POMOLOGICAL CHARACTERISTICS OF THE MOST REPRESENTED AUTOCHTHONOUS APPLE CULTIVARS FROM THE AREA OF NORTHEAST BOSNIA

ORIGINAL SCIENTIFIC PAPER

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ABSTRACT:

Introduction:Autochthonous apple cultivars are present in the life of the population of almost every country. They have economic imporance, especially in the nourishment of the population, as well as very valuable genetic material in breeding process. There is little literature based on scientific methods related to the description of these varieties. Mostly the descriptions of local apple varieties are given through folk tales and poems.

Task of the paper: The aim of this research is the description of autochthonous apple cultivars and creation of preconditions for their registration and their placing in the Bosnian and Herzegovina's list of cultivars.

Results and discussion: Varieties of apples covered by this work were monitored for two years in an *ex situ* collection of autochthonous apple cultivars in Špionica, municipality of Srebrenik. The description of fruits is given through the following parameters: fruit weight, axis height and diameter, fruit index, length of fruit stalk, depth of calix end and firmness of fruits. The results are statistically processed and presented in tables and graphs.

Conclusion: Due to the diversity of the pomological characteristics of autochthonous apple cultivars, their quality and purpose of fruits and because of the longevity that is result of their resistance to unfavorable abiotic and biotic factors of growing, they represent a real small treasure because they are a source of genetic diversity and a factor of biodiversity

KEYWORDS: autochthonous apple cultivars, pomological descriptions, biodiversity

INTRODUCTION

Autochthonous varieties are those varieties that have been related to our region for centuries, whose origin is not known, or if it is known, origin is uncertain[1].

Autochthonous fruit varieties represent significant plant genetic resources that will be especially important in the future. The area of BiH has been exposed to different influences over time. The first recorded data about cultivation of fruit trees in our country originated from the Ottoman Empire[2], but the first official data appeared during the Austro-Hungarian empire[3].

Pomological characterization as the first determinant of fruit and then the morphological and ecophysiological characterisation of these genotypes will be the first evaluation and indetification of apple genetic pool which on at the level of BiH has status of autochthonous cultivars.

The pomological characterization defined with the purpose of research represent the basis for future scientific research work on the standardization of autochthonous genetic pool (pomological and genotypic standardization) and creation of new cultivars adapted to given conditions with certain resistance and predisoposition for the commercial and ecological production of apples in Bosnia and Herzegovina[4].

Detection, collation, characterization and identification of potentially valuable but threatened genetic resources is of primary interest in many countries[5].

The diversity of cultivated plant species is a basis for entire biodiversity in agriculture[6].

Over the past decades, several research on autochthonous fruit germplasm in Bosnia and Herzegovina has been carried out[7], in the review of the results of previous research conducted in the former Yugoslavia, provided that this area has 124 registered wild species of fruit trees and relatives. In this, very important research is done on spontaneous seedlings of fruit trees[7].

Characterization is regular activity in established collections and gene banks, with the aim of more detailed evaluation and removal of possible duplicates. In the available literature, there are data on the characterization of germplasm of autochthonous apple and pear varieties[5, 8, 9].

Traditional methods of cultivar characterization are based on agronomic and morphological parameters and most commonly they are used to distinguish varieties of one species[5]. Characterization of germplasm of one species has huge importance and is the subject of many contemporary researches.

MATERIAL AND METHOD

Assaying included 6 autochthoneous cultivars of apple planted in an *ex situ* collection in Špionica, the plants are 12 years old. The trees of these apples were maintained by usual agro and pomologycal measures as well as chemical protection against pests.

Domestic (autochthonous) genotypes that were the subject of research are some of the most famous and most widely used autochthoneous cultivars in BiH, collected from the five most important fruit regions in BiH (Bosanska Krajina, Posavina, North East BiH, Podrinje and Herzegovina).

Table 1. List of autochthonous apple cultivars of BiH in the collection Špionica – Srebrenik

No	CULTIVAR	CODE
1	Srebrenička	J- VII - 7
2	Senabija	J – X - 3
3	Bukovija	J- VIII - 3
4	Đulabija	J-VII - 1
5	Žuja-Ramićka	J – X - 10
6	Kanjiška	J – XI - 2

The fruits of autochthonous varieties for pomological analyzes are picked at the stage of physiological maturity (which is determined on basis of the number of days from bloom to harvest in the previous years of fruit bearing) from each of the 4 trees and from all parts of crown. The fruits were then transported to the laboratory, where pomological analyzes were performed. Fruit analysis includes the following parameters: fruit weight, axis height and diameter, fruit index, length of fruit stalk, depth of calix end and firmness of fruits.

The average weight of the fruit is determined by weighing 30 fruits of each variety, on a digital scale (Exacta 300 EB) and expressed in grams (g).

Fruit firmness was measured with a GY - 1 manual penetrometer, value expressed in kilograms (1 kg corresponding to a value of 10 N) and a cylindrical probe Ø 11 mm for measuring ranges from 0.5 to 12 kg / cm2

The axis height, diameter, length of fruit stalk and depth of calix were measured using the Vernier calipers, 150 x 0.05.

RESULTS AND DISCUSSION

FRUIT WEIGHT

The average weight of autochthonous apple cultivars in the northeastern BiH in the collection of plant Špionica - Srebrenik, in the period 2016 - 2017, is shown in table 2.

Table 2. Average fruit weight in g

Year / Variety	2016		2017		2016/2017	
	$\bar{x}\pm S\bar{x}$	Vk	$\bar{x}\pm S\bar{x}$	Vk	$\bar{x}$	t
Srebrenička	155.26 ± 3.566	12.37	149.98 ± 2.757	9.90	152.62	1.189
Senabija	92.19 ± 1.826	10.67	90.21 ± 1.492	8.91	91.20	0.853
Bukovija	76.03 ± 1.248	8.84	75.29 ± 1.333	9.54	75.66	0.412
Đulabija	90.01 ± 1.294	7.75	89.39 ± 1.296	7.81	89.70	0.342
Žuja-Ramićka	92.13 ± 1.804	10.55	91.28 ± 1.245	7.35	91.71	0.394
Kanjiška	103.13 ± 3.743	19.55	102.28 ± 1.928	10.15	102.70	0.206

On average, for the both years the largest weight of the fruit had the variety Srebrenička (152.62 g), and the smallest variety Bukovija (75.66 g). Based on the comparison of the average weight of the fruit according to the market criteria for the first class fruit (160-180 g) and the obtained results it can be concluded that the fruits of the analyzed varieties do not belong to the first class fruits.

The variation of the fruit weight, expressed by the coefficient of variation, shows that the variation in the weight of the fruit was more pronounced in 2016 (7.75% - 19.55%), which can be explained by poor climatic conditions.

In 2017, the variation in fruit weight was less pronounced (7.35% - 10.15%) which means that va-

rieties responded equally to favorable climatic conditions.

There were no statistically significant differences in the weight of fruits of the varieties examined in 2016 and 2017.

AXIS HEIGHT

The highest fruit axis height on average for both years had the variety Srebrenička (68.00), and the lowest fruits height on average had the variety Žuja (47.71). From the standpoint of axis height of the fruit of the observed varieties, compared with the standard varieties of apples it can be concluded that these autochthonous varieties do not have an attractive appearance which puts them in the other plan at choice of customers.

The variation of the fruit axis height, expressed by the coefficient of variation, shows that variation at the axis height of the fruit was slightly less in 2016, which indicates that the axis height of the fruit depends more on the hereditary characteristics of the variety than on the climatic conditions. Observing the significance of the differences in the fruit axis height of the varieties in 2016. and 2017. is observed that the variety Kanjiška had a statistically significantly lower fruit height, and the variety of Srebrenička highly significant lower fruit height than in 2017. In the case of other varieties these differences were not statistically significant.

Table 3. Average fruit axis height in mm

Year / Variety	2016		2017		2016/2017	
	$\bar{x}\pm S\bar{x}$	Vk	$\bar{x}\pm S\bar{x}$	Vk	$\bar{x}$	t
Srebrenička	71.60 ± 1.508	11.35	64.40 ± 1.703	14.25	68.00	3.218
Senabija	53.00 ± 0.734	7.45	51.59 ± 0.677	7.07	52.30	1.436
Bukovija	57.98 ± 0.931	8.65	57.61 ± 1.408	13.17	57.80	0.227
Đulabija	54.07 ± 1.256	12.52	52.77 ± 1.100	11.23	53.42	0.792
Žuja-Rami	51.17 ± 0.873	9.19	49.35 ± 0.848	9.26	50.04	1.520
Kanjiška	48.52 ± 0.690	7.67	46.91 ± 0.598	6.87	47.71	1.795

FRUIT DIAMETER

Fruit diameter of autochthonous apples in BiH, as well as axis height of the fruit, is important from the agronomic point of view and for the market of the fruits, because a harmonious relation of height and width of the fruit makes the fruit attractive for the market.

The average fruit diameter on average for both years had variety Kanjiška (78.305 mm), and the smallest fruit diameter on average had variety Bukovija (60.310 mm).

Table 4. Average fruit width in mm

Year / Variety	2016		2017		2016/2017	
	$\bar{x}\pm S\bar{x}$	Vk	$\bar{x}\pm S\bar{x}$	Vk	$\bar{x}$	t
Srebrenička	74.20 ± 1.830	13.28	72.59 ± 1.707	12.67	73.39	0.654
Senabija	76.57 ± 2.181	15.34	76.00 ± 2.062	14.61	76.28	0.193
Bukovija	61.20 ± 2.242	19.73	59.41 ± 2.241	20.32	60.31	0.574
Đulabija	68.30 ± 1.720	13.56	67.79 ± 1.700	13.51	68.04	0.217
Žuja-Ram	72.60 ± 1.535	11.39	72.59 ± 1.707	12.67	72.59	0.004
Kanjiška	79.80 ± 1.334	9.01	76.81 ± 1.529	10.72	78.31	1.499

The variation of the fruit diameter, expressed by the coefficient of variation, shows that variation of fruit diameter was less insignificant in 2016 indicating that the diameter of the fruit depends more on the hereditary characteristics of the variety rather than climatic conditions. Observing the significance of

differences in fruit diameter of the varieties in 2016 and 2017 it was noticed that it is not statistically significant.

Based on fruit diameter and criteria in the European market (65-90 mm I class), we can say that most of the investigated cultivars (except Bukovija) have the fruits of the I class. However, the ratio of axis height and diameter of the fruit that is expressed through the fruit index is unfavorable.

FRUIT INDEX

Fruit index represents the ratio of axis height and diameter of the fruit (table 4) and was used for the detection of the shape of the fruit by the following scale: less than or equal to 0.90 - flattened fruit, from 0.90 - 1.00 elliptical fruit and 1.0 and higher elongated fruit.

Table 5. Fruit index

SN	CULTIVAR	AXIS HEIGHT	DIAMETER	INDEX
1	Senabija	52,3	76,2	0,68
2	Srebrenička	73,4	69,4	1,05
3	Bukovija	60.3	57.8	1.04
4	Đulabija	53,4	68,0	0,78
5	Žuja-Ramićka	50,4	72,1	0,69
6	Kanjiška	47.7	78.3	0.61

On basis of the obtained results of measurements and given parameters, it can be concluded that cultivar Srebrenička and Bukovija have elongated fruit and all other have flattened fruit. According to agronomic and market criteria, the varieties with flattened fruit are not of high market value.

LENGTH OF FRUIT STALK

The length of the fruit stalk is presented in table 6. Besides being a good morphological indicator in the pomologycal description of fruit, it also represents an important pomological characteristic because it keeps the fruit on the tree and prevents fall of fruit. Varieties with longer fruit stalk are easier to harvest.

Table 6. Length of fruit stalk in mm

No	CULTIVAR	2016	2017	$\bar{X}$
		$\bar{x}$	$\bar{x}$	
1	Senabija	7.61	7.33	7.47
2	Srebrenička	10.53	10.76	10.65
3	Bukovija	8.92	8.64	8.78
4	Đulabija	7.84	7.61	7.73
5	Žuja-Ramićka	8.67	8.91	8.79
6	Kanjiška	9.23	8.87	9.05

From this table it can be seen that Srebrenička had the longest fruit stalk on the average (10.65 mm) and the Senabija variety had the shortest on average (7.47 mm). All the investigated varieties had a very short or short stalk. which is a negative characteristic.

FRUIT FIRMNESS

Fruit firmness was analyzed in the physiological maturity of the fruit. In this paper fruit firmness was observed as a significant pomological characteristic which indicates the predisposition of varieties for storage as well as their sustainability in the process of selling fruits. The fruit firmness is shown in table 7 as kg / cm²

Table 7. Fruit firmness

SN	CULTIVAR	2016	2017	$\bar{X}$
		$\bar{x}$	$\bar{x}$	
1	Senabija	7.50	7.40	7.45
2	Srebrenička	6.31	6.36	6.33
3	Bukovija	6.00	6.16	6.08
4	Đulabija	6.82	6.88	6.85
5	Žuja-Ramićka	7.43	7.52	7.47
6	Kanjiška	6.42	6.49	6.45

From the results in table 7 we can make conclusion that the fruits of these autochthoneous cultivars have soft and spongy fruit flesh. only the Senabija and Žuja-Ramićka cultivars have somewhat harder flesh. The Western European market is looking for hard and crunchy flesh of apple fruits. so it can freely be said that this is one of the reasons for reduced production of these cultivars. They are more of a local importance and are nostalgically related to our childhood.

CONCLUSIONS

1. A pomological analysis of fruit of autochthoneous apple cultivars creates the basis for the registration and placing of these varieties on the cultivar list. So far, very few papers have been published on this subject. and especially papers based on scientific methods.

2. The fruits of these varieties belong to a group of smaller fruits and are not attractive to the market

3. The relation between axis height and diameter of the fruit. or the fruit index. is not in accordance with market requirements.

4. They are of local importance and are used to make traditional apple product- pekmez.

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