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RESEARCH ARTICLE

Characterization of Selected Sweet Cherry (*Prunus avium* L.) Varieties using DUS Test Guidelines

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The present study was conducted to characterize and decipher the genetic variability among twenty sweet cherry (*Prunus avium* L.) varieties. Different morphological traits namely, growth habit, foliage, flower, fruit and stone characteristics were studied for further improvement and utilization. Growth habit varied from upright (5 varieties) to semi-upright and spreading (15 varieties). Shape of leaves was observed as obovate and lanceolate. Most of the varieties were late in maturity early. Huge variation was recorded for quality determining traits namely, fruit size, shape, flesh and skin colour. Fruit shape was observed as reniform in fourteen varieties and elliptic in rest of the varieties except cordate in Rainier. Fruit firmness was found to be soft and intermediate for the most of the varieties, whereas, varieties *viz.*, Lambert, Rainier, Red Heart, Stella and Sunburst had hard fruit firmness.

Key Words: Characterization, DUS, Fruit quality, Sweet cherry

Introduction

Sweet cherry (*Prunus avium* L.) belonging to the family Rosaceae and sub-family Prunoideae is one of the most important and delicious fruits of temperate regions of the world (Wunsch and Hormaza, 2004). Sweet cherries contain high nutritional content and are available in market from mid-week of May until July with non-competence among different temperate fruit crops (Zheng *et al*., 2016).

Sweet cherry is native to the areas adjoining Black Sea and Caspian Sea (Watkins, 1976) from where it diversified to different regions of the World. They are usually grown in the coldest climates at an altitude of about 1600 to 2700 m above mean sea level and its cultivation is mainly confined between 35 °N and 55 °S latitude. Jammu and Kashmir is the major producer, (90 % of total production) of sweet cherry in India with 2713 ha area and 11789 MT production (Anonymous, 2019a). In Himachal Pradesh, it is grown under 453 ha area having 225 MT production (Anonymous, 2019b). Shimla, Kullu, Mandi, Chamba and Lahaul & Spiti are the main districts in Himachal Pradesh where cherries are grown extensively. Shimla district alone accounts for 80 per cent of total production of the state.

The fruits of sweet cherries are highly perishable in nature as it has a short shelf life which is a serious bottleneck for efficient handling, transportation and marketing of the produce. Moreover, with the sudden upsurge of global warming, standard varieties of sweet cherry, due to their inability to meet the chilling requirement in temperate areas of Himachal Pradesh face the risk of crop failure. Besides, the dominance of few cherry varieties such as Black Heart, Red Heart, Stella, Durone Nero and Van in cherry growing pockets of Himachal Pradesh at times, leads to glut in the market resulting in colossal economic loss to the farmers. This situation may be only countered by broadening the germplasm base through introduction and characterization of improved sweet cherry varieties.

Characterization helps in recording and compilation of data for important characteristics which distinguish genotype within a species or between the species and allows for easy and quick discrimination among them. It aids in easy accession grouping, gap identification and extraction of valuable germplasm for breeding programs, resulting in a greater understanding of the collection's composition and genetic diversity. It also enables a check on the true-to-type nature of homogeneous samples, allowing the detection of misidentifications or duplicates, as well as highlighting possible errors made during other operations.

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Although, the characterization and evaluation work on selected sweet cherry varieties has been carried out earlier, by several workers. The study was put forward to check the performance (qualitatively as well as quantitatively) of these sweet cherry varieties under wet temperate zone to extend their farming in Himachal Pradesh by selecting the most promising varieties, that perform good at this elevation. This will also help in the identification, description, assessment of uniformity of traits and stabilization of their expression at different locations over the time period. Keeping in view its significance, the characterization and evaluation of different sweet cherry varieties was performed at the Regional Horticultural Research and Training Station, Mashobra, Shimla (HP).

Materials and Methods

The present investigation was carried out in the experimental block of Regional Horticultural Research and Training Station, Mashobra, Shimla (H.P.) at an elevation of 2286 m amsl (latitude 31.1° N and longitude 77.1° E) during the years 2019 and 2020. The following varieties *viz*. Bing, Black Heart, Bradbourne Black, Durone Nero - II, Durone Nero - III, Early Rivers, Lambert, Lapins, Merton Glory, Noir De Guben, Rainier, Red Heart, Roundel Heart, Sam, Seneca, Stella, Sunburst, Triumph Domini, Van and Vega were characterized for the tree, foliage, floral and fruit characters. 20-24 years old plants of each variety, maintained at a spacing of 6.0 m × 6.0 m were selected and arranged in Randomized Complete Block Design with 3 replications for recording data on various quantitative characters.

The varieties were characterized for 29 morphological characters at specific growth stage when character had full expression, as per UPOV (2006) and PPV&FRA (2012) descriptors. Among 29 characters, 10 (tree habit, leaf: presence of nectaries, nectaries colour, flower diameter, flower: arrangement of petals, flower: shape of petals, fruit shape, fruit pistil end, colour of fruit juice and fruit juiciness) characters were characterized as per UPOV descriptor, whereas, PPV&FRA descriptor was used to characterize rest of the 19 (one year old shoot: length of internodes, leaf length, leaf width, leaf length/leaf width ratio, leaf shape, leaf: angle of apex, leaf: shape of base, leaf: length of petiole, days from full bloom to harvest, fruit weight, fruit length, fruit width, fruit skin colour, fruit flesh colour, fruit firmness, length of fruit stalk, eating quality, stone weight and stone shape) characters. The observations for the assessment of distinctiveness, uniformity and stability were made on plants from each replication selected randomly. All observations on the tree and the branches were made during dormancy. For foliage characters randomly picked thirty fully matured leaves (ten in each replication) from the middle portion of the current season's flush at the end of summer growth. Similarly, for fruit and stone characters, 15 representative fruit samples (five in each replication) were taken at optimum maturity. Observations on the mature fruit were recorded when fruit was ready for harvesting.

Results and Discussion

Tree growth characters such as growth habit and length of internode were observed as per UPOV (2006) descriptor

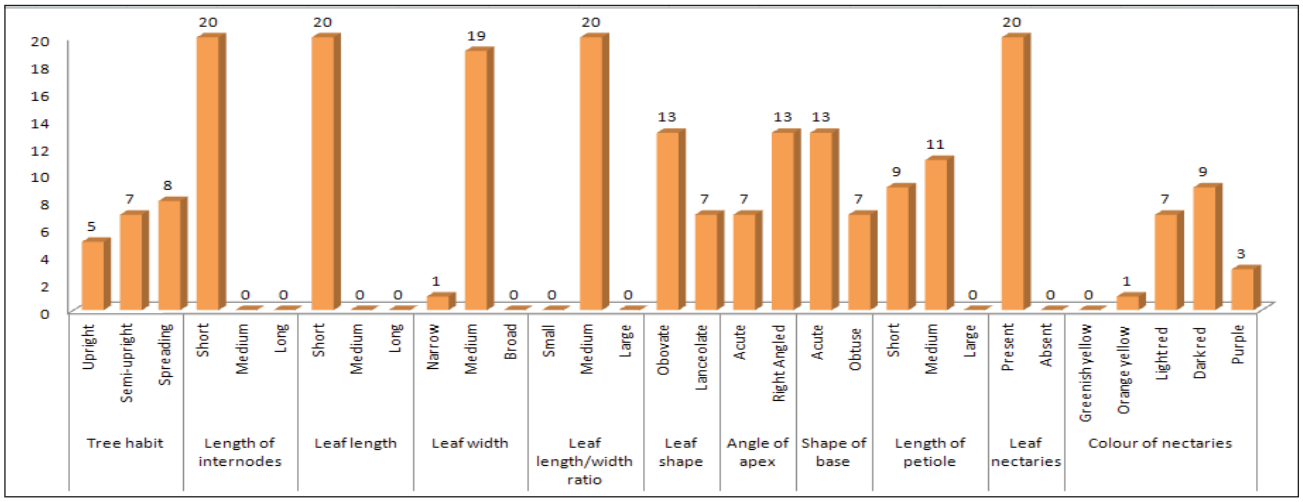

Fig 1. Frequency distribution of 20 sweet cherry varieties based on tree and foliage characters

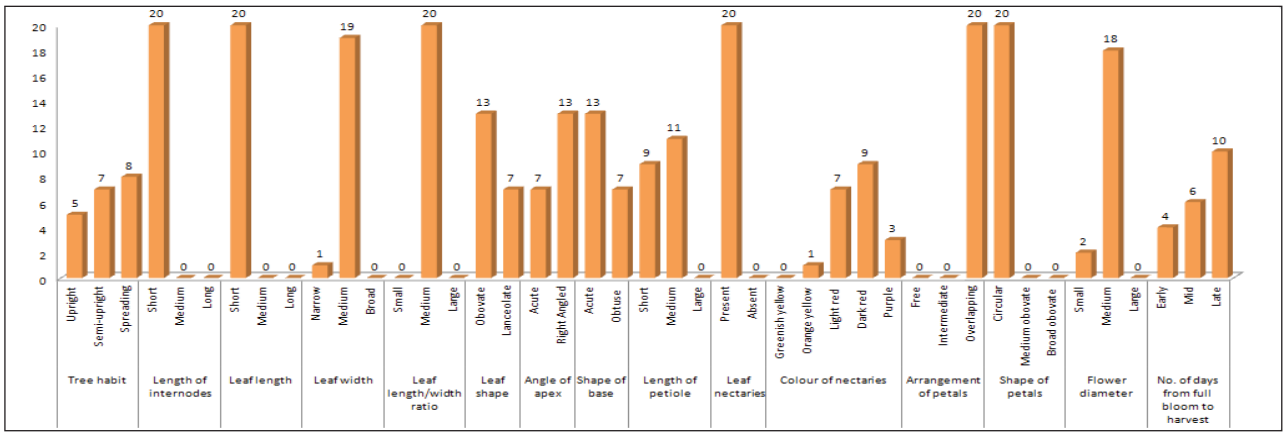

Fig. 2. Frequency distribution of 20 sweet cherry varieties based on tree, foliage and flower characters

and PPV&FRA (2012) descriptor. These guidelines varied considerably amongst the sweet cherry varieties under study which fell into distinct classes. Out of twenty sweet cherry varieties as many as eight varieties were found to have spreading type of growth habit (Black Heart, Bradbourne Black, Durone Nero-III, Lambert, Roundel Heart, Seneca, Stella and Sunburst), whereas, seven varieties had semi-upright growth habit (Durone Nero-II, Merton Glory, Red Heart, Sam, Triumph Domini, Van and Vega) and five had upright type of growth habit (Bing, Early River, Lapins, Noir De Guben and Rainier). No such variation in internodal length was reported in the present study. Upright growth habit observed in these varieties (Bing, Early River, Lapins, Noir De Guben and Rainier) suggests their suitability under high density planting system. Rakonjac *et al*. (2014) reported growth habit to be as upright, semi-upright and drooping in different cherry cultivars. This is also in agreement with the results of Matteo *et al.* (2017).

The variation in leaf characters is considered as distinguishing features for description and identification of fruit species and cultivars (Upshall, 1924). In the present study huge variation was observed in leaf shape, leaf: angle of apex, leaf: shape of base, leaf: length of petiole and nectaries colour except for leaf length, leaf width, leaf length/width ratio and leaf: presence of nectaries, in which no marked variation was observed. In the present study, leaf shape was found as obovate and lanceolate, whereas, leaf: shape of base as acute and obtuse, which were similar to the findings of Ljubojevic *et al*. (2016). Leaf: angle of apex was observed as acute and right angled in the present study. The nectaries colour was observed as orange yellow, light red, dark red and purple in the sweet cherry varieties under study. Similar variation in nectaries colour has been reported earlier by Olmstead *et al*. (2011). Leaf: length of petiole reported as short and medium in the present study, whereas, Matteo *et al.* (2017) found short, medium and long classes of leaf petiole length in their study.

Similar to foliage characters, some floral characters also varied considerably among sweet cherry varieties, whereas, flower: arrangement of petals and flower: shape of petals did not show any variation. However, Gjamovski *et al*. (2016) reported variation in petals shape as circular, medium obovate and broad obovate, whereas, flower: arrangement of petals as free, intermediate and overlapping. In the present study, most of the varieties had medium flower diameter except for the varieties Durone Nero-II and Lambert, which had small flower diameter. Most of the varieties were late in maturity (DFFH), whereas, some of them were medium and some of them were early. This is in accordance with the findings of Karlidag *et al*. (2009) i.e., early, late and very late.

Huge variation in fruit characters like fruit weight, fruit length, fruit width, fruit shape, fruit skin colour, fruit flesh colour, fruit juice colour, fruit firmness, fruit stalk length, fruit juiciness, and eating quality were observed except for fruit pistil end, which was observed as flat in all the studied varieties. However, Gjamovski *et al.* (2016) recorded pointed, flat and depressed type of fruit pistil end. Considerable variation in fruit skin colour, flesh colour and colour of fruit juice was found with appreciable variation in fruit shape *viz*; reniform elliptic and cordate type of fruit shape among all varieties under consideration. However, Gjamovski *et al*. (2016) found cordate, reniform, oblate, circular and elliptic type of fruit shape in different cherry cultivars.

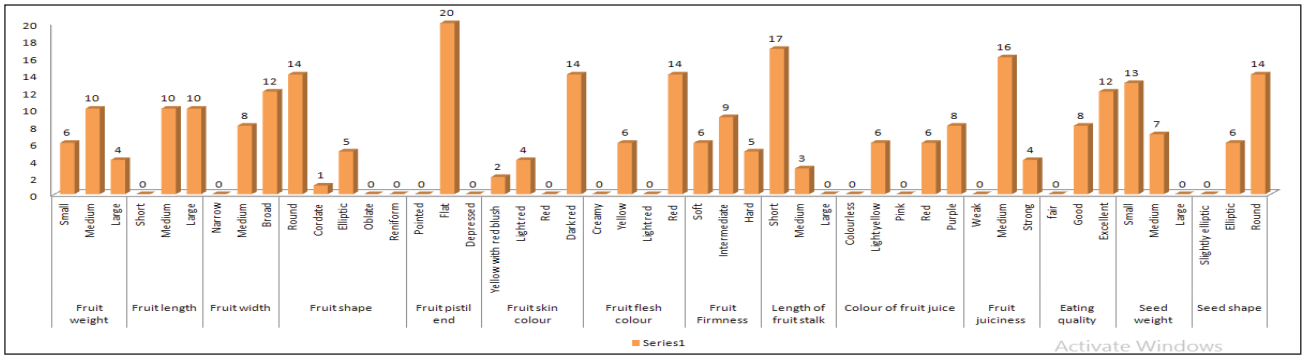

Fig. 3. Frequency distribution of 20 sweet cherry varieties based on fruit and stone characters

Sweet cherry fruits are mainly used for fresh consumption, hence appearance (shape, shiny fruit skin, dark red fruit skin color, length of the fruit stalk and eating quality) is really important in order to define good quality. In the present study considerable variation in fruit skin colour (yellow with red blush, red and dark red), fruit flesh colour (yellow and red), fruit juice colour (light yellow, red and purple) was observed. Similar type of variation in fruit skin colour (yellow, orange red, vermilion, wine red, mahagony and black), fruit flesh colour (cream white, pink, red, dark red and black red), and fruit juice colour (colourless, pink, red, purple and black red) were also noticed by Rakonjac *et al*. (2014). Dark skin and flesh colour are important considerations for fresh fruit marketing. The findings show that appealing taste accompanied by skin colour are the most important characteristics for sweet cherry consumers.

Fruit juiciness was observed as medium and strong in the present study which is similar to the findings of Matteo *et al*. (2017) i.e., extremely weak, weak, medium and strong. Fruit firmness was found to be as soft, intermediate and hard type, which is in accordance with the findings of Iurea *et al.* (2019) as average and firm in their study. Greater fruit firmness is an important trait from the marketing and consumer preference angles. Fruit stalk length was found to be short to medium in the present study, whereas, Matteo *et al.* (2017) reported short, medium and long type of fruit stalk length in their studies. The fruit stalk is one of the important markers of freshness; this is a reason for marketing cherry fruits with stalk. Medium to long type of fruit stalk length is mostly preferred by the consumers and breeders for easy hand picking of fruits (Bujdoso *et al*., 2020). The eating quality in the present study was classified as Excellent and Good. However, Corneanu *et al.* (2020) reported eating quality (taste) of sweet cherry as average sweet to very sweet in their study. Sweet taste is the most important characteristic for the sweet cherry consumers, but fruits with less sweet taste are also preferred in many countries (Bujdoso *et al.*, 2020).

Most of the varieties had low (Black Heart, Durone Nero - II, Durone Nero - III, Early Rivers, Lambert, Lapins, Roundel Heart, Sam, Seneca, Stella, Triumph Domini, Van and Vega) stone weight, whereas, some of the varieties had medium (Bing, Bradbourne Black, Merton Glory, Noir De Guben, Rainier, Red Heart and Sunburst) stone weight. The stone shape among all the twenty varieties under study was observed as elliptic (Early Rivers, Lapins, Noir De Guben, Rainier, Seneca and Triumph Domini) and round (Bing, Black Heart, Bradbourne Black, Durone Nero - II, Durone Nero - III, Lambert, Merton Glory, Red Heart, Roundel Heart, Sam, Stella, Sunburst, Van and Vega). Such type of variation in stone shape was reported by Matteo *et al.* (2017).

Conclusion

On the basis of present study, conclusion may be drawn that morphological descriptors developed through characterization of sweet cherry varieties alone may not meet the DUS criteria for establishment of distinctness among them. So, there is a need to employ some biochemical tools and molecular markers in addition to morphological DUS descriptors for the establishment of distinctness of the morphologically allied varieties. However, the qualitative characterization of sweet cherry varieties revealed that some of these do possess one or more horticulturally desirable characteristics enlisted below.

Sweet cherry varieties	Distinguishing character(s)
i) Black Heart	Early maturity, dark red coloured, small stone
ii) Sam	Large fruits, dark red coloured, small stone
iii) Bing	Upright tree habit, large fruits, dark red coloured
iv) Rainier	Upright tree habit, firm fleshed, dark red coloured
v) Merton Glory	Large fruits, dark red coloured

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