UHF CAP-24, UHF CAP-25, UHF CAP-26, UHF CAP-27, UHF CAP-29, UHF CAP-30, UHF CAP-31, UHF CAP-32, UHF CAP-33, Arka Basant, Solan Bharpur, California Wonder, Yolo Wonder, IIHR-35, IIHR-36, IIHR-37, IIHR-38, IIHR-39
Corolla shape	Campanulate	27	100	UHF CAP-1, UHF CAP-2, UHF CAP-3, UHF CAP-4, UHF CAP-13, UHF CAP-20, UHF CAP-21, UHF CAP-22, UHF CAP-23, UHF CAP-24, UHF CAP-25, UHF CAP-27, UHF CAP-26, UHF CAP-29, UHF CAP-30, UHF CAP-31, UHF CAP-32, UHF CAP-33, Arka Basant, Solan Bharpur, California Wonder, Yolo Wonder, IIHR-35, IIHR-36, IIHR-37, IIHR-38, IIHR-39
Fruit shape	Square	18	66.67	UHF CAP-1, UHF CAP-3, UHF CAP-4, UHF CAP-20, UHF CAP-21, UHF CAP-23, UHF CAP-24, UHF CAP-25, UHF CAP-27, UHF CAP-29, UHF CAP-32, California Wonder, Yolo Wonder, IIHR-35, IIHR-36, IIHR-37, IIHR-38, IIHR-39
	Rectangular	7	25.93	UHF CAP-2, UHF CAP-13, UHF CAP-22, UHF CAP-26, UHF CAP-30, UHF CAP-33, Arka Basant
	Trapezoidal	1	3.70	UHF CAP-31
	Cordate	1	3.70	Solan Bharpur

Plant descriptor	Range in expression	Number of genotypes	Frequency	Genotypes
Fruit surface	Smooth	11	40.74	UHF CAP-13, UHF CAP-20, UHF CAP-21, UHF CAP-22, UHF CAP-25, UHF CAP-26, UHF CAP-27, UHF CAP-32, UHF CAP-33, California Wonder, Yolo Wonder
	Semi wrinkled	13	48.15	UHF CAP-4, UHF CAP-23, UHF CAP-24, UHF CAP-29, UHF CAP-30, UHF CAP-31, Arka Basant, Solan Bharpur, IIHR-35, IIHR-36, IIHR-37, IIHR-38, IIHR-39
	Wrinkled	3	11.11	UHF CAP-1, UHF CAP-2, UHF CAP-3
Fruit shape at pedicle attachment	Truncate	3	11.11	UHF CAP-21, UHF CAP-26, California Wonder
	Cordate	9	33.33	UHF CAP-2, UHF CAP-3, UHF CAP-4, UHF CAP-23, UHF CAP-24, UHF CAP-25, Yolo Wonder, IIHR-37, IIHR-39
	Lobate	15	55.56	UHF CAP-1, UHF CAP-13, UHF CAP-20, UHF CAP-22, UHF CAP-27, UHF CAP-29, UHF CAP-30, UHF CAP-31, UHF CAP-32, UHF CAP-33, Arka Basant, Solan Bharpur, IIHR-35, IIHR-36, IIHR-38
Blossom end fruit appendages	Absent	23	85.19	UHF CAP-1, UHF CAP-2, UHF CAP-3, UHF CAP-20, UHF CAP-21, UHF CAP-22, UHF CAP-23, UHF CAP-24, UHF CAP-25, UHF CAP-26, UHF CAP-27, UHF CAP-29, UHF CAP-30, UHF CAP-31, UHF CAP-32, UHF CAP-33, California Wonder, Yolo Wonder, IIHR-35, IIHR-36, IIHR-37, IIHR-38, IIHR-39
	Present	4	14.81	UHF CAP-4, UHF CAP-13, Arka Basant, Solan Bharpur
Fruit shape at blossom end	Sunken	23	85.19	UHF CAP-1, UHF CAP-2, UHF CAP-3, UHF CAP-4, UHF CAP-13, UHF CAP-21, UHF CAP-22, UHF CAP-23, UHF CAP-24, UHF CAP-25, UHF CAP-26, UHF CAP-27, UHF CAP-30, UHF CAP-32, UHF CAP-33, Solan Bharpur, California Wonder, Yolo Wonder, IIHR-35, IIHR-36, IIHR-37, IIHR-38, IIHR-39
	Pointed	3	11.11	UHF CAP-29, UHF CAP-31, Arka Basant
	Sunken and pointed	1	3.70	UHF CAP-20

showed sunken and pointed fruit shape at blossom end appendages (Fig. 4).

Authors' contribution

Conceptualization and designing of the research work (DA, DKM, AS); Execution of field experiments and data collection (DA); Analysis of data and interpretation (DA); Preparation of manuscript (DA, DKM, AS).

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