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GENETIC RESOURCES OF SOUR AND BITTER CHERRY IN THE SPONTANEOUS AND CULTIVATED FLORA FROM NORTHEAST AREA OF ROMANIA

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Abstract

The aim of the paper is to describe the valuable traits of bitter and sour cherry genotypes selected from the spontaneous and cultivated flora (in the Moldova region), approved as new cultivars between 1990-2016. That improve the domestic assortment of sour and bitter cherry with new cultivars that shows resistance to disease and frost, have qualitative fruits, adapted to the particular conditions of the Northeastern region of Romania. In terms of the weight of the fruits (g) cultivars that were highlighted are the cherry cultivar 'Amaris' (5.5 g) with very significant positive differences and the sour cherry cultivar 'De Botoşani' (6.0 g) with significant positive differences in comparison with the control (4.2 g for bitter and 5.7 g for sour cherry). In terms of stone size, the values for the cherry cultivars were between 0.25-0.33 g, while the values for the sour cherry cultivars were between 0.30-0.34 g, being classified as small to middle size according to the UPOV guideline. The studied bitter and sour cherry cultivars present good resistance to fruit cracking with 0.0-3.7% cracked fruits.

Key words*: fruit, biometry, size, traits.*

INTRODUCTION

In the Moldova region (Northeast area of Romania), the cherry and sour cherry tree species have been cultivated since ancient times (Grădinariu & Istrate, 2003). Evidence of this fact is represented by numerous old local cultivars and populations as: 'Boambe de Cotnari', 'Vârtoase de Comarna', 'Crăieşti de Comarna' (for cherry) and 'Mocăneşti', 'Crişane' (for sour cherry) (Istrate, 2007; Sestraş, 2004; Budan and Grădinariu, 2000; Dumitrescu, 1981).

Considering the high interest for cherry and sour cherry crops expansion, many recent studies were initiated to identify and select biotypes and valuable clones (Radičević et al., 2012; Petre et al., 1994). The genotypes collected were adapted to the climate conditions specific to the area, that can fit efficiently with the modern crop technologies from all points of view and their fruits can fit to various ways of capitalization both in fresh or processing way (Petre et al., 2007).

The aim of this paper is to describe the valuable traits of bitter and sour cherry genotypes selected from the spontaneous and cultivated flora adapted to the specific conditions of the Northeast area of Romania.

MATERIALS AND METHODS

Aiming to highlight the biologic fund of genotypes that exist in the spontaneous and cultivated flora in the NE of Romania, positive selection tasks on valuable sour and bitter cherry biotypes were performed. For the selected genotypes, a minimum of 3 years of observations were recorded at their place of origin about particular agronomical traits of the trees and organoleptical traits of the fruits before they were grafted in the nursery and planted in trial field next to other local cultivars.

The studies were performed between 2013-2020, using three bitter cherry cultivars ('Amar Galata', 'Amar Maxut' and 'Amaris') and two sour cherry cultivars ('Timpuriu de Osoi' and 'De Botoşani') as research material.

The trees are found in experimental lots, grafted on mahaleb. The cherry tree gets planted at a distance of 5 × 4 m and the sour

cherry tree at a distance of 3.5 × 4 m, with the crown guided as free flattened palmette on the direction of the row with trees, without a supporting or irrigation system. On the row of trees, the soil was prepared with the rotary orchard tiller and between the rows, the soil was grassed.

In the experimental plantation, observations and measurements have been performed regarding the trees' vigour, their resistance to frost and anthracnose (Cociu & Oprea, 1989) and the main growing and fructification phenophases (Meier, 2001) along with measuring the cultivars' self-fertility, according to the UPOV TG/35/7 questionnaire for cherry and TG/230/1 for sour cherry, measurements and determinations about the physical, chemical and quality traits of the fruits were also performed.

The productivity was determined based on the fruits yield (kg/tree) and fertility index, representing the percentage of fruits resulted 25-30 days after the petals' fall and the cultivars with values above 30-35% are considered highly productive (Cociu & Oprea, 1989).

The experimental data was statistically analysed by the variance test.

RESULTS AND DISCUSSIONS

In terms of growing vigour of the trees, the cherry cultivar 'Amaris' was classified to be of low vigour, 'Amar Maxut' and 'Amar Galata' were of average vigour, while the two sour cherry cultivars ('Timpuriu de Osoi' and 'De Botoșani') were of average vigour (Table 1). Low vigour of the tree is an important parameter for establish high density of the orchards, the new trends in the fruit tree growing being to increase constant the productivity (Stănică, 2019).

In terms of the studied cultivars' resistance to frost, during 2013 (when the cherry was out of dormant stage), 2017, 2019 and 2020, at the end of March to beginning of April when the cherry was in bloom, the recorded temperatures were between -2.5°C and -10.8°C. Under these conditions, the flower buds are more sensitive, getting the gynoecium damaged inside the flower bud and the recently fertilized ovary damaged in the opened flowers, compromising at the same time an important amount of the fruits production (these results are in accordance with other research in cherry cultivars (Asănică et al., 2014; Long, 2013; Rodrigo, 2000).

Table 1. Tree's features in cherry and sour cherry cultivars (FGRS Iasi, 2013-2020)

Cultivar	Tree's vigour	Resistance to:			
		Frost	Anthracnose (*Coccomyces hiemalis* Higg.)		
		Damaged flower buds (%)	F[1] (%)	I[2] (%)	AD[3] (%)
Bitter cherry					
Amar Galata	average	2	3.3	8	0.26
Amar Maxut	average	3	2.9	11	0.32
Amaris	weak	8	2.7	13	0.35
Sour cherry					
Timpuriu de Osoi	average	0	0.0	0	0.0
De Botoșani	average	0	0.0	0	0.0

[1]- attack frequency; [2]- attack intensity mark on a scale of 1-6: 1 = 1-3% attacked surface; 2 = 4-10%; 3 = 11-25%; 4 = 26- 50%; 5 = 51-75%; 6 = 76-100%; AD[3]- attack degree (Cociu & Oprea, 1989).

In our study, the degree of damage of the flower buds in cherry tree varied in rather small limits, recording 2% in 'Amar Galata', 3% in 'Amar Maxut' and 8% in 'Amaris'.

The sour cherry cultivars had a very good resistance (Table 1). With regard to resistance to diseases, the years 2013, 2016, 2017 and 2018 were rainy years (with surplus of rainfall compared with normal period), favourable to pathogens evolution as *Monilia* sp. or anthracnose.

During these years, the bitter cherry cultivars manifested a slight sensitivity to anthracnose, the frequency of the attack being between 2.7-3.3%, while the sour cherry cultivars presented a very high tolerance (Table 1).

The flowering period for the two species (bitter and sour cherry) took place between the 3rd and the 30th of April (Table 2).

The values recorded for the natural fertility in the three cherry cultivars was between 35.1% ('Amaris') and 45.6% ('Amar Galata') and for the sour cherry cultivars, 'Timpuriu de Osoi' recorded 23.8% and 'De Botoșani' 41.5%, all of them being classified as highly productive cultivars, because their fertility index recorded values above 30%, except for the sour cherry cultivar 'Timpuriu de Osoi' (23.8%) (Table 2).

The results recorded for self-pollination throughout the eight years shows that the cherry cultivars are partially self-fertile, recording a low percentage of fruits (0.9-7.1%) and the sour cherry are self-sterile (table 2). For these cultivars, it is mandatory to plant them together with the suitable pollinators.

The harvesting maturity was recorded over the three decades of June both for the cherry and sour cherry cultivars. The number of days between the end of flowering to maturation was 42-68 days for cherry and 51-62 days for sour cherry (Table 2). The phenological periods for the same cherry genotypes are variable depending on the climatic conditions of each year (Darbyshire et al., 2012).

Table 2. The main fructification phases in bitter and sour cherry cultivars (FGRS Iasi, 2013-2020)

Cultivar	Beginning of flowering (BBCH 61)	End of flowering (BBCH 69)	Natural fertility (%)	Self-fertility (%)	Fruits' maturation date (BBCH 87)	Period from end of flowering to maturation (days)
Limit dates (earliest - latest):						
Bitter cherry						
Amar Galata	05 - 25.04	11 - 30.04	45.6	7.1	17 - 24.06	55 - 68
Amar Maxut	05 - 25.04	12 - 29.04	36.7	0.9	05 -18.06	45 - 51
Amaris	03 - 19.04	09 - 27.04	35.1	3.7	27.05 - 07.06	42 - 49
Sour cherry						
Timpuriu de Osoi	04 - 22.04	13 – 28.04	23.8	0.0	02 -20.06	51 - 54
De Botoşani	08 – 25.04	14 – 30.04	41.5	0.0	11 - 30.06	59 - 62

The average yield (kg/tree), the physical, chemical and quality traits of the fruit are presented in tables 3 and 4. Analyzing the average yields over eight years, from a statistical point of view, it is found that the bitter cherry varieties Amar Galata (34.6 kg/tree), Amar Maxut (31.1 kg/tree) and sour cherry variety Timpuriu de Osoi (25.4 kg/tree) recorded a significantly positive difference in production compared to the average of the all studied varieties taken of control.

In terms of fruits' weight (g) and equatorial diameter (mm), the 'Amaris' cherry cultivar got highlighted (5.5 g and 21.1 mm) with very positive significant differences and the 'De Botoşani' cultivar (6.0 g and 21.1 mm) with positive significant differences in comparison with the variants average (in cherry: 4.2 g and 18.9 mm; in sour cherry: 5.7 g and 21.8 mm) (Table 3).

With regards to the stone's size, the values for the cherry cultivars were between 0.25-0.33 g and for the sour cherry cultivars were between 0.30-0.34 g, classifying them as small to middle size according to the UPOV questionnaire.

The fruit/stone ratio for the cherry cultivars was between 12.0 ('Amar Maxut') and 19.6 ('Amaris'), recording distinctly negative significant differences in comparison to the control (14.4) and for the sour cherry cultivars, it was between 17.6 and 18.0 being non-significant in comparison to the control (17.8).

In cherry, the percentage of stone from the weight of the fruit recorded values between 5.09% ('Amaris') and 8.33% ('Amar Maxut') but in sour cherry, the values were between 5.55% ('Timpuriu de Osoi') and 5.66% ('De Botoşani'). Statistically, the cherry cultivar 'Amaris' recorded negative significant differences in comparison with the control (6.90%), while 'Amar Maxut' and 'Amar Galata' recorded very significant and respectively distinctly positive significant differences. In sour cherry, the values were non-significant in comparison with the control (5.61%).

In terms of soluble dry substance, the values in cherry were between 17.5% for 'Amar Galata'

and 20.1% for 'Amar Maxut' and the values in sour cherry were between 14% for 'De Botoșani' and 14.2% for 'Timpuriu de Osoi', the differences being non-significant in comparison with the variants average for both species (Table 3).

Table 3. The physical-chemical traits in cherry and sour cherry cultivars (RSFG Iași, 2013-2020 average; n = 8)

Cultivar/Species		Average fruit yield (kg / tree)	Fruit's weight (g)	Stone's weight (g)	Fruit/stone ratio	Stone in the fruit's weight (%)	Equatorial diameter of the fruit (mm)	SDS[1] (%)
Bitter cherry	Amar Galata	34.6^{+++}	4.2	0.33^{++}	12.7^{00}	7.85^{++}	18.4	17.5
	Amar Maxut	31.1^{+++}	3.0^{000}	0.25^{00}	12.0^{00}	8.33^{+++}	17.3^{00}	20.1
	X (Control)	26.9	4.2	0.29	14.4	6.90	18.9	18.6
	Amaris	15.0^{000}	5.5^{+++}	0.28	19.6^{+++}	5.09^{000}	21.1^{+++}	18.3
	LD 5%	2.1	0.51	0.03	1.43	0.61	1.00	2.2
	LD 1%	2.9	0.71	0.04	1.98	0.85	1.38	3.0
	LD 0.1%	4.1	0.99	0.06	2.75	1.18	1.92	4.2
Sour cherry	Timpuriu de Osoi	25.4^{+}	5.4^{0}	0.30	18.0	5.55	21.1	14.2
	X (control)	23.0	5.7	0.32	17.8	5.61	21.8	14.1
	De Botoșani	20.6^{0}	6.0^{+}	0.34	17.6	5.66	22.6+	14.0
	LD 5%	2.1	0.28	0.05	2.0	0.74	0.8	1.6
	LD 1%	3.1	0.41	0.07	2.6	1.10	1.2	2.4
	LD 0.1%	4.7	0.64	0.11	4.7	1.71	1.8	3.7

[1]SDS - soluble dry solids; [2]Control = the average of variants.

The fruits' colour in cherry was from yellow-reddish ('Amar Galata'), dark red ('Amaris') to black ('Amar Maxut') (Figures 1-3) and in sour cherry, both cultivars taken into study were dark red (Table 4; Figures 4-5).

Table 4. Fruits' physical and quality traits in cherry and sour cherry cultivars (RSFG Iasi, 2013-2020)

Cultivar	Epidermis colour	Pulp firmness	Fruit shape	Stone adherence to pulp	Cracked fruits (%)	Fruit's destination
Bitter cherry						
Amar Galata	yellow-reddish	semi-firm	heart-shaped	semi-adherent	3.7	jam
Amar Maxut	black	average	kidney-shaped	semi-adherent	0.4	jam, liqueur
Amaris	dark red	average	heart-shaped	non-adherent	0.2	jam
Sour cherry						
Timpuriu de Osoi	dark red	average	flattened sphere	semi-adherent	0.2	jam, compote
De Botoșani	dark red	average	flattened sphere	semi-adherent	0.0	jam, compote

Figure 1. 'Amaris' bitter cherry cultivar (original)

Figure 2. 'Amar Galata' bitter cherry cultivar (original)

Figure 3. ‘Amar Maxut’ bitter cherry cultivar (origina

Figure 4. ‘De Botoșani’ sour cherry cultivar (original)

Figure 5. ‘Timpuriu de Osoi’ sour cherry cultivar (original)

In terms of stone’s adherence to pulp and its firmness, both the cherry and sour cherry cultivars have semi-firm pulp and are semi-adherent, except for the ‘Amari’s genotype for which the stone does not have any adherence to the pulp.

The shape of the fruit was heart-shaped for ‘Amar Galata’ and ‘Amaris’, kidney-shaped for ‘Amar Maxut’ and flattened sphere for the two sour cherry cultivars.

The studied bitter and sour cherry genotypes present very good resistance to the phenomenon of fruit cracking, the values being between 0.0 - 3.7% cracked fruits (table 4).

The fruits of the sour and bitter cherry genotypes are targeted only for processing.

CONCLUSIONS

‘Amaris’ and ‘Timpuriu de Osoi’ are harvested in early season and ‘Amar Galata’ has a late harvest season being varieties with high economic potential.

The studied varieties were highlighted by the tree’s low vigour, good resistance to frost and fruit cracking, quality of the fruits targeted for processing as jams, compote or liqueurs.

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