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Distinctness, uniformity and stability testing of various cherry tomato accessions

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Abstract

The Distinctness, Uniformity and Stability (DUS) characterization of various cherry tomato accessions and their hybrids generated in Half-Diallel mating design was undertaken to generate guidelines for their testing, as it is a legitimate pre-requisite prior to the registration of varieties and accord of Plant Breeder's Rights (PBR), to create distinctness of candidate variety from all other varieties and to adopt these varieties as reference ones for the protection of other varieties under PPV & FR Act. The testing revealed that all the accessions and their crosses can be categorized for each trait based upon twenty-six descriptors which may be used as reference material. In India, all the undertakings related with plant variety testing, registration of new cultivars and the Plant Breeders' Rights are furnished by the National Bureau of Plant Genetic Resources (NBPGR), New Delhi. The DUS testing procedures for various cherry tomato accessions and their hybrids are as per the Minimal Descriptors of Agri-Horticultural Crops for tomato (Srivastava *et al.*, 2001).

Keywords: Distinctness, uniformity, stability, accessions, cherry tomato

Introduction

Cherry tomato (*Solanum* spp., $2n=2x=24$), one of the important botanical variety of the cultivated tomato (*Solanum lycopersicum* L.) is a member of nightshade family 'Solanaceae', consisting of 96 genera (Akhtar *et al.*, 2013) [1] and over 3000 species (Melomey *et al.*, 2019; Sharma *et al.*, 2019) [9, 13]. It is a warm season crop generally characterized by high dry matter content and soluble solids levels than normal-sized fresh tomato cultivars; these differences are due to their higher content of sugars (fructose and glucose) and organic acids (citric and malic), which, in turn, are major factors in determining their greater sweetness, sourness, and overall flavor intensity (Muttappanavar *et al.*, 2014) [10, 11]. It is perennial in its native habitat, but is often grown as an annual crop in temperate climate. The growth habit of the plant is usually indeterminate and may reach up to 3 meters in height.

It is considered to be the probable ancestor of cultivated tomato, on the basis of its wide presence in Central America and the presence of shorter style length in the flower (Grandillo *et al.*, 2011) [6]. It is native to the Andean region encompassing Ecuador and Peru of South America and thereafter it spread around the world following the Spanish colonization of the Americas (Grandillo *et al.*, 2011) [6]. Though it became popular as a cash crop in various Asian countries but it is still new in India as well as in Kashmir, as such its area, production and productivity has not been documented till date.

The higher amount of variability and the true character expression in cherry tomato accessions and its various hybrids acquire a greater significance under the PPV&FR Act, 2001, to create distinctness of candidate variety from all other varieties, to adopt these varieties as reference ones for the protection of other varieties as per the Minimal Descriptors of Agri-Horticultural Crops furnished by the National Bureau of Plant Genetic Resources (NBPGR), New Delhi. A variety is recognized on the basis of a set of morpho-physiological characteristics different from other known varieties of that species. Hence, the present study was undertaken to generate DUS testing guidelines required for characterizing a variety, assessing the stability of expression and level of uniformity of characteristics which will be helpful in effective utilization of cherry tomato genetic resource for DUS testing and further improvement of crop.

Materials and Methods

The experimental material consisted of 57 cherry tomato accessions including 12 diverse genotypes of cherry tomato viz., Suncherry, WIR-5032, EC-520074, EC-914115, EC-165690, EC-914092, EC-520078, WIR-3957, EC-914097, VRT-02, Cherry tomato local and World's smallest tomato and forty-five F₁ hybrids. The study was carried out at Vegetable

Experimental Farm, Division of Vegetable Science, SKUAST-Kashmir, Shalimar, India during *Kharif* season, 2020. The seeds of all the accessions were first sown in nursery and then transplanted to the main field at a spacing of 60 x 60 cm between rows and plants respectively in an Augmented Block Design. All the recommended package of practices were followed for the successful cultivation of the crop for DUS characterization. Observations on 26 descriptors were recorded at different growth stages as per the DUS test guidelines (2001).

Results and Discussion

DUS characterization of various cherry tomato accessions was attempted as per the DUS test guidelines of PPV & FR Authority (2001). A wide range of variation was observed among all the accessions and their crosses for twenty-six scorable DUS traits as presented in Table 1 to 5.

Among the 57 accessions, the plant growth habit of 54 accessions was indeterminate except for Suncherry (semi-determinate), EC-914115 and VRT-02 (determinate). The dominant leaf type observed was standard type which was observed in about 24 accessions except for Suncherry, EC-914115, EC-165690, WIR-5032 x EC-914115, WIR-5032 x EC-914092 and EC-914115 x EC-165690 (potato leaf type); WIR-5032, EC-520074 x EC-914115, EC-914115 x EC-914092, EC-914115 x EC-520078 and EC-165690 x EC-520078 (pimpinellifolium type); EC-522074 (small leaf type); EC-914092, VRT-02, World's smallest tomato, Suncherry x EC-520074, Suncherry x EC-914115, Suncherry x EC-165690, Suncherry x WIR-3957, Suncherry x EC-914097, WIR-5032 x EC-520074, WIR-5032 x EC-165690, WIR-5032 x WIR-3957, WIR-5032 x EC-914097, EC-520074 x EC-914092, EC-520074 x EC-520078, EC-520074 x EC-914097, EC-520074 x EC-914092, EC-165690 x EC-914092, EC-165690 x EC-914097, EC-165690 x VRT-02, EC-914092 x WIR-3957, EC-914092 x EC-914097 and EC-520078 x WIR-3957 (peruvianum type). The prominent leaf colour observed in all the 57 accessions was dark green. The leaf pubescence was found absent in 42 accessions except for EC-914115, EC-914092, EC-520078, WIR-3957, VRT-02, Suncherry x EC-914097, WIR-5032 x EC-914097, EC-914115 x EC-914092, EC-165690 x EC-914097, EC-914092 x WIR-3957 and EC-520078 x WIR-3957 (sparse); EC-520074 x EC-914097, EC-914115 x EC-914097, EC-914115 x VRT-02 and WIR-3957, VRT-02 (medium). The leaf/ foliage cover was found excellent in about 46 accessions except for Suncherry, EC-914115, EC-165690, WIR-3957, VRT-02, World's smallest tomato, WIR-5032 x EC-914115, WIR-5032 x EC-914092, EC-520074 x EC-165690, EC-520074 x EC-520078 and EC-520074 x VRT-02 in which the leaf/ foliage cover was found good. The petiole pubescence was found absent in 22 accessions except for EC-914115, EC-914092, EC-520078, WIR-3957, EC-914097, VRT-02, World's smallest tomato, Cherry tomato local, Suncherry x EC-520078, WIR-5032 x EC-520074, WIR-5032 x EC-165690, EC-520074 x EC-914097, EC-5914115 x EC-520078, EC-914115 x VRT-02, EC-165690 x EC-520078, EC-165690 x EC-914097, EC-165690 x VRT-02, EC-914092 x WIR-3957, WIR-3957 x EC-914097 and EC-914097 x VRT-02 (sparse); Suncherry x EC-914115, Suncherry x EC-914092, Suncherry x WIR-3957, WIR-5032 x EC-914097, EC-520074 x EC-914115, EC-914115 x EC-914097, EC-914092 x EC-520078, EC-914092 x VRT-02 and EC-520078 x EC-914097 (medium); Suncherry x EC-914097, EC-914115 x EC-914092, EC-914092 x EC-914097, EC-520078 x WIR-

3957, EC-520078 x VRT-02 and WIR-3957 x VRT-02 (dense).

Out of 57 accessions, 32 accessions exhibited angular stem type except for Suncherry, WIR-5032, EC-520074, EC-914097, VRT-02, World's smallest tomato, Cherry tomato local, Suncherry x WIR-5032, Suncherry x EC-520074, Suncherry x EC-165690, Suncherry x VRT-02, WIR-5032 x EC-165690, WIR-5032 x EC-520078, EC-520074 x EC-165690, EC-520074 x WIR-3957, EC-520074 x VRT-02, EC-914115 x EC-520078, EC-914115 x EC-914097, EC-165690 x EC-520078, EC-165690 x WIR-3957, EC-165690 x EC-914097, EC-165690 x VRT-02, EC-914092 x WIR-3957, EC-520078 x VRT-02 and WIR-3957 x EC-914097 in which the stem type was found round. Thirty-six accessions, out of 57 accessions showed medium stem thickness except for WIR-5032, EC-520074, World's smallest tomato, Suncherry x WIR-5032, Suncherry x EC-520074, Suncherry x EC-165690, Suncherry x EC-520078, WIR-5032 x EC-520074, WIR-5032 x EC-165690, WIR-5032 x EC-914092, EC-520074 x EC-914115, EC-520074 x EC-165690, EC-520074 x EC-914097, EC-914115 x EC-520078 and EC-165690 x VRT-02 (thin); Cherry tomato local, EC-165690 x EC-914092, EC-914092 x EC-914097, EC-520078 x EC-914097, WIR-3957 x VRT-02 and EC-914097 x VRT-02 (thick). The stem pubescence was found absent in 16 accessions, sparse in 13 accessions, medium in 12 accessions and dense in 16 accessions, out of 57 accessions. The stem pigmentation was found green in 51 accessions out of 57 accessions except for EC-914115 x EC-520078, EC-914115 x EC-914097, EC-914092 x EC-914097, EC-520078 x EC-914097, EC-520078 x VRT-02 and WIR-3957 x VRT-02 which showed anthocyanin type of stem pigmentation.

Among the 57 accessions, the flower size was found small in 6 accessions, medium in 29 accessions and large in 22 accessions. The predominant flower colour was deep yellow which was found in 53 accessions out of 57 accessions. The fruit size was found very small (≤ 20 g) in 50 accessions except for EC-914092, Cherry tomato local, EC-914115 x EC-914092, EC-914115 x EC-914097 and EC-914092 x EC-520078 in which the fruit size was found small (>20 -30g); EC-914115 and EC-914092 x VRT-02 in which the fruit size was found medium (>30 -80g). The predominant fruit shape which was found in 42 accessions, out of 57 accessions was round except for Suncherry, EC-914097, EC-914115 x EC-914097, EC-165690 x VRT-02, EC-914092 x EC-520078, EC-520078 x WIR-3957 and EC-520078 x VRT-02 (flat round); EC-914092, EC-520078, Suncherry x EC-914092, Suncherry x EC-520078, WIR-5032 x EC-914097, EC-914115 x EC-914092 and EC-914115 x VRT-02 (oval/oblong); VRT-02 (heart shaped). Out of 57 accessions, immature fruit skin colour was found light green in 33 accessions, greenish white in 15 accessions and green in 9 accessions. The presence of green (shoulders) tips on the fruits was found absent (uniform ripening) in EC-914115, EC-520078, VRT-02, WIR-5032 x EC-520078, WIR-5032 x EC-914097, EC-520074 x VRT-02, EC-914115 x VRT-02 and EC-520078 x VRT-02 while in rest of the accessions it was found present. The predominant fruit colour was red which was found in 46 accessions out of 57 accessions except for Suncherry, EC-914115 x EC-914092, EC-914115 x WIR-3957, EC-914115 x EC-914097, EC-914092 x VRT-02, EC-520078 x WIR-3957, EC-520078 x EC-914097 and WIR-3957 x VRT-02 (yellow and red); WIR-5032 (orange); VRT-02 (tangerine and red) and WIR-3957 x EC-914097 (pink).

Out of 57 accessions, the fruit surface was found corrugated in EC-520078, EC-914097, VRT-02, EC-165690 x VRT-02 and EC-520078 x VRT-02 while it was found smooth in the rest 52 accessions. The stem end fruit shape/pistil scar was found dot type in 31 accessions, stellate in 21 accessions and irregular in 5 accessions. The blossom end fruit shape was found indented in 42 accessions, flat in 14 accessions and pointed/nippled in VRT-02. The fruit firmness and seediness were found medium in all the 57 accessions. The fruits of all the 57 accessions were found pulpy along with triangular with pointed base kind of seed shape and brown seed colour. The organoleptic test revealed that 50 accessions out of 57 accessions were sour in taste except for Suncherry, EC-914115, EC-520078, WIR-3957, VRT-02, Cherry tomato local and EC-165690 x VRT-02 which were found medium-sweet in taste.

Conclusion

From this study, it is concluded that all the cherry tomato accessions can be effectively distinguished by their morphological characters. In future, further studies need to be carried over locations or years with the inclusion of yield and its attributing traits, to facilitate further utilization in breeding programme and registration of germplasm with PPV and FR authority.

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Notes

The authors declare no competing financial interest.

Table 1: Morphological characterization of Cherry tomato (*Solanum* spp.) genotypes based on DUS guidelines

S. No.	Characteristic	Suncherry	WIR-5032	EC- 520074	EC-914115	EC-165690	EC-914092	EC-520078	WIR- 3957	EC-917097	VRT-02
1.	Plant growth habit	Semi-determinate	Indeterminate	Indeterminate	Determinate	Indeterminate	Indeterminate	Indeterminate	Indeterminate	Indeterminate	Determinate
2.	Leaf type	Potato leaf	Pimpinellifolium type	Small	Potato leaf	Potato leaf	Peruvianum type	Standard	Standard	Standard	Peruvianum type
3.	Leaf colour	Dark green									
4.	Leaf pubescence	Absent	Absent	Absent	Sparse	Absent	Sparse	Sparse	Sparse	Absent	Sparse
5.	Leaf/ Foliage cover	Good	Excellent	Excellent	Good	Good	Excellent	Excellent	Good	Excellent	Good
6.	Petiole pubescence	Absent	Absent	Absent	Sparse	Absent	Sparse	Sparse	Sparse	Sparse	Sparse
7.	Stem type	Round	Round	Round	Angular	Angular	Angular	Angular	Angular	Round	Round
8.	Stem thickness	Medium	Thin	Thin	Medium						
9.	Stem pubescence	Absent	Dense	Absent	Medium	Sparse	Dense	Dense	Medium	Medium	Sparse
10.	Stem pigmentation	Green									
11.	Flower size	Medium	Medium	Small	Large	Medium	Large	Large	Medium	Large	Large
12.	Flower colour	Deep yellow	Light yellow/ cream	Deep yellow	Light yellow/ cream	Deep yellow	Deep yellow				
13.	Fruit size	Very small (<=20g)	Very small (<=20g)	Very small (<=20g)	Medium (80-100g)	Very small (<=20g)	Small (>20-30g)	Very small (<=20g)	Very small (<=20g)	Very small (<=20g)	Very small (<=20g)
14.	Fruit shape	Flat round	Round	Round	Round	Round	Oval/ oblong	Oval/ oblong	Round	Flat round	Heart shaped
15.	Immature fruit skin colour	Light green	Light green	Light green	Greenish white	Light green	Light green	Greenish white	Light green	Light green	Greenish white
16.	Presence of green (shoulders) tips on the fruits	Present	Present	Present	Absent (uniform ripening)	Present	Present	Absent (uniform ripening)	Present	Present	Absent (uniform ripening)
17.	Fruit colour	Yellow and Red	Yellow	Red	Tangerine and Red						
18.	Fruit surface	Smooth	Smooth	Smooth	Smooth	Smooth	Smooth	Corrugated	Smooth	Corrugated	Corrugated
19.	Stem-end fruit shape/ Pistil scar	Irregular	Dot	Dot	Stellate	Dot	Stellate	Dot	Dot	Stellate	Stellate
20.	Blossom-end fruit shape	Indented	Flat	Flat	Indented	Indented	Indented	Indented	Indented	Indented	Pointed/ Nippled
21.	Fruit firmness	Medium									
22.	Pulpiness	Pulpy									
23.	Seediness	Medium									
24.	Seed shape	Triangular with pointed base									
25.	Seed colour	Brown									
26.	Organoleptic test	Medium sweet	Sour	Sour	Medium sweet	Sour	Sour	Medium sweet	Medium sweet	Sour	Medium sweet

Table 2: Morphological characterization of Cherry tomato (*Solanum* spp.) genotypes based on DUS guidelines

S. No.	Characteristic	World's smallest tomato	Cherry tomato local	Suncherry x WIR - 5032	Suncherry x EC - 520074	Suncherry x EC - 914115	Suncherry x EC - 165690	Suncherry x EC - 914092	Suncherry x EC - 520078	Suncherry x WIR - 3957	Suncherry x EC - 917097	Suncherry x VRT - 02
1.	Plant growth habit	Indeterminate	Indeterminate	Indeterminate	Indeterminate	Indeterminate	Indeterminate	Indeterminate	Indeterminate	Indeterminate	Indeterminate	Indeterminate
2.	Leaf type	Peruvianum type	Standard	Standard	Peruvianum type	Peruvianum type	Peruvianum type	Standard	Standard	Peruvianum type	Peruvianum type	Standard
3.	Leaf colour	Dark green	Dark green	Dark green	Dark green	Dark green	Dark green	Dark green	Dark green	Dark green	Dark green	Dark green
4.	Leaf pubescence	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Sparse	Absent
5.	Leaf/ Foliage cover	Good	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
6.	Petiole pubescence	Sparse	Sparse	Absent	Absent	Medium	Absent	Medium	Sparse	Medium	Dense	Absent
7.	Stem type	Round	Round	Round	Round	Angular	Round	Angular	Angular	Angular	Angular	Round
8.	Stem thickness	Thin	Thick	Thin	Thin	Medium	Thin	Medium	Thin	Medium	Medium	Medium
9.	Stem pubescence	Absent	Dense	Absent	Absent	Medium	Absent	Sparse	Dense	Sparse	Medium	Absent
10.	Stem pigmentation	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
11.	Flower size	Small	Large	Small	Small	Medium	Medium	Medium	Medium	Large	Large	Medium
12.	Flower colour	Deep yellow	Deep yellow	Deep yellow	Deep yellow	Deep yellow	Deep yellow	Deep yellow	Deep yellow	Deep yellow	Deep yellow	Deep yellow
13.	Fruit size	Very small (<=20g)	Small (>20-30g)	Very small (<=20g)	Very small (<=20g)	Very small (<=20g)	Very small (<=20g)	Very small (<=20g)	Very small (<=20g)	Very small (<=20g)	Very small (<=20g)	Very small (<=20g)

14.	Fruit shape	Round	Round	Round	Round	Round	Round	Oval/ oblong	Oval/ oblong	Round	Round	Round
15.	Immature fruit skin colour	Greenish white	Light green	Green	Light green	Green	Light green	Light green	Light green	Light green	Light green	Light green
16.	Presence of green (shoulders) tips on the fruits	Present										
17.	Fruit colour	Red										
18.	Fruit surface	Smooth										
19.	Stem-end fruit shape/ Pistil scar	Irregular	Stellate	Stellate	Stellate	Stellate	Dot	Stellate	Irregular	Stellate	Dot	Dot
20.	Blossom-end fruit shape	Flat	Indented	Flat	Flat	Indented						
21.	Fruit firmness	Medium										
22.	Pulpiness	Pulpy										
23.	Seediness	Medium										
24.	Seed shape	Triangular with pointed base										
25.	Seed colour	Brown										
26.	Organoleptic test	Sour	Medium sweet	Sour								

Table 3: Morphological characterization of Cherry tomato (*Solanum* spp.) genotypes based on DUS guidelines.

S. No.	Characteristic	WIR – 5032 x EC – 520074	WIR – 5032 x EC – 914115	WIR – 5032 x EC – 165690	WIR – 5032 x EC – 914092	WIR – 5032 x EC – 520078	WIR – 5032 x EC – 3957	WIR – 5032 x EC – 917097	WIR – 5032 x VRT - 02	EC- 520074 x EC – 914115	EC- 520074 x EC – 165690	EC- 520074 x EC – 914092
1.	Plant growth habit	Indeterminate										
2.	Leaf type	Peruvianum type	Potato leaf	Peruvianum type	Potato leaf	Standard	Peruvianum type	Peruvianum type	Standard	Pimpinellifolium type	Standard	Peruvianum type
3.	Leaf colour	Dark green										
4.	Leaf pubescence	Absent	Absent	Absent	Absent	Absent	Absent	Sparse	Absent	Absent	Absent	Absent
5.	Leaf/ Foliage cover	Excellent	Good	Excellent	Good	Excellent	Excellent	Excellent	Excellent	Excellent	Good	Excellent
6.	Petiole pubescence	Sparse	Absent	Sparse	Absent	Absent	Absent	Medium	Absent	Medium	Absent	Absent
7.	Stem type	Angular	Angular	Round	Angular	Round	Angular	Angular	Angular	Angular	Round	Angular
8.	Stem thickness	Thin	Medium	Thin	Thin	Medium	Medium	Medium	Medium	Thin	Thin	Medium
9.	Stem pubescence	Medium	Absent	Dense	Absent	Dense	Sparse	Dense	Dense	Sparse	Sparse	Absent
10.	Stem pigmentation	Green										
11.	Flower size	Medium	Medium	Medium	Medium	Large	Medium	Large	Medium	Medium	Medium	Small
12.	Flower colour	Deep yellow										
13.	Fruit size	Very small (<=20g)										
14.	Fruit shape	Round	Round	Round	Round	Round	Round	Oval/ oblong	Round	Round	Round	Round
15.	Immature fruit skin colour	Light green	Light green	Light green	Green	Greenish white	Light green	Greenish white	Light green	Green	Light green	Green
16.	Presence of green (shoulders) tips on the fruits	Present	Present	Present	Present	Absent (uniform ripening)	Present	Absent (uniform ripening)	Present	Present	Present	Present
17.	Fruit colour	Red										
18.	Fruit surface	Smooth										
19.	Stem-end fruit shape/ Pistil scar	Dot	Dot	Dot	Stellate	Dot	Stellate	Dot	Stellate	Dot	Dot	Dot
20.	Blossom-end fruit shape	Indented	Indented	Indented	Flat	Flat	Flat	Indented	Indented	Indented	Indented	Indented
21.	Fruit firmness	Medium										
22.	Pulpiness	Pulpy										
23.	Seediness	Medium										
24.	Seed shape	Triangular with pointed base										
25.	Seed colour	Brown										
26.	Organoleptic test	Sour										

Table 4: Morphological characterization of Cherry tomato (*Solanum* spp.) genotypes based on DUS guidelines

S.No.	Characteristic	EC- 520074 x EC – 520078	EC- 520074 x WIR – 3957	EC- 520074 x EC – 917097	EC- 520074 x VRT - 02	EC- 914115 x EC – 165690	EC- 914115 x EC – 914092	EC- 914115 x EC – 520078	EC- 914115 x WIR – 3957	EC- 914115 x EC – 917097	EC- 914115 x VRT - 02	EC – 165690 x EC – 914092	EC – 165690 x EC – 520078
1.	Plant growth habit	Indeterminate	Indeterminate										
2.	Leaf type	Peruvianum type	Standard	Peruvianum type	Standard	Potato leaf	Pimpinellifolium type	Pimpinellifolium type	Standard	Standard	Standard	Peruvianum type	Pimpinellifolium type
3.	Leaf colour	Dark green	Dark green										
4.	Leaf pubescence	Absent	Absent	Medium	Absent	Absent	Sparse	Absent	Absent	Medium	Medium	Absent	Absent
5.	Leaf/ Foliage cover	Good	Excellent	Excellent	Good	Excellent	Excellent						
6.	Petiole pubescence	Absent	Absent	Sparse	Absent	Absent	Dense	Sparse	Absent	Medium	Sparse	Absent	Sparse
7.	Stem type	Angular	Round	Angular	Round	Angular	Angular	Round	Angular	Round	Angular	Angular	Round
8.	Stem thickness	Medium	Medium	Thin	Medium	Medium	Medium	Thin	Medium	Medium	Medium	Thick	Medium
9.	Stem pubescence	Sparse	Absent	Sparse	Sparse	Absent	Dense	Absent	Dense	Medium	Dense	Dense	Absent
10.	Stem pigmentation	Green	Green	Green	Green	Green	Green	Anthocyanin	Green	Anthocyanin	Green	Green	Green
11.	Flower size	Medium	Medium	Medium	Large	Medium	Large	Large	Medium	Medium	Medium	Large	Medium
12.	Flower colour	Deep yellow	Light yellow/ cream	Deep yellow	Deep yellow								
13.	Fruit size	Very small (<=20g)	Small (>20-30g)	Very small (<=20g)	Very small (<=20g)	Small (>20-30g)	Very small (<=20g)	Very small (<=20g)	Very small (<=20g)				
14.	Fruit shape	Round	Round	Round	Round	Round	Oval/ oblong	Round	Round	Flat round	Oval/ oblong	Round	Round
15.	Immature fruit skin colour	Light green	Green	Light green	Greenish white	Light green	Green	Light green	Light green	Light green	Greenish white	Green	Greenish white
16.	Presence of green (shoulders) tips on the fruits	Present	Present	Present	Absent (uniform ripening)	Present	Present	Present	Present	Present	Absent (uniform ripening)	Present	Present
17.	Fruit colour	Red	Red	Red	Red	Red	Yellow and Red	Red	Yellow and Red	Yellow and Red	Red	Red	Red
18.	Fruit surface	Smooth	Smooth										
19.	Stem-end fruit shape/ Pistil scar	Dot	Dot	Stellate	Stellate	Dot	Dot	Dot	Dot	Irregular	Dot	Dot	Dot
20.	Blossom-end fruit shape	Indented	Flat	Flat	Flat	Indented	Flat	Indented	Indented	Indented	Indented	Indented	Indented
21.	Fruit firmness	Medium	Medium										
22.	Pulpiness	Pulpy	Pulpy										
23.	Seediness	Medium	Medium										
24.	Seed shape	Triangular with pointed base	Triangular with pointed base										
25.	Seed colour	Brown	Brown										
26.	Organoleptic test	Sour	Sour										

Table 5: Morphological characterization of Cherry tomato (*Solanum* spp.) genotypes based on DUS guidelines

S.No.	Characteristic	EC-165690 x WIR-3957	EC – 165690 x EC – 917097	EC – 165690 x VRT - 02	EC – 914092 x EC – 520078	EC – 914092 x WIR -3957	EC – 914092 x EC – 917097	EC – 914092 x VRT - 02	EC – 520078 x WIR– 3957	EC – 520078 x EC – 917097	EC – 520078 x VRT - 02	WIR-3957 x EC– 917097	WIR – 3957 x VRT - 02	EC – 917097 x VRT - 02
1.	Plant growth habit	Indeterminate												
2.	Leaf type	Standard	Peruvianum type	Peruvianum type	Standard	Peruvianum type	Peruvianum type	Standard	Peruvianum type	Standard	Standard	Standard	Standard	Standard
3.	Leaf colour	Dark green												
4.	Leaf pubescence	Absent	Sparse	Absent	Absent	Sparse	Absent	Absent	Sparse	Absent	Absent	Absent	Medium	Absent
5.	Leaf/ Foliage cover	Excellent												
6.	Petiole pubescence	Absent	Sparse	Sparse	Medium	Sparse	Dense	Medium	Dense	Medium	Dense	Sparse	Dense	Sparse
7.	Stem type	Round	Round	Round	Angular	Round	Angular	Angular	Angular	Angular	Round	Round	Angular	Angular
8.	Stem thickness	Medium	Medium	Thin	Medium	Medium	Thick	Medium	Medium	Thick	Medium	Medium	Thick	Thick
9.	Stem pubescence	Absent	Absent	Sparse	Medium	Medium	Medium	Sparse	Dense	Medium	Medium	Sparse	Dense	Dense
10.	Stem pigmentation	Green	Green	Green	Green	Green	Anthocyanin	Green	Green	Anthocyanin	Anthocyanin	Green	Anthocyanin	Green
11.	Flower size	Medium	Medium	Small	Large	Medium	Large	Large	Large	Medium	Large	Large	Large	Large
12.	Flower colour	Deep yellow	Light yellow/ Cream	Deep yellow										
13.	Fruit size	Very small (<=20g)	Very small (<=20g)	Very small (<=20g)	Small (>20-30g)	Very small (<=20g)	Very small (<=20g)	Medium (>30-80g)	Very small (<=20g)					
14.	Fruit shape	Round	Round	Flat round	Flat round	Round	Round	Round	Flat round	Round	Flat round	Round	Round	Round
15.	Immature fruit skin colour	Light green	Light green	Greenish white	Greenish white	Light green	Light green	Greenish white	Greenish white	Greenish white	Greenish white	Light green	Light green	Green
16.	Presence of green (shoulders) tips on the fruits	Present	Absent (uniform ripening)	Present	Present	Present								
17.	Fruit colour	Red	Red	Red	Red	Red	Red	Yellow and Red	Yellow and Red	Yellow and Red	Red	Pink	Yellow and Red	Red
18.	Fruit surface	Smooth	Smooth	Corrugated	Smooth	Smooth	Smooth	Smooth	Smooth	Smooth	Corrugated	Smooth	Smooth	Smooth
19.	Stem-end fruit shape/ Pistil scar	Dot	Dot	Irregular	Dot	Dot	Dot	Stellate	Dot	Stellate	Stellate	Irregular	Stellate	Stellate
20.	Blossom-end fruit shape	Flat	Flat	Indented										
21.	Fruit firmness	Medium												
22.	Pulpiness	Pulpy												
23.	Seediness	Medium												
24.	Seed shape	Triangular with pointed base												
25.	Seed colour	Brown												
26.	Organoleptic test	Sour	Sour	Medium sweet	Sour									

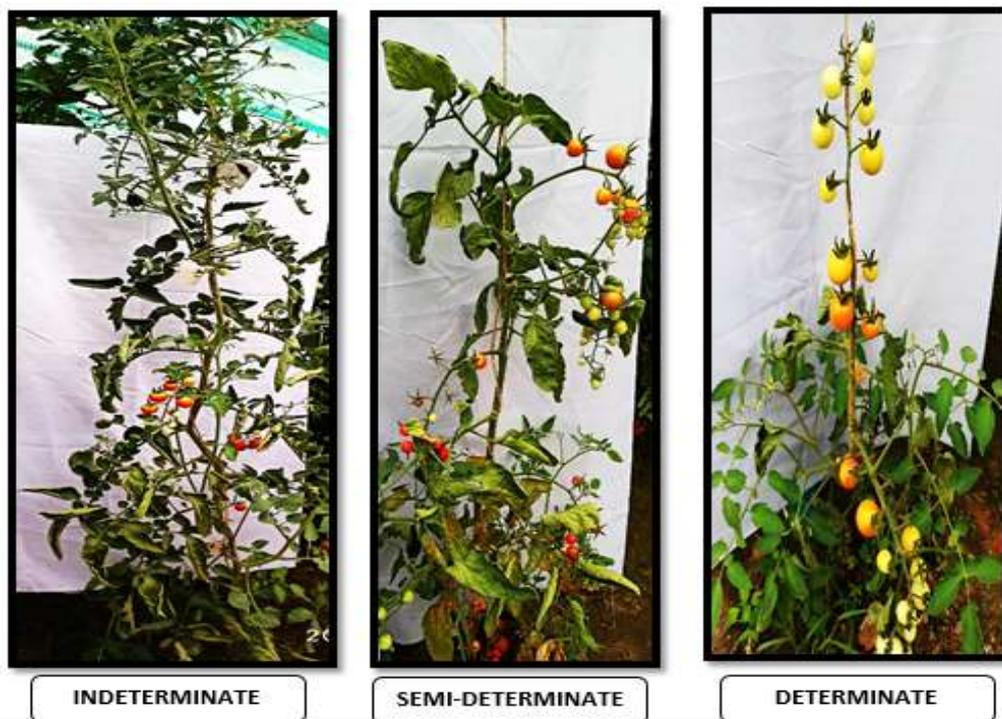


Fig 1: Plant growth habit

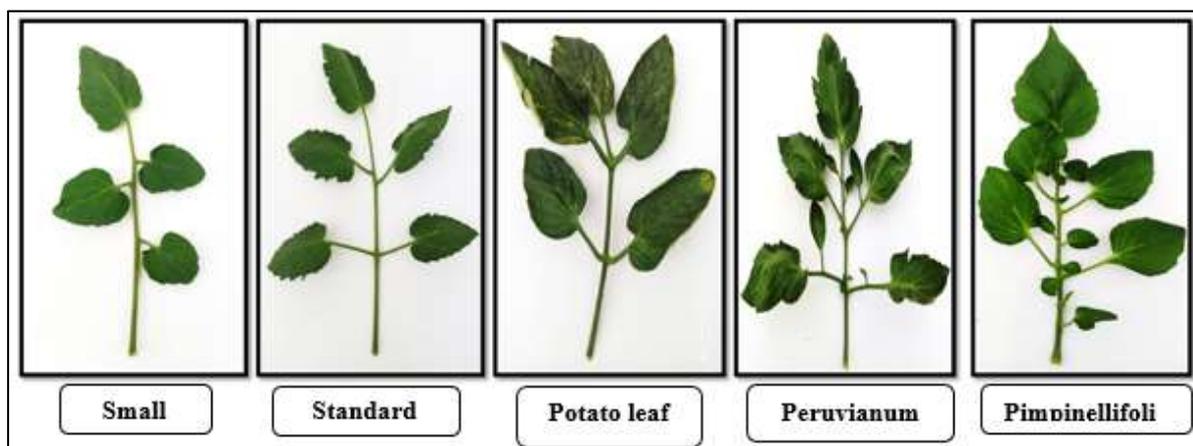


Fig 2: Leaf type

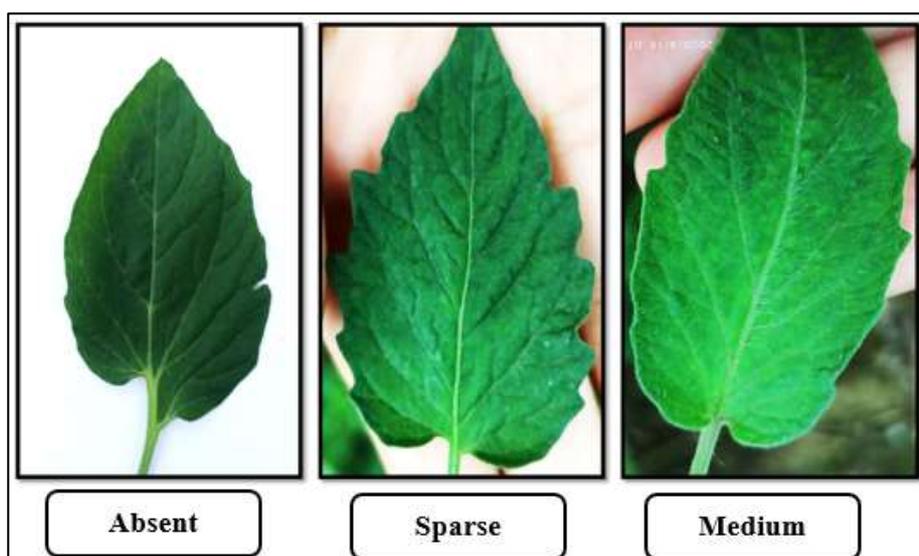


Fig 3: Leaf pubescence



Fig 4: Petiole pubescence

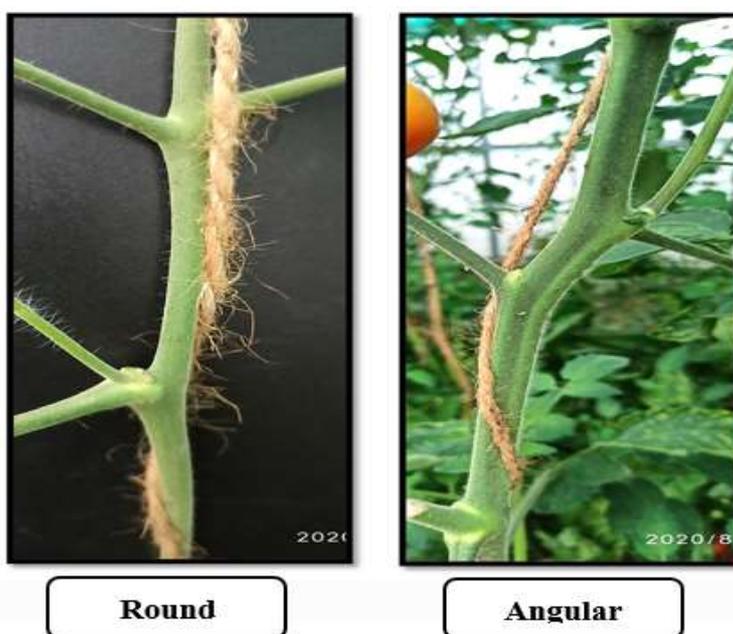


Fig 5: Stem type



Fig 6: Stem thickness



Fig 7: Stem pubescence

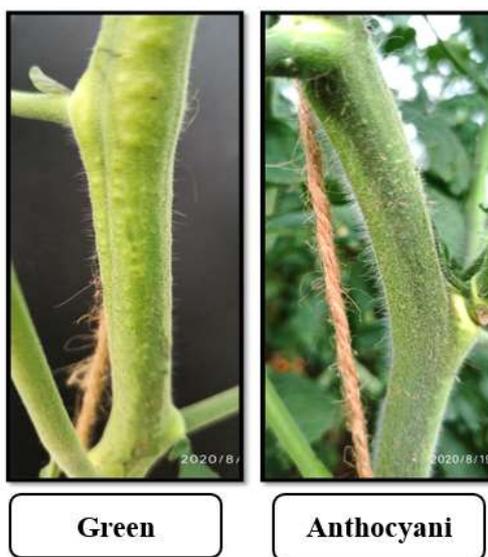


Fig 8: Stem pigmentation

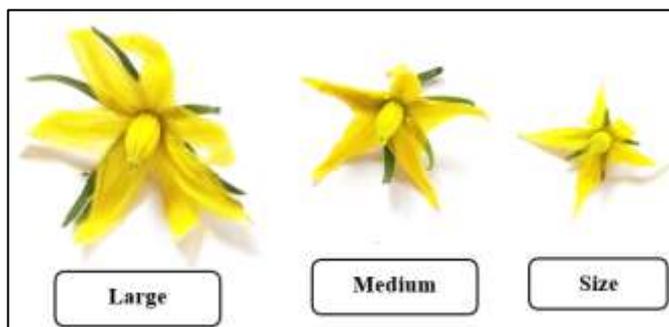


Fig 9: Flower size

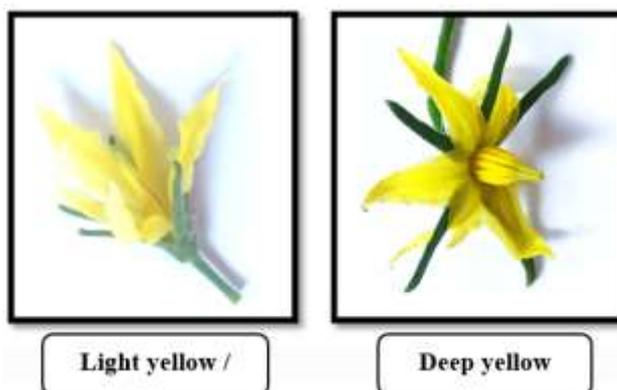


Fig 10: Flower colour

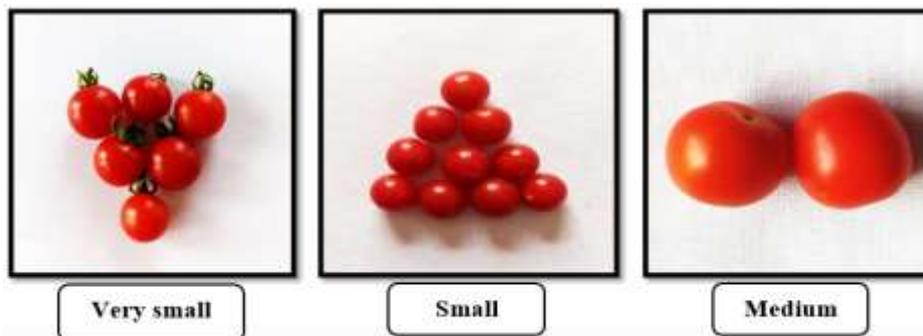


Fig 11: Fruit size

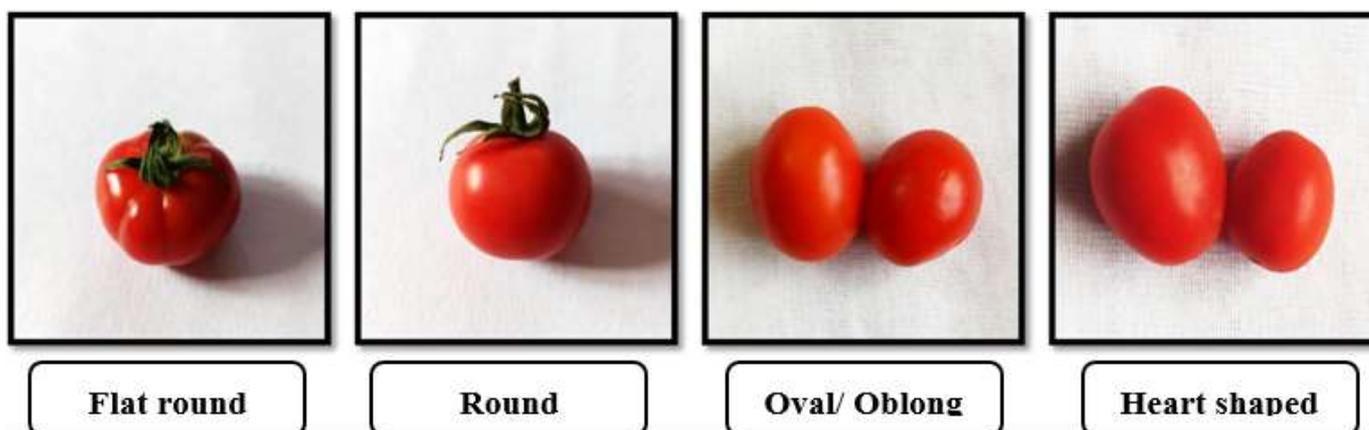


Fig 12: Fruit shape

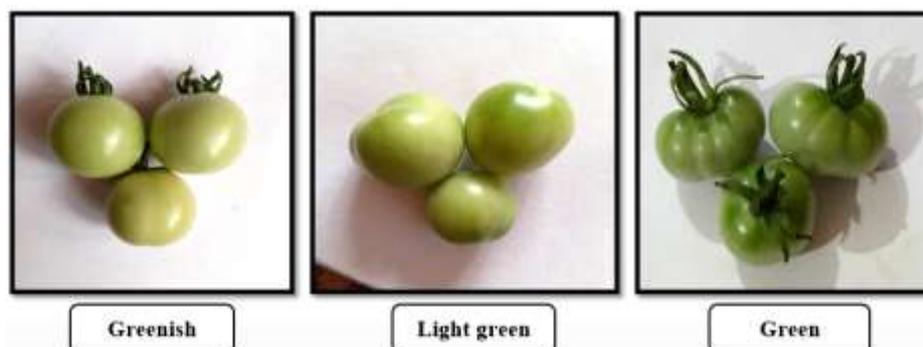


Fig 13: Immature fruit skin colour

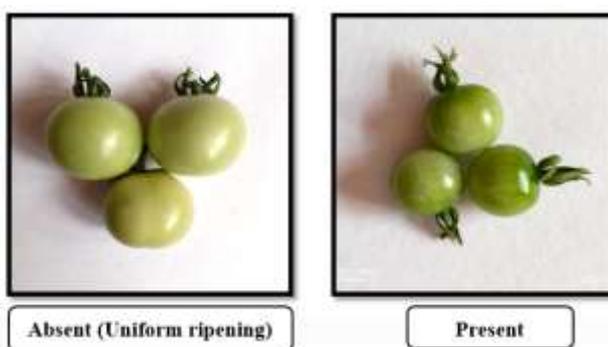


Fig 14: Presence of green (shoulders) tips on the fruits

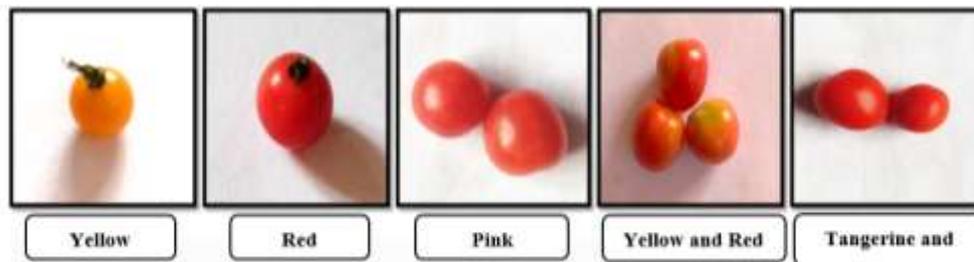


Fig 15: Fruit colour

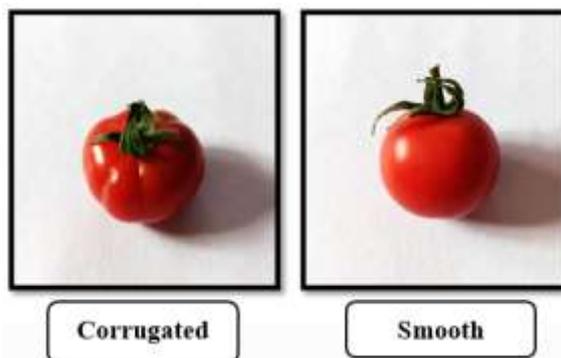


Fig 16: Fruit surface

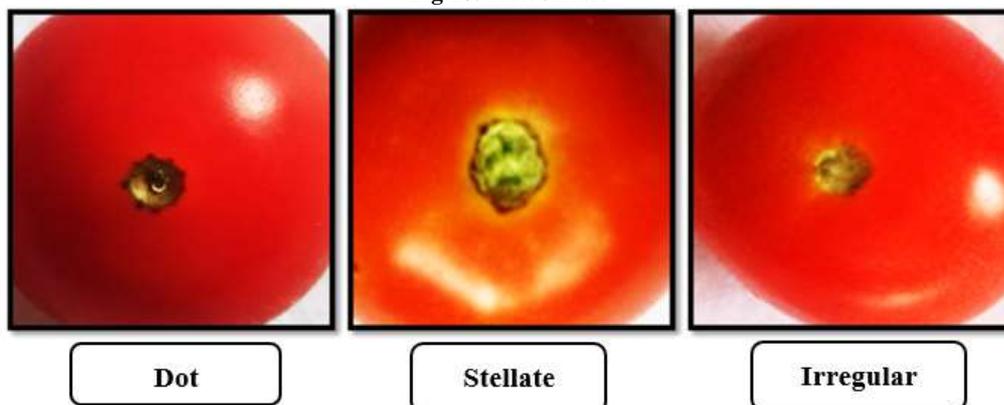


Fig 17: Stem-end fruit shape/ Pistil scar

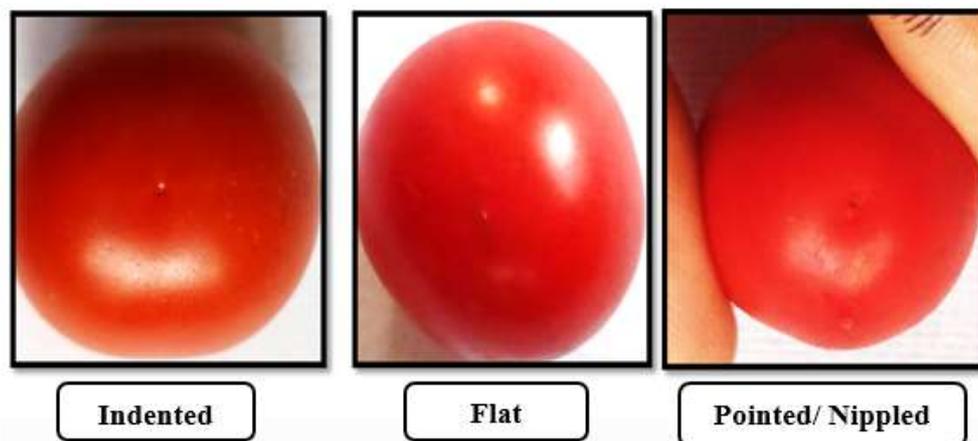


Fig 18: Seed shape and Seed colour



Triangular with pointed base and Brown

Fig 19: Seed shape and Seed colour

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