Cercetări Agronomice în Moldova
Vol. XLVIII , No. 3 (163) / 2015

RESULTS OBTAINED IN BREEDING OF BITTER CHERRY ASSORTMENT AT FRUIT GROWING RESEARCH STATION IAŞI - ROMANIA

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Received March 11, 2015

ABSTRACT. The paper proposes the improvement of the current bitter cherry assortment with new creations made at Iaşi, adapted to the specific conditions from the NE area of Romania. For the improvement of the bitter cherry assortment with new, productive, disease resistant cultivars with fruits of good quality, resistant to cracking with different maturation stages, in 1981 at Fruit Growing Research Station (F.G.R.S.) Iaşi - Romania has begun an action of selection and promoting of some valuable genotypes of bitter cherry (existent in the spontaneous flora or in plantations from the Iaşi county), which were being planted with cultivars and other genotypes from all around the country. Following the positive and gradual selection there were selected three biotypes of bitter cherry from which two of them have been approved as new cultivars in 1994, with the names „Amar Maxut", respectively, „Amar Galata" and the biotype „Amar R5.P10" has been registered in 2013 at the State Institute for Variety Testing and Registration Bucharest to be approved as a new cultivar. All three bitter cherry genotypes correspond to the objectives of the main assortment breeding. They have a high productivity because the natural fertility index registered values between 36.5-63.7%, the trees have a reduced vigour, they present a good resistance to frost (1-9% affected buds) and to diseases (values of I% anthracnose, 1.1-2.8%). The fruits are high quality and the maturation stages are at the extremities of the cherries maturation season.

Key words: Genotypes; Productivity; Maturation; Fruit; Quality.

REZUMAT. Rezultate obţinute în ameliorarea sortimentului de cireş amar la S.C.D.P. Iaşi. Lucrarea propune îmbunătăţirea actualului sortiment de cireş amar cu creaţii noi, realizate la Iaşi, adaptate condiţiilor specifice din nord-estul României. Pentru îmbunătăţirea sortimentului de cireş amar cu soiuri noi, productive, rezistente la boli, cu fructe de calitate bună, rezistente la crăpare, cu diferite epoci de maturare a fructelor, la S.C.D.P. Iaşi a început din anul 1981 o acţiune de selecţie şi promovare a unor genotipuri valoroase de cireş amar (existente în flora spontană sau în plantaţii din judeţul Iaşi), care au fost plantate alături de soiuri şi alte genotipuri din ţară. În urma selecţiei pozitive şi succesive au fost alese trei biotipuri de cireş amar, din care două

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biotipuri au fost omologate ca soiuri noi în anul 1994, cu denumirea de „Amar Maxut" şi, respectiv, „Amar Galata", iar biotipul Amar R5.P10 a fost înscris în anul 2013 la I.S.T.I.S. Bucureşti în vederea omologării acestuia ca soi nou cu denumirea de „Amaris". Cele trei genotipuri de cireş amar corespund principalelor obiective de ameliorare sortimentală. Acestea au productivitate ridicată, deoarece indicele de fertilitate naturală a înregistrat valori cuprinse între 36,5-63,7%, vigoarea pomilor este redusă, prezintă o rezistenţă bună la ger (1- 9% afecţiuni la muguri) şi boli (valori I% antracnoză, 1,1-2,8%). Fructele sunt de calitate superioară, iar epocile de coacere se află la extremităţile sezonului de maturare a cireşelor.

INTRODUCTION

The bitter cherries represent valuable raw materials to obtaining some traditional Romanian products as jams, liqueurs, syrups (Petre *et. al.,* 2007; Beceanu, 2009; Budan, 2014). At international level the syrups and the liqueurs made of bitter cherries make the object of numerous researches (Hui, 2006; Webster and Looney, 1998; Nikolic *et. al,* 1998) but the jams are less investigated (Jamba and Carabulea, 2002).

In the Iaşi area, the cherry both the one with sweet fruits and the one with bitter fruits has been harvested from ancient times (Dumitrescu *et. al.,* 1981; Petre *et al.,* 1997). The producers selected and multiplied the most valuable bitter cherry biotypes with different colours (yellow, bicoloured, red or black) which can be met in both the plantations and spontaneous flora (Petre *et al.,* 1997).

To improve the bitter cherry assortment with new cultivars at Fruit Growing Research Station (F.G.R.S.) Iaşi has begun in 1981 a selection and promoting action of some valuable bitter cherry genotypes which were being planted alongside cultivars and other genotypes from all around the country (Petre *et al.,* 1997).

The paper aims to improve the current bitter cherry assortment with new cultivars made at F.G.R.S. Iaşi, adapted to the specific conditions from the NE area of Romania.

MATHERIALS AND METHODS

To value the biological background of existent genotypes in the spontaneous and grown flora of the Iaşi area there have been made works of positive selections for some valuable bitter cherry biotypes. The selected genotypes were planted in the cherry collection and in the varieties trial from Fruit Growing Research Station Iaşi.

The studies were made during 2011-2013 having as research matherial three bitter cherry genotypes from the Iaşi area: „Amar Galata", „Amar Maxut" and the biotype „Amar R5.P10". The trees can be found in the experimental field grafted on mahaleb and planted at a distance of 5 x 4 m with the shape of crown as free palmate flattened on the trees row direction without a sustaining system and without a irrigation system. On the row with the trees the soil was worked with probe laterally disc and between the trees rows the soil was covered by grass. The control of the diseases and pests was made to the received warnings phytosanitary treatments being done.

In the experimental plantation there were made observations and studies

concerning the trees vigour, the resistance to frost and the anthracnose (Cociu and Oprea, 1989) and the main phenological stages (Fleckinger, 1960).

The physical features of the fruit have been determined this way:

- the weight (g) by weighing 10 fruits/stones x three repetitions with the electronic balance type Radwag (0,01g sensitivity);
- the dimensions fruit/stone (D, d, H) have been determined with the digital callipers LumyTools for 10 fruits/stones x three repetitions;
- the fruit/ stone ratio was calculated; the fruit colour has been determined in accordance to the questionnaire UPOV TG/35/7 being noted between 1to 8 (***, 2006);

The chemical and quality features of the fruits have been determined this way:

- the soluble substance content (SSC) has been determined refractometrically, using a hand refractometer Zeiss;
- the pulp firmness and the adherence of the fruit stone to the pulp has been determined through tasting with marks between 3 to 9 in accordance with the UPOV questionnaire (***, 2006);
- the fruits resistance to cracking was determined sinking 100 fruits from each cultivar in distilled water and the number of cracked fruits was verified once after 6 hours, determining in this way the cracking percentage of each cultivar (Cociu and Oprea, 1989);
- the productivity has been determined depending on the fertility index, which represents the percentage of resulted fruits after 25-30 days from the petals falling and are considered cultivars of high productivity those with values above 30-35% (Cociu and Oprea, 1989).

The experimental data have been statistically interpreted by analysing the variation and it has been calculated the variation coefficient (s%) for which the next values are arbitrary admitted: 0-10% - reduced variation coefficient; 10-20% - average variation coefficient; 20-30% - high variation coefficient. The correlation coefficient (r) was found out using the formula of Bravais (1978).

RESULTS AND DISCUSSION

After successive selections there have been selected three biotypes of bitter cherry from which two biotypes have been approved in 1994 with the names „Amar Maxut" and „Amar Galata" and the biotype „Amar R5.P10" has been registered in 2013 at the State Institute for Variety Testing and Registration Bucharest to be homologated as cultivar with the new name „Amaris".

Concerning the vigour tree the cultivars „Amar Maxut" and „Amar Galata" has medium vigour and the biotype „Amar R5.P10" is a tree of low vigour all of them being recommended for plantations with increased density per hectare (*Tab. 1*).

Referring to diseases resistance the year 2013 was a rainy year (in the first six months of the year 446.5 mm rainfall have been accumulated) and that means a favourable year for the pathogens evolution. All the genotypes taken in study manifested some sensitivity to anthracnose, attack frequency being between 1.1-2.8% (*Tab. 1*).

In the conditions of the winter 2011-2012 (when the minimum temperature registered on 12th of

February 2012 was -24,3°C) the affection degree of the flowering buds varied in relatively small limits, registering 1% on „Amar Galata", 2% on „Amar Maxut" and 9% on „Amar R5.P10" (*Tab. 1*).

Table 1 - The tree's features on three genotypes of bitter cherry (average 2011 - 2013)

Cultivar/Biotype	Tree's vigour*	Resistance to frost:			
		Frost	Anthracnose (*Coccomyces hiemalis* Higg.)		
		Affected flowering buds (%)	The attack frequency (%)	Attack intensity (%)**	Attack degree (%)
Amar Galata	5	1	2,8	10	0,06
Amar Maxut	5	2	2,0	5	0,04
Amar R5.P10	3	9	1,1	5	0,02

*the tree's vigour grade on a scale of 1-9: 1=very weak; 3=weak; 5=average; 7=strong; 9=very strong (***, 2006); ** the attack intensity grade on a scale of 1-6: 1=3% attacked surface; 3=25% attacked surface; 4=50% attacked surface; 6=100% attacked surface (Cociu and Oprea, 1989).

To highlight the biological value and the productive features of the three genotypes, observations have been taken concerning the development of the main fructification phenophases (*Tab. 2*). The flowering period took place between the 12th of April and the 1st of May, period that overlaps the flowering for the other cultivars, making the cross pollination possible.

The fertility coefficient through open pollination constitutes a main element to assess pollinators. The recorded results of the natural fertility for the three genotypes were between 36.5% („Amar Maxut") and 63.7% („Amar Galata"), registering a high variation coefficient (22.2%) and they are classified as being of high productivity because the fertility index registered values of over 30% (*Tab. 2*).

The harvesting maturity was registered in the 3rd decade of May („Amar R5.P10") and in the 2nd and the 3rd decades of June („Amar Maxut" and „Amar Galata") and the number of days from the end of the flowering till maturity was between 34-55 days, registering a medium to low variation coefficient (18.4- 8.5%) (*Tab. 2*).

The phenological stages for the same cherry genotypes are varying according to the climatic conditions of each year (Darbyshire *et al.,* 2012). The order in which the cherry cultivars get to maturity is always the same the differences being that the time interval between two successive cultivars is longer or shorter.

Table 2 - The main phenological stages and the natural fertility for three genotypes of bitter cherry (2011 - 2013)

Cultivar/ Biotype	Flowering beginning (stage E)*	End of flowering (stage G)	Natural fertility (%)	Fruits maturation date	End of the flowering – maturation (days)
	Limit data (the earliest – the latest):				
Amar Galata	15-25.04	24-30.04	63,7	16-22.06	54-55
Amar Maxut	16-25.04	24.04-1.05	36,5	10-16.06	47-48
Amar R5.P10	12-19.04	19-27.04	50,0	23-27.05	34-45
Average	14,3-23,0	22,3-19,3	50,1	16,3-21,7	45-49,3
Standard variation	1,7-2,8	2,4-13,0	11,1	5,3-4,5	8,3-4,2
The variation coefficient %	**11,9-12,3**	**10,5-67,3**	**22,2**	**32,5-20,8**	**18,4-8,5**

*stages E - the beginning of the flowering: the flowers are open for 5%; stage G - end of the flowering: petals fall from over 75% of flowers

The fruit's quality is determined by the fruit's size, the skin colour, the pulp firmness, the stone size and the easy detachment of the pulp (Budan and Grădinariu, 2000; Webster and Looney, 1996).

The three genotypes taken in study registered an average weight of the fruit between 2.3 g for „Amar Maxut" and 4.8 g for „Amar R5.P10" (*Tab.3*). From the statistical point of view, the „Amar R5.P10" biotype registered positive significant differences and the „Amar Maxut" cultivar registered negative significant differences, compared to the variants average. A continuous increasing of the fruit's weight determined a corresponding increase of the equatorial diameter (D) (*Fig. 1*). Therefore, the genotypes „Amar Galata" (17 mm) and „Amar R5.P10" (19.8 mm) registered positive differences of the equatorial diameter and „Amar Maxut" (13.5) registered negative significant differences compared to the variant average.

The fruit/stone ratio was between 10.4 („Amar Maxut") and 19.5 („Amar R5.P10") but „Amar Maxut" and „Amar Galata" registering negative differences compared to the control, while the genotype „Amar R5.P10" registered positive differences. The percentage of the stone from the fruit's weight registered values between 5.1% („Amar R5.P10") and 9.8% („Amar Maxut"). From the statistical point of view the „Amar R5.P10" genotype registered negative differences compared to the control while „Amar Maxut" and „Amar Galata" registered positive differences.

Concerning the soluble substance content (SSC), the values were between 17% for the „Amar R5.P10" biotype and 20.4% for „Amar Galata" but the differences was positive, compared to the control (*Tab. 3*). The value registered by the

„Amar R5.P10" biotype is satisfying for the early cultivars (Dolenc and Štampar, 1998), the difference being negative, compared to the control from the statistical point of view.

Table 3 - The physical and chemical features for three bitter cherry genotypes (average 2011 – 2013)

Cultivar/ Biotype	Fruit weight (g)	Stone weight (g)	Fruit / stone ratio	Stone (%)	Fruit width D (mm)	SSC (%)
Amar R5.P10	4,8*	0,25	19,5	5,1	19,8	17,0
Amar Galata	3,7	0,27	13,0	7,9	17,0	20,4
Average	3,6	0,25	14,3	7,6	16,8	19.2
Amar Maxut	2,3^{0}	0,20	10,4	9,8	13,5^{0}	20,2
LD 5%	0,4	0,09	6,1	3,6	2,3	5,0
LD 1%	2,6	0,15	10,1	5,9	3,9	8,2
LD 0,1%	4,9	0,29	18,9	11,1	7,3	15,4

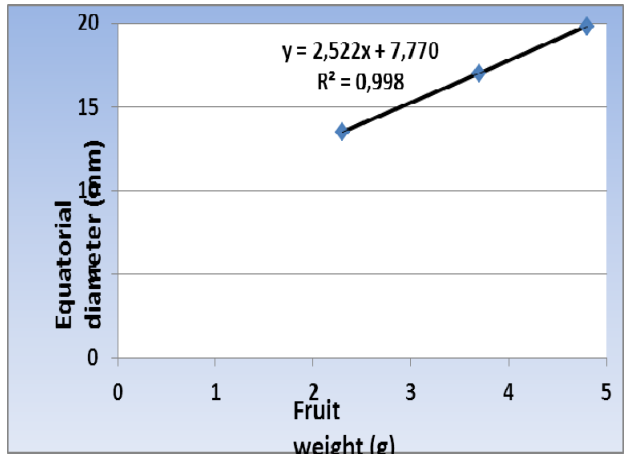

Figure 1 - Correlation between the fruit's weight and equatorial diameter for the three bitter cherry genotypes

The fruits colour was bicoloured (half yellow half red) for the genotype „Amar Galata", dark red for the genotype „Amar R5.P10" and black at „Amar Maxut" (*Fig. 2*). For the biotype „Amar R5.P10" the stone is not adherent to pulp while for „Amar Galata" and „Amar Maxut" the stone is almost non-adherent to pulp. The fruit is heart-shaped for „Amar Galata" and „Amar R5.P10" and kidney-shaped for „Amar Maxut" .

The cherry genotypes taken in study have good resistance to the fruit cracking the registered values being between 0.3-3.3% cracked fruits (*Tab.4*).

All three bitter cherry genotypes correspond to the main objectives of the assortment breeding, they are

superior regarding productivity (36.5-63.7%), low vigour of the trees, they present a good resistance to frost and diseases, high quality of the fruits and ripening stages at the extremities of the maturation season of the cherries (*Fig. 2*).

Table 4 - Physical and quality features of the fruits for the bitter cherry genotypes

Cultivar/ Biotype	Skin colour*	Pulp firmness**	Fruit's shape***	Stone adherence to pulp	Cracked fruits after 6 hours (%)
Amar Galata	2	5	1	Semi adherent	3,3
Amar Maxut	8	5	2	Semi adherent	0,3
Amar R5.P10	7	5	1	Non-adherent	0,3

* the grade of skin colour on a scale of 1 to 8: 1=yellow; 2= yellow with red; 7=dark red; 8=black (***, 2006); ** the grade of pulp firmness on a scale of 3 to 9: 3 =soft; 5=average; 7=firm; 9=very firm (***, 2006); ***fruit's shape on a scale of 1-5: 1=heart-shape; 2=kidney-shape (***, 2006).

AMAR MAXUT **AMAR GALATA** **AMAR R5.P10**

Figure 2 – The bitter cherry genotypes taken in study

CONCLUSIONS

From the existent rich genetic background in the north-east of Moldavia - Romania, a lot of bitter cherry biotypes have been found. After checking them in varietes trial, in 1994, two new bitter cherry cultivars have been approved („Amar Galata" and „Amar Maxut") and in 2013 the biotype „Amar R5.P10" has been proposed to be approved.

The cultivars „Amar Maxut" and „Amar Galata" have a medium vigour of the tree and the biotype „Amar R5.P10" has a low vigour. Each of the three genotypes is productive and presents a good resistance to frost and diseases.

The cherry biotype „Amar R5.P10" has an early maturation, „Amar Maxut" has maturation in medium season and „Amar Galata" is semi-late as maturation stage assuring a ripening period of 22-27 days.

The biotype „Amar R5.P10" has the fruit weight 4.8 g, a very good appearance for a fruit with bitter taste, with a size of 19,8 mm, the pulp is semi - firm and it does not present adherence to the stone, it has a content of 17% soluble substance content and

it presents a very good resistance to the fruit cracking (0.3%).

The listed qualities give the biotype „Amar R5.P10" gives certain approval as new cultivar so current assortment bitter cherry will be supplementing with a valuable creation.

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