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ASSESSMENT OF SWEET CHERRY (PRUNUS AVIUM L.) GENOTYPES GROWN IN CONDITIONS OF ROMANIAN NORTHEASTERN AREA

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Abstract
The soil and climate conditions in Romanian Northeastern area are favorable for cherry cultivation, but some times can occurred some calamities. The paper presents a study which during 2020 at the Research Station for Fruit Growing (N-E of Romania), using five sweet cherry genotypes as research material: 'Van', 'Croma', 'Elaiași', 'HC920402', 'HC930208'. Observations and determinations were performed in regards to the frostdamages, the main growing and phenological stages and the physical and chemical traits of the fruit. The phenological stages were evaluated for beginning of flowering and fruit ripening (expressed in growing degree-days, GDD). For these sweet cherry cultivars, the highest values concerning the fruit's weight have been recorded for 'Elaiași' (9.15 g) and 'HC920402' (7.7 g), while fruit's equatorial diameter have ranged between 23.21 mm and 25.16 mm. The content of soluble dry solids (SDS) was between 14.6 and 20.2 °Brix. The proposed objective aims at introducing in the assortment the new varieties with quality fruits and their resistance to cracking, with ripening time at the extremities of the sweet cherry season.

Keywords: determination, genotypes, observation, sweet cherry

1. INTRODUCTION

Sweet cherry (*Prunus avium* L.) is a crop of great importance in the NE region of Romania, due to the favorable cultural conditions it finds in this area. Romanian sweet cherry production shows an increasing tendency (Bujdoso and Hrotko, 2017). Sweet cherry orchards, according to FAO data, occupy significant areas, approximately 7,058 ha with annual production of 90,837 tones (FAOSTAT, 2018), thus placing our country in the world top of sweet cherry producing countries, along with Turkey, Chile, Italy, Spain and others. Of the area occupied by sweet cherry orchards in Romania, Iași County has the largest share, 1,275 ha (Coman and Chițu, 2014). According to Grădinaru (2002), sweet cherry culture has specific requirements and their fulfillment is necessary for the success of the orchards. Regarding the soil characteristics, cherries require well-drained and aerated soil, but can tolerate soils ranging from sandy loam as long as there is good drainage (Roper and Frank, 2004). Also, cherry tree has been grown succesfully and gave high yields in soil with organic matter contents ranging less than 1% in sandy soils in warm, semi-arid regions to as high as 10 % in cooler temperate regions (Neilsen et al., 2017).

The addition of new local varieties, created at research stations in the area together with foreign varieties is a method to improve the assortment of sweet cherries in different types of orchard management (Zlati et al., 2019). For sweet cherry growers, although the concept of 'fruit quality' depends on the product itself and the consumer's preferences (Romano et al., 2006). It is widely accepted that the main characteristics related to sweet cherry quality are fruit weight, color,

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firmness, sweetness, sourness, flavor and aroma with important differences among cultivars (Díaz-Mula et al., 2009). Pérez-Sánchez et al., (2008) show that for consumers must have distinct agronomic characteristics, such as low susceptibility to fruit cracking, high levels of soluble solids, ripening times at the extremities of the sweet cherry ripening season and high hardiness.
The purpose of this study was to evaluate five sweet cherry genotypes suitable for the Romanian Northeastern area: 'Van', 'Croma', 'Elaiași', 'HC920402', 'HC930208'.

2. MATERIALS AND METHODS

This study was carried out during 2020 in the experimental fields of the Research and Development Station for Fruit Growing (RSFG) Iași using as research material five sweet cherry genotypes: 'Van', 'Croma', 'Elaiași', 'HC920402', 'HC930208'.
Originating from Canada, 'Van'is an early and very productive variety with high ecological plasticity and and the ripening of the fruit is the second decade of June (Grădinaru, 2002). The varieties 'Croma' and 'Elaiași' are two new sweet cherry varieties approved at the Research Station for Fruit Growing Iași. These varieties were obtained by controlled hybridization (Iurea et al. 2019). 'Croma' is a variety withvery large fruits and a late fruit ripening period (the end of June, the first decade of July), according UPOV questionaire. The variety 'Elaiași' also has very large fruits with a medium ripening period. The sweet cherry hybrids studied 'HC920402' and 'HC930208'are in progress for approval.
The selected genotypes have been grafted on *Prunus mahaleb* L. seedling. The sweet cherry treeswas planted in 2000 in an experimental design of randomized blocks with three replicates. Planting distance was of 5x4 m and training as free palmette.
The following characteristics of the sweet cherry genotypes were recorded: the date of bud development, the beginning of flowering (62 BBCH stage 10% of flowers fully open), the beginning of fruit ripening (75 BBCH stage10% of fruits with full colour). Based on this, the growing degree-days (GDD) from bud swelling to the beginning of flowering and after that until the start of ripening were calculated according to equation (McMaster, Wilhelm, 1997; Aydin et al., 2019):

$$\mathbf{GDD}=\frac{Tmax+Tmin}{2}-T\,base,$$

where $\mathbf{T_{max}}$ and $\mathbf{T_{min}}$ are daily max and minim temperatures, $\mathbf{T_{base}}$ is base temperature. The sweet cherry base temperature for European temperate climate zones is used 5°C(Wenden et al., 2016). To observe the bud-development, the flowering and the fruiting phenophases were used the BBCH-scale.
The fruits were collected at full maturity stage. For each cultivar 30 fruits with similar size and without visible external damage were selected for physico-chemical analysis. Biometric measurements and determinations were performed as follows: equatorial diameter of the fruit (mm), thickness (mm) and length (mm) using the Lumytools sliding tool (Radu et al., 1957). The fruit weight was measured using an analytical balance Radwag. The chemical analyzes consisted in determining thesoluble dry solids (SDS%) using a Zeiss refractometer (Cociu and Oprea, 1989). Geometric diameter (Dg) and sphericity (Ø) of fruits were calculated using two equations:

$\mathbf{Dg = (LWT)^{0.333}}$ and $\mathbf{Ø = Dg/L}$ (Aydin, 2003; Mohsenin,1986);

where: L= lenght; W =width; T=thickness.

The obtained results were processed statistically. Differences between means were evaluated by using the Duncan's multiple range test at $P \leq 0.05$.

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3. RESULTS AND DISCUSSIONS

Weather conditions, in special temperature is an important factor for the growth and development of phenophases. Plant phenology is more clearly measured on growing degree- days (GDD, ºC-day) compared to other approaches of this kind as the time of year (McMaster and Wilhelm, 1997). The GDD required to the beginning of flowering and fruit ripening of sweet cherry depends on both growth conditions and genotype (Table 1). In the spring conditions of 2020 the average temperature in the period from the buds development to the beginning of flowering was 7,6ºC according to the data registered at RSFG Iași. Also, the buds development starts between 7th of March at 'HC930208' and 11th of March ('Van', 'Elaiași'). Based on the registered observations on the five genotypes, it was established that the stage from the buds development to the beginning of flowering will occur between 126.45 GDD for 'HC930208'early genotype and 189.7 GDD for 'Elaiași'. To start ripening, the fruits needed the highest amount of GDD depending on precocity. Thus, 'HC930208' need just 369.9 GDD, but Croma needed the highest amount of 472.95 GDD, being a late ripening variety.

Table 1. The growing degree-days (GDD) to the beginning of flowering and fruit ripening of sweet cherry genotypes (RSFG Iași, 2020, n=3)

Genotypes	Bud development (54 BBCH)	Start of flowering (62 BBCH)	No. days from bud development to flowering	GDD (days)	Start of flowering (62 BBCH)	Ripening time (75 BBCH)	No. days from start of flowering	GDD (days)
CROMA	08.03	9.04	33	**189.15**	9.04	26.06	79	**472.95**
VAN	11.03	7.04	28	**166.15**	7.04	16.06	71	**433.05**
ELAIAȘI	11.03	10.04	31	**189.7**	10.04	21.06	71	**433.35**
HC 920402	08.03	08.04	32	**180**	08.04	15.06	69	**419.85**
HC930208	07.03	31.03	25	**126.45**	31.03	29.05	60	**369.9**

*****BBCHscale- Biologische Bundesantalt, Bundessortenamt und Chemische Industrie

*GDD-The growing degree-days

Table 2 shows several characteristics of the fruit by physical and chemical analysis. The statistical calculation resulted in significant differences between the characteristics of the fruits particularly fruit weight(g) or geometric diameter(mm), also the the soluble dry solids (SDS%). The 'Elaiași' variety had the highest average fruit in terms of physical characteristics. The average fruit weight for 'Elaiași' was 9.07 g whereas significantly lower average fruit weight was recorded in 'HC930208' (6.46 g). The high values for 'Elaiași' were previously reported by Iurea et al. (2019). The fruit diameter of the studied genotypes varied between 25.11 mm and 23.08 mm. This parameter is considered to be the most important commercial feature that defines sweet cherry fruit characteristics, because the market demand for fresh fruit is directed to fruits as large as possible (Christensen, 1996). With regard to sphericity, the genotypes are of flattened form with value of 0.89, and only 'Elaiași' genotype produced more elongated fruits (Øf = 0.92). The content in dry

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substance is extremely important in sweet cherries as the taste of the fruits depends highly on it (Corneanu et al., 2020). 'Van' ranked the highest in terms of SDS (20.24%), while the lowest content in soluble dry solids was found in 'Croma' (14.50%).

Table 2. Physico-chemical properties of varieties and perspective hybrids of sweet cherry (RSFG Iași, 2020), n=3

Genotypes	Fruit weight (g)	First fruit diameter (mm)	Second fruit diameter (mm)	Fruit height	Geometric Diameter (mm)	Sphericity (mm^2)	S.D.S (%)
CROMA	6.81^{d}	23.49^{cd}	20.05^{c}	20.14^{d}	20.98^{d}	0.89^{d}	14.50^{d}
VAN	7.18^{c}	24.05^{bc}	20.64^{b}	20.63^{c}	21.63^{c}	0.89^{b}	20.24^{a}
ELAIAȘI	9.07^{a}	25.11^{a}	22.19^{a}	22.95^{a}	23.26^{a}	0.92^{a}	15.66^{c}
HC 920402	7.70^{b}	24.71^{a}	19.94^{c}	22.03^{b}	22.07^{b}	0.89^{d}	18.88^{b}
HC930208	6.46^{e}	23.08^{d}	20.04^{c}	19.56^{e}	20.84^{e}	0.89^{c}	15.66^{c}

Different letters after the numbering within a column corresponds with statistically significant differences for P≤0,05 according to Duncan's multiple range test.

The stone and stalk traits are presented in Table 3. It was evaluated physical parameters such as weight, diameter, length or width. Regarding the stone weight turned to be between 0.26 g and 0.35 g, with the smallest value of 'Elaiasi', and the largest of 'HC920402'.
The studied sweet cherries genotypes showed fruit with short to medium stalk length, with values varied between 23.99 mm and 35.66 mm. However, Pérez-Sánchez et al. (2010) reported that the consumers prefer sweet cherries with short stalk or without stalk as are the 'picotas' cherries.

Table 3. Physical properties of stone and peduncle in varieties and perspective hybrids of sweet cherry (RSFG Iași, 2020, n=3)

Genotypes	Stone				Stalk		
	Weight (g)	Thickness (mm)	Length (mm)	Width (mm)	Length (mm)	Weight (g)	Diameter (mm)
CROMA	0.30^{a}	8.61^{a}	7.24^{c}	10.06^{a}	31.66^{a}	0.10^{c}	1.35^{a}
VAN	0.28^{e}	7.94^{b}	6.32^{b}	9.07^{d}	23.99^{a}	0.07^{d}	1.25^{a}
ELAIAȘI	0.26^{c}	8.79^{c}	7.21^{b}	9.68^{b}	33.32^{a}	0.06^{e}	1.22^{a}
HC 920402	0.35^{d}	9.39^{d}	6.95^{d}	9.72^{b}	35.30^{a}	0.11^{h}	0.73^{a}
HC930208	0.33^{b}	9.50^{a}	7.92^{a}	9.52^{c}	35.66^{a}	0.12^{a}	1.27^{b}

Different letters after the numbering within a column corresponds with statistically significant differences for P≤0,05 according to Duncan's multiple range test.

4. CONCLUSIONS

Following the study conducted during 2020, the selected genotypes present superior agroproductive characteristics adapted to the conditions in North-Eastern Romania. The high qualities of the fruis and the different ripening times, from the earliest genotype ('HC930208') to the latest ('Croma') determine their recommendation and the introduction in the assortment for growing area from the Northeast of Romania, or in other areas with similar soil and climate conditions.

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