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AUTOCHTONOUS CULTIVARS OF APPLE FROM THE AREA OF THE UPPER POLIMLJE

SUMMARY

Results of monitoring phenological characteristics of 12 autochthonous apple cultivars were summarized during the years. Morphological fruit and branch characteristics were described and chemical characteristics were analysed (content of dry substance, content of sugar and total acid). In 4 autochthonous cultivars, resistance to low temperatures was evaluated based on: a) content of macronutrients (N, P and K) and their relation in one-year-old branches and b) dynamics and content of total anthocyanins in the bark of one-year-old branches during the winter dormancy. Resistance to drought was analysed according to the capacity of leaves to retain water.

Keywords: autochthonous cultivars, morphological characteristics, chemical characteristics, resistance.

INTRODUCTION

During previous few decades, the structure of pome fruit production has changed in favour of better, more qualitative cultivars. However, many producers still appreciate autochthonous cultivars, especially ones that are satisfactory in terms of fruit bearing performance, better resistance to economically relevant diseases and pests, frost and draught. Before making a decision to use autochthonous cultivars in modern organic apple orchards, especially in hilly-mountainous area of Montenegro, it is necessary to make selection of the best cultivars on the basis of many biologically important parameters, studied during 20 years of scientific research conducted on this material, which has genetic, practical and enriching importance.

The Balkan Peninsula is known as one of the most important genetic, species and ecosystem diversity centres in Europe. It is an extremely rich source of genetic variation in apple, which may contribute greatly to the improvement of economically important traits of this valuable fruit. Because of the existing variability in the region, differing ecological conditions and human activities, the Balkan Peninsula can be regarded as one of the most important secondary centres of genetic diversity in apple. (Ognjanov, 2012.) Some old varieties of apples have a high degree of horizontal and race non-specific resistance to pests and diseases such as apple scab, powdery mildew and downy mildew (Ognjanov *et al.*, 2000) and that is why they are used as resistance donors to parasites (Ognjanov, 2005).

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MATERIAL, RESULTS AND DISCUSSION

Flowering of observed autochthonous apple cultivars in the area of Bijelo Polje, Berane and Plav lasts from 15 to 25 days. Flowering process is conditioned by inherited characteristics, whilst its duration and flowering are conditioned by weather conditions. Insignificant differences were noticed between locations of Bijelo Polje and Berane in terms of flowering time and duration of flowering phenophase. As regards the Plav location, beginning of flowering commenced with a delay (2-3 days) in comparison to two previously mentioned locations, due to higher altitude and lower temperatures. Concerning the autochthonous apple cultivars, the earliest flowering was with pašinka (27 April) and the latest was with zelenika (3 May). The earliest end of flowering occurred with the cultivar dapsićanka (10 May) and the latest with the cultivar zelenika (20 May). During the observed period, the flowering phenophase of autochthonous cultivars lasted in average to 13 days with cultivars: petrovača, voskovača, šarenika and krstovača to 19 days with zelenika. The observations showed that the autochthonous cultivars have adopted their flowering phenophase to the conditions of Gornje Polimlje. Flowering phenophase starts at the moment when the danger of late spring frosts is gone or is significantly reduced. Therefore, they could be recommended for growing in the areas where the occurrence of late spring frosts is possible, in hilly areas of Gornje Polimlje, which has preserved its unpolluted environment, soil and water..(Šebek Gordana and Jaćimović Vučeta, 1997.)

In respect to the fruit ripening time, it is possible to divide apple cultivars into four groups: I group (ripens at the end of VIII month) – petrovača (1); II group (end of IX month) – voskovača and besjemena (2); III group (ripens at the end of X month) – šarenika, rumenika, bjelija, dapsićanka, arapka and pašinka (6); IV group (end of XI month) - babovača, zelenika and senabija. According to the before mentioned groups, most of cultivars belong to winter cultivars (9). (Šebek Gordana and Jaćimović Vučeta, 1997.)

The highest fruit mass of apple cultivars was recorded with babovača (320.3 g) ant the lowest with petrovača (63.6 g).Variation ratio indicates that the fruit mass is the most equal with the cultivars that have medium-size fruits. Cultivars with the largest fruits (babovača and rumenika) and the smallest fruits (petrovača, besjemena and zelenika) have the highest variation ratio, respectively the most equal fruits. The observed cultivars can be divided into four groups in respect to their size:

- -I group (cultivars with very small fruits to 70g) - petrovača, besjemena, zelenika (3);
- -II group (cultivars with medium-size cultivars 100-150 g) - voskovača, arapka and pašinka (3);
- -III group (cultivars with large fruits 150-200 g) - šarenika, rumenika, bjelija and senabija (4);
- -IV group (cultivars with very large fruits 200 g and over) - dapsićanka and babovača (2).

The longest fruit length of apple cultivars was recorded with babovača (82.10mm) and the shortest with petrovača (46.33mm). The widest fruit width of apple cultivars was recorded with babovača (94.63mm) and the narrowest with arapka (49.67mm). The longest petiole of apple cultivars was with the cultivar arapka (24.40 mm) and the shortest with the cultivar bjelija (6.20mm). (Šebek Gordana and Đina Peković, 1997)

Regarding the fruits, it was noticed that one cultivar did not have additional color. There were 11 multicolored or additionally colored cultivars. The majority were fairly colored cultivars (7) with additional color covering a small fruit surface. There were 4 well colored cultivars. Two groups can be distinguished among well colored cultivars: cultivars with uniform red flush and cultivars with extremely striped red flush. Thus, apple cultivars can be divided into 4 groups: I group (without additional color)– cultivar voskovača (1); II group (fairly colored cultivars)- petrovača, besjemena, bjelija,pašinka, dapsićanka, senabija and babovača (7) III group (well colored – red flush in form of stripes) – zelenika and šarenika (2); IV group (well colored – uniform color)– rumenika and arapka (2). (Šebek Gordana and Đina Peković, 1997).

Content of dry matter in fruits of observed apple cultivars was unequal. The lowest concentration was registered in fruits of pašinka cultivar (9.77%) and the highest in fruits of dapsićanka cultivar (13.53%). Classification of cultivars in respect to the content of dry matter was performed according to the method of Nenadović-Mratinić (1988): I group: with relatively low content of dry matter (from 9% to 12%); II group: medium high content of dry matter (from 12% to 15%); III group: high content of dry matter (over 15%).

10 cultivars belong to the first group (petrovača, voskovača, besemena, šarenika, rumenika, bjelija, arapka, pašinka, senabija, zelenika) and other two belong to the second group (dapsićanka and babovača). It can be noticed that most of cultivars in Polimlje have low level of dry matter content (10 out of 12 cultivars, or 83.33%).(Šebek Gordana, 2001.)

Content of total sugars in fruits of observed apple cultivars was unequal. The lowest content was in fruits of bjelija cultivar (9.47 %) and the highest in fruits of cultivar dapsićanka (12.16%). Content of inverted sugars was the lowest with bjelija cultivar (6.16%) and the highest with cultivar dapsićanka (8.47%). The lowest level of sucrose was with the apple cultivar zelenika (2.890%) and the highest with the cultivar dapsićanka (3.505%). (Šebek Gordana, 2001.)

Content of total acids in fruits of observed apple cultivars was unequal. The lowest concentration was registered in fruits of besjemena cultivar (0.21%) and the highest in fruits of arapka cultivar (0.67%). According to the classification by Nenadović- Mratinić (1988.), all observed apple cultivars can be divided into following groups in respect to their total acid content: I group- with low acid content (to 0.30%); II group- with medium acid content (from 0.30% to 0.60%); III group – high acid content (from 0.60 to 0.90%), IV group- with a very high acid content (over 0.90%). Majority of apple cultivars from Gornje Polimlje belong to the first group (8), as follows: petrovača, voskovača, pašinka, besjemena, šarenika, bjelija,

babovača and senabija. Then, we have cultivars from the second group (3), as follows: rumenika, zelenika and dapsićanka. Cultivar arapka belongs to the third group with the highest acid content (0.67%).

As regards the interrelation between sugar and acid, it can be concluded that sweet and sweet-sour cultivars dominate, with a low content of degradable dry matter. The best relation between sugar and acid was noticed with the cultivar dapsićanka, i.e. this cultivar, in addition to the highest content of dry matter, also has a satisfactory acid volume (II group), which is favorable from the aspect of contemporary market. (Šebek Gordana, 2001)

There is a difference regarding the quantitative presence of the most relevant types of fruit branches of the observed cultivars, which is primarily a consequence of cultivar characteristics and the age of fruit trees. The highest quantitative presence was noticed with long fruit branches of cultivars with medium vigor:(petrovača 55.57%, pasinka 49.33% and arapka 43.7 %) and high vigor cultivars (voskovaca 58.98%, šarenika 64.95%, dapsićanka 69.06 %, senabija 47.09 %, zelenika 64.75% and babovaca 46.9%.

The most leaf-scarred fruit branches were with bjelija and rumenika. The least present were ring-scarred fruit branches. Two-year-old fruit tree had more long fruit branches than three-year-old tree. However, the situation is opposite regarding the leaf-scarred fruit branches, which means that three-year-old trees had more of them in comparison to two-year-old trees. The most drastic difference in terms of percentage of presence of long fruit branches and leaf-scarred branches was with the dapsićanka cultivar (69.06 % to 13.28 %), which is, due to its fruit quality, recommended for growing and expansion in hilly-mountainous area. Nevertheless, particular attention has to be given to pruning manner due to moving of fruits to the outer edge of crown. Similar ratio was noticed with zelenika (64.75% to 12.74 %), voskovača (58.98% to 13.22%) and šarenike (64.95% to 13.6 %), therefore, the same conclusion apples to these cultivars also. (Šebek Gordana, 2001.)

As regards the level of water retention, leafs of pašinka cultivar showed the highest capacity. When separated from the one-year-old branches of observed cultivars (in sity) and during the time interval (8 hours after the sampling), they lost in average 38.09% of water. The lowest level of water retention were shown by the leafs of arapka cultivar (40.64%) (Šebek Gordana, 2004.).

The average content of N in bark (tab 1.) was from 0.86 % with arapka cultivar to 1.2 % with senabija cultivar. The average content of N in tree (tab1.) was from 0.42 % with arapka cultivar to 0.64 % with pašinka cultivar. Therefore, content of nitrogen in bark was higher than content of nitrogen in the tree. The average content of P in bark (tab 1.) was from 0.26 % with arapka cultivar to 0.37 % with senabija cultivar.

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Tab 1. The content of NPK in a bark and in a tree of branches (N%,P_2O_5 %, K_2O %)

Variety	N-bark	N-tree	P-bark	P-tree	K-bark	K-tree	N: P:K (average)
Senabija	-	0.62	0.37	0.3	0.68	0.42	2.716: 1: 1.642
Arapka	-	0.42	0.26	0.23	0.64	0.4	2.612: 1: 2.122*
Pašinka	-	0.64	0.34	0.32	0.82	0.5	2.469: 1: 2.000*
Šarenika	-	0.48	0.32	0.29	0.75	0.41	2.360: 1: 1.901

The average content of P in bark (tab 1.) was from 0.26 % with arapka cultivar to 0.37 % with senabija cultivar. The average content of P in tree (tab 1.) was from 0.23 % with arapka cultivar to 0.32 % with pašinka cultivar. The average content of K in bark (tab 1.) was from 0.64 % with arapka cultivar to 0.82 % with pašinka cultivar. The average content of K in tree (tab 1.) was from 0.4 % with arapka cultivar to 0.50 % with pašinka cultivar. For the reasons of rationality, the ratio N: P: K of the one-year-old branches of observed cultivars was mathematically determined. N: P: K ration was as follows: Senabija (2.716 : 1: 1.642); Arapka (2.612 : 1: 2.122)*; Pašinka (2.469 : 1: 2.000)*; Šarenika (2.360 : 1: 1.901). (Šebek Gordana, 2004).

Tab 2. Dynamics of total anthocyanins in the bark of one year old branches (g/l)

Variety	1997				1998			
	XII	I	II	III	XII	I	II	III
Senabija	0.354	0.141	0.542	0.846	0.353	0.281	0.183	0.32
Arapka	0.592	0.689	0.181	0.461	0.275	0.337	0.261	0.36
Pašinka	0.092	0.061	0.291	0.366	0.591	0.307	0.289	0.16
Šarenika	0.608	0.046	0.311	0.566	0.456	0.383	0.461	0.46
Variety	1999				*(average)*			
	XII	I	II	III	1997	1998	1999	X
Senabija	0.412	0.321	0.275	0.584	0.47	0.28	0.4	0.38
Arapka	0.312	0.445	0.292	0.414	0.48	0.31	0.37	0.39
Pašinka	0.523	0.392	0.312	0.265	0.20	0.34	0.38	0.32
Šarenika	0.421	0.425	0.384	0.514	0.38	0.44	0.44	0.43

Observing the content and dynamics of total anthocyanins in respect to years, it can be noticed that three autochthonous cultivars (senabija, arapka and šarenika) had higher level of anthocyanins at the beginning of winter dormancy during the first year in comparison to the second or third year. In addition, during the first year, these three cultivars had the highest difference between the maximum and minimum value of anthocyanins content. Therefore, according to our researches, senabija, arapka and šarenika cultivars have certain dependence between the content of anthocyanins at the beginning of the winter dormancy and winter asperity, i.e. as the winter is harsher the level of anthocyanins is higher, as well as the variation amplitude between maximum and minimum content of total

anthocyanins. The problem is pašinka cultivar, which is exemption among observed autochthonous cultivars, since its behavior in respect to the content of anthocyanins at the beginning of winter dormancy differs from three before mentioned cultivars. If, in the attempt to explain such behavior, we reject possibility of experimental error, we can then pursue the hypothesis that in case of harsh winters occurring early, in terms of calendar, and intensively, pašinka as a cultivar does not have capability to quickly diverge biological processes towards creation of higher volume of anthocyanins. However, it succeeds in that during relatively average and mild winters. Nevertheless, during the first year of observations, pašinka succeeded to significantly increase by the end of winter dormancy (February, March) the level of accumulated non-ferrous metals (0.291 g/l; 0.366 g/l) i.e. to diverge biochemical processes towards creation and accumulation thereof. Therefore, during the three-year-long researches, the level of anthoncyanins in March 1997 (0.366 g/l) was an absolute maximum for March. (Šebek Gordana,2002).

CONCLUSIONS

Among the observed cultivars, dapsićanka cultivar stands out due to its fruit quality. Other cultivars have medium fruit quality, but also feature many interesting characteristics related to the low temperature and drought resistance, which could be used in selection work. The observed trees had no major damages caused by diseases and pests, but such visual and observation conclusion is not sufficient. It has to be checked by exact methods in future, particularly in respect to:

1. Resistance of cultivars towards disease-makers, such as: *Venturia inaequalis* (apple scab), *Podosphaera leucotricha* (powdery mildew), *Erwinia amylovara* (fire blight), *Nectria galligena* (apple cancer), *Monilinia fructigena* (brown rot)

2. Resistance towards pests: apple aphid (*Dysaphis plantaginea and Sappaphis devecta*), wooly apple aphid (*Eriosoma lanigerum*), apple sawfly (*Hoplocampa testudinea*).

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AUTOHTONE SORTE JABUKA SA PODRUČJA GORNJEG POLIMLJA

SAŽETAK

Sumirani su višegodišnji rezultati praćenja fenoloških osobina 12 autohtonih sorti jabuke. Opisane su morfološke osobine ploda i rodnih grančica i analizirane hemijske osobine ploda (sadržaj suve materije, sadržaj šećera i ukupne kiseline). Kod 4 autohtone sorte ocenjena je otpornost na niske temperature na osnovu: a) sadržaja makroelemenata (azot, fosfor i kalijum) i njihovog odnosa u jednogodišnjim grančicama i b) sadržaja i dinamike ukupnih antocijana u kori jednogodišnjih grančica tokom zimskog mirovanja. Otpornost prema suši analizirana je na osnovu vododržeće sposobnosti listova.

Ključne riječi: autohtone sorte, morfološke osobine, hemijske osobine, otpornost.