

Assessment of New Sweet Cherry Cultivars Released at RSFG Iași, Romania

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Abstract

The research concerning the improvement of the cherry assortment, the cultivars' quality and the avoiding of market crowding with fresh cherries only on a short term are extremely important objectives for cherries' breeding. To accomplish some of these objectives, during 1981-2017, hybridization and selection of hybrids were performed at the Research Station for Fruit Growing Iași (RSFG Iași), in the N-E part of Romania, concluding with a series of promising hybrid selections. They have been grafted, planted and studied in trial fields. Therefore, during 1994-2016, RSFG Iași released 28 sweet cherry cultivars with high quality fruits and different maturation stages. In the studies performed during 2014-2017, there were analysed three new sweet cherry cultivars ('Elaiiași', 'Mușatini' and 'Croma'), obtained through controlled hybridization. The comparison of these new cultivars was performed against 'Van', used as control, this being a well-known cultivar in the orchards from the study area. Observations and measurements concerning the main phenological stages, natural fertility, physical features, organoleptic, quality and chemical traits of fruit were registered. The cultivars with the biggest dimensions of the fruits were 'Elaiiași' and 'Croma' (with a weight between 8.9 and 9.4 g and a fruits' diameter between 25.2 and 26.6 mm), having significantly larger dimensions in comparison with 'Van'. In the new investigated cherry cultivars, the values of soluble solids content were comprised between 17.0 and 20.2 °Brix, titratable acidity was between 0.46 - 0.57 mg of malic acid 100 mL⁻¹ juice and the total polyphenols content was recorded between 382.87 - 780.25 mg GAE 100 mL⁻¹ of fresh juice.

Keywords: breeding; cultivar; fruit; sweet cherry; quality

Introduction

The sweet cherry tree represents the first ring of the yearly chain of fruits production due to its fruits' ripening age, the quality and the savour of the cherries, highly appreciated by consumers and due to the constant fruits production (Kazantzis *et al.*, 2011; Maglakelidze *et al.*, 2017; Quero-García *et al.*, 2017). The assessment of sweet cherry cultivars obtained as a result of the genetic breeding represents a way to complete and improve the current assortment (Höfer and Giovannini, 2017; Ganopoulos *et al.*, 2018).

The research concerning the improvement of sweet cherry assortment in regard with the cultivars' quality, as well as the avoidance of fresh cherries market crowding only on a short term are extremely important objectives for sweet cherry breeding (Budán and Grădinaru, 2000; Sansavini and Lugli, 2008; Milatović, 2011; Schuster *et al.*, 2014).

To accomplish some of these objectives, hybridization and positive selection of hybrids were performed at the Research Station for Fruit Growing (RSFG) Iași during 1981-2013, following which a series of promising hybrid selections were remarked. They have been grafted, planted and studied in trial fields. Therefore, during 1994-2018, RSFG Iași released 28 sweet cherry cultivars with different stages of maturation of the fruits.

The research aimed to present the most recent sweet cherry cultivars obtained at the Research Station for Fruit Growing Iași, Romania, released in 2016 with the names 'Elaiiași', 'Mușatini' and 'Croma'.

Materials and Methods

The studies were performed during 2014-2017, using as research material three sweet cherry cultivars ('Elaiiași', 'Mușatini' and 'Croma') obtained through controlled hybridization at RSFG Iași, N-E of Romania. The

comparison of the cultivars was performed using cultivar 'Van' as control. The cultivars were studied in trial fields, with the trees placed linearly in BCRD, in three repetitions. The trees were grafted on mahaleb and led under the shape of free palmette, without installing the sustaining system or the irrigation system; the distance in the field between trees were 5×4 m. On the tree rows, the soil was prepared with the lateral disk with feeler and between the rows the soil was grassed. The control of diseases and pests was performed according to the received warnings, phytosanitary treatments being applied.

To appreciate the flowering and fructification phenophases, the Fleckinger system was used (1960) (landmark stages).

The cultivars with a fertility index (respectively the percentage of resulted fruits, determined at 25-30 days after the fall of petals) that recorded minimum values of 30-35% were considered cultivars of high productivity (Cociu and Oprea, 1989).

To describe the fruits, descriptors utilised for *Prunus avium* L. have been used, according to the questionnaire UPOV TG/35/7, 2006. To determine the average weight of the fruit and stone (g), 25 fruits and 25 stones have been weighted for three times with the electronical scale 0,01G Radwag type sensitivity; the equatorial diameter of the fruit (D) was determined with the digital calliper Luumytools for 25 fruits over three repetitions. The pulp firmness, the adherence of the pulp to the stone and the fruit's taste have been evaluated with marks from 1 to 9 (UPOV, 2006).

The resistance of the fruits to cracking was determined using the Cristensen method, counting the cracked fruits after immersion in distilled water at 20 °C for a period of six hours (Webster and Looney, 1996).

The soluble dry substance from the fruit was measured with the Zeiss portable digital refractometer (degrees Brix); the titratable acidity of the fruits was determined using the potentiometric method (Ghimicescu, 1977); the total content of polyphenols was determined using the Folin-Ciocalteu method (Jayaprakasha *et al.*, 2001).

The experimental data has been statistically processed using ANOVA and the multiple comparisons method (Duncan test, with $P \leq 5\%$) as post-hoc, if was appropriate.

Results

During the four years of study, the average date for the beginning of the sweet cherry flowering was between 8th - 14th of April, data considered as a landmark for the cherry flowering in the NE area of Romania. By analysing the flowering phase for the four cultivars, it was noticed that 'Elaiasi' and 'Muşatini' bloom in the same period as the control cultivar 'Van', while the 'Croma' cultivar blooms one week later (Table 1).

All the studied cultivars were extremely productive because the values of the fertility index exceeded by far the value of 30% (Table 1).

Regarding the harvesting maturity, 'Elaiasi' and 'Muşatini' cultivars mature during the same period as the control cultivar 'Van' (the second decade of June), while the 'Croma' cultivar matures later than the control by 14-21 days (the 3rd decade of June - the first decade of July). The number of days from the end of flowering till maturation was between 64-75 days (Table 1).

The main features of the fruit followed in the hereby investigation were: physical features (epidermis colour, pulp firmness, fruit's shape, pulp adherence to stone), organoleptical features (taste), quality features (fruit's resistance to cracking), average weight of the fruits, average weight of the stone, stone percentage from the fruit's weight, morphological features (equatorial diameter of the fruit), biochemical characteristics of the fruits (content in soluble dry substance, titratable acidity, ratio between soluble dry substance and titratable acidity, total content of polyphenols).

In terms of physical and organoleptic characteristics of the fruits, the three cultivars ('Elaiasi', 'Muşatini' and 'Croma') present the same features as the control cultivar 'Van': the epidermis colour is dark red, the pulp is firm, the pulp adherence to stone is absent and the taste is sweet. Regarding the resistance of fruits to cracking, 'Elaiasi' (2.1%), 'Muşatini' (3.0%) and 'Croma' (17.0%) presented a resistance superior to the control cultivar 'Van' (44.0%) (Table 2). The equatorial diameter (mm) and the fruit's weight (g) were larger for each studied cultivar in comparison with the control cultivar 'Van' (Table 3).

Table 1. The progress of the fructification phenophases in the investigated cherry cultivars (RSFG Iaşi; 2014-2017)

Cultivar	Flowering beginning (data)	Average data for flowering beginning	Natural fertility (%)	Harvesting maturity (data)	No. of days from the beginning of flowering till harvesting maturity
Limit data (earliest - latest)					
'Van' (control)	04 IV-16 IV	08 IV	58.4	11 VI-17 VI	66 ^b
'Croma'	09 IV-23 IV	14 IV	49.6	25 VI-04 VII	75 ^{a1}
'Elaiasi'	05 IV-16 IV	08 IV	43.1	13 VI-20 VI	68 ^b
'Muşatini'	05 IV-17 IV	09 IV	53.5	11 VI-16 VI	64 ^b

^aDifferent letters correspond with the significant statistical difference for $P \leq 5\%$, Duncan test.

Table 2. Physical, organoleptic and quality features of the fruits in the investigated cherry cultivars (RSFG Iasi; 2014-2017)

Cultivar	Epidermis colour ¹	Pulp firmness ²	Fruit's shape ³	Pulp adherence to stone	Taste ⁴	Fruit's resistance to cracking (%) ⁵
'Van' (control)	7	7	4	Non-adherent	5	44.0 ^a
'Croma'	7	7	2	Non-adherent	7	17.0 ^b
'Elaiasi'	7	7	1	Non-adherent	7	2.1 ^d
'Muşatini'	7	7	2	Non-adherent	5	3.0 ^c

¹UPOV test: epidermis colour mark on the scale 1-8: 1= yellow; 2= yellow with red; 7= dark red; 8 = black (UPOV, 2006);²UPOV test: pulp firmness mark on the scale 3-9: 3=soft; 5=middle; 7=firm; 9=very firm (UPOV, 2006);³UPOV test: fruit's shape mark on the scale 1-5: 1= heart-shaped; 2= kidney-shaped 4= circular (UPOV, 2006);⁴UPOV test: fruit's taste mark on the scale 3-7: 5= middle sweet; 7= very sweet (UPOV, 2006);⁵Different letters correspond with the significant statistical difference for P ≤ 5%, Duncan test.

Table 3. Physical features of the fruit in the investigated sweet cherry cultivars (RSFG Iasi; 2014-2017)

Cultivar	Fruit's equatorial diameter (mm)	Fruit's average weight (g)	Stone's average weight (g)	Stone from the fruit's weight (%)
'Van' (control)	24.2 ^b	7.3 ^c	0.27 ^b	3.69 ^a
'Croma'	25.2 ^b	8.9 ^b	0.32 ^b	3.59 ^a
'Elaiasi'	26.6 ^a	9.4 ^a	0.37 ^a	3.92 ^a
'Muşatini'	25.3 ^b	8.3 ^b	0.33 ^b	3.98 ^a

^aDifferent letters correspond with the significant statistical difference for P ≤ 5%, Duncan test.

The cultivars with the largest dimensions of the fruit were 'Elaiasi' and 'Croma' (with a weight between 8.9-9.4 g and an equatorial diameter between 25.2-26.6 mm), being significantly bigger than 'Van' (Table 3).

The percentage occupied by the stone from the fruit's weight does not differ statistically between the three cultivars and 'Van' (Table 3).

In terms of chemical components of the fruits, respectively content in soluble dry substance, in acidity and polyphenols, these are comparable or superior to the control cultivar (Table 4). The content in dry substance is extremely important for cherries, the fruits' taste being dependent on it to the fullest extent. Hence, this parameter was between 17.0 °Brix and 20.2 °Brix for 'Elaiasi' cultivar, representing a value significantly higher than 'Van'.

The titratable acidity recorded values in relatively tight limits, between 0.46% ('Van') and 0.57% ('Croma'). All the studied cultivars had larger values than the control cultivar and did not differ statistically.

The soluble dry substance and titratable acidity ratio ranged between 34.4 to 37.9, but no statistically differences were registered (Table 4).

Total content of polyphenols values varied largely between cultivars and were statistically assured, whereas the differences were significant for 'Muşatini' (780.25 mg GAE 100 mL⁻¹) and 'Elaiasi' (655.52 mg GAE 100 mL⁻¹) in comparison with the control cultivar 'Van' (400.53 mg GAE 100 mL⁻¹) (Table 4).

All the studied cultivars have sweet fruit, with a pleasant flavour.

Table 4. Biochemical characteristics of the fruits in the investigated sweet cherry cultivars (RSFG Iasi; 2014-2017)

Genotype	SDS (°Brix) ¹	TA (%) ²	SDS/TA ³	Total content of polyphenols (mg GAE 100 mL ⁻¹)
'Van' (control)	17.0 ^b	0.46 ^a	36.95 ^a	400.53 ^c
'Croma'	20.2 ^{a1}	0.57 ^a	35.43 ^a	382.87 ^c
'Elaiasi'	18.2 ^b	0.48 ^a	37.90 ^a	655.52 ^b
'Muşatini'	17.2 ^b	0.50 ^a	34.40 ^a	780.25 ^a

^aDifferent letters correspond with the significant statistical difference for P ≤ 5%, Duncan test.¹SDS= the soluble dry substance;²TA= the titratable acidity;³SDS/TA= the report between the soluble dry substance and titratable acidity.

Discussion

The late flowering is extremely important to avoid damage caused by the late spring frost and hoarfrost. Also, Ganji Moghaddam *et al.* (2012) observed great differences among the full blooms of 13 sweet cherry genotypes grown under Mashhad environmental conditions. However, Garcia *et al.* (2014) noted that early and middle flowering times are important to produce enough flowers for a normal early sweet cherry crop.

The fruit's size (equatorial diameter and fruit's weights) represent a genetic feature specific to each cultivar, being influenced by the crop technology, quantity of fruits' production, pedoclimatic factors, parent stock etc. the hereby results are consistent with other researches who studied the pomology features of sweet cherry cultivars (Radicevic *et al.*, 2008; Pal *et al.*, 2017). However, Bieniek *et al.* (2011) found an average weight of 3.78 g to 6.45 g as mean value of three years investigation of sweet cherry fruits in the Lithuanian climatic and soil conditions.

The resistance to the phenomenon of fruits' cracking is extremely important to avoid the economic efficiency decrease (Milatović *et al.*, 2011). The current results showed that all three new investigated sweet cherry cultivars tested are more resistant than control.

The data concerning the chemical composition of the fruits is consistent with previous findings of Vursavus *et al.* (2006). The chemical composition of fruits represents a major source of antioxidant compounds (Serrano *et al.*, 2005; Coşofreţ *et al.*, 2006; Beceanu, 2008; Usenik *et al.*, 2008), so consumers have an increasing interest on fruits in the last years (Šimunić *et al.*, 2005; Khanizadeh *et al.*, 2007).

The ratio between the soluble dry substance and the titratable acidity is considered extremely important to determine the fruits' taste, reflecting a balance between the sweet and the sour taste of the fruits (Crisosto *et al.*, 2002). From this point of view, all the studied cultivars recorded large values, between 34.40-37.90. But, in some sweet cherry cultivars from Italian assortment SDS:TA ratio ranged from 20.3 at 'Durone dell'Anella tardiva' and 27.5 at 'Mora de Vignola' (Lugli *et al.*, 2006). The total content of polyphenols is important to determine the cherries' taste and flavour and it plays an antioxidant role with anticancer effect (Chaovanalikit and Wrolstad, 2004); Skrzynski *et al.*, 2016; Hallmann and Rozpara, 2017; Nizioł-Lukaszewska, 2019).

Conclusions

For the new sweet cherry cultivars 'Croma', 'Elaişi', 'Muşatini' released at the Research Station for Fruit Growing Iaşi, Romania, all the studied parameters were superior to the control cultivar 'Van', getting remarked by late flowering ('Croma'), high productivity, particular quality of the fruits, resistance to the phenomenon of fruit cracking ('Elaişi', 'Croma', 'Muşatini') and lateness of rapening ('Croma'). The studied cultivars can be recommended to be grown in all the areas favourable to sweet cherry crop from the North-Eastern area of Romania and other areas of the country to establish the new orchards with high density per hectare. The cultivars were released in 2016 and than patented in January 2018.

Acknowledgements

This work was partially supported by the Romanian Ministry of Research and Innovation, Grant No. PN-III-P1-1.2-PCCDI-2017-0662, with title 'Increasing Institutional Research Capacity – Development - Innovation in the Field of Ecological Fruit Growing'.

Conflicts of interest

The authors declare that there are no conflicts of interest related to this article.

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