Evaluation of Pear (*Pyrus communis* L.) Germplasm Collected in Bosnia and Herzegovina Using Some Pomological and Ecophysiological Characteristics

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Abstract

33 pear (*Pyrus communis* L.) accessions originating from the five most important fruit BiH regions were collected in ex situ collection and evaluated during a three-year long research. Evaluation of pomological and biochemical fruit analyses as well as of ecophysiological characteristics has been conducted. The experimental data were biometrically processed by arithmetic mean with related measures of variability, t-test and cluster analysis. Analyzed pear accessions ripen from early July to early October and were appropriate for the local market. Half of them ripen before and half after the cultivar 'Williams'. The total content of soluble solids in fruit flesh was on the average level of commercial genotypes. According to the firmness of the fruit flesh most genotypes do not manifest predisposition for longer storage and transport. Some accessions have full predisposition to parthenocarpy and others have more than 80% mature embryos. Demonstrated differences in the dynamics of flowering must be taken into account in their expansion, i.e., the introduction in plantation cultivation and selection of genotypes as pollinators. Most of the analyzed accessions can be an important source of germplasm for breeding because of stable characteristics.

INTRODUCTION

Throughout the centuries the Balkans were exposed to frequent migrations of people. In all that time fruit trees were always a synonym for peaceful life. Whenever people were ready to plant a fruit tree that would grow and bloom for many years, it was a sure sign that they saw a safe future ahead. Such an almost sacred relationship with fruit trees is the reason why the local population, in accordance with their ethnic and religious groups, cherished and cared for an accession of fruit trees as a part of their personal and cultural identity. Because of this relation to fruit trees, the Balkan region has become a treasure trove of different species and genotypes of natural populations of spontaneously selected genotypes. This contributed to the very rich fruit gene pool on a relatively small area. Over time, in the region of Bosnia and Herzegovina (hereafter: BiH), many private garden collections of fruit trees have sprung up. Some of these fruit trees were local and some were introduced from the West and from the East (Djuric et al., 2009a,b). Due to their propagation through generations, the information about the origin of certain genotypes was lost, and the same accession can be found under different names. In this fruit magic, the pear has a special place for many reasons: it can be grown in a wide range of climatic conditions, different genotypes ripen from early summer to late autumn and its fruit can be used in many ways. This use ranges from consumer use to drying, making jam, fruit juices, pickles and liquor (brandy), to prolonged preservation in storage clamps, etc. Vitolović (1949) points out those most autochthonous genotypes of pears in BiH are suitable for processing. The evaluation of biochemical and nutritional properties of pear fruits are important in terms of fruit and market value for the production expansion (Hudina and Štampar, 2000).

The richness of the pears gene pool in BiH is confirmed by the fact that 20,000 young trees of pears are sold and grafted per year. These pears have spontaneously expanded and have been given the status of autochthonous cultivars even though, until the present date, it has not been scientifically confirmed whether it is a genetic material that can be determined as a cultivar, or whether it is a population of genotypes under one name, i.e., the same genotypes which were given different local names. These assertions are in some way confirmed by the comparison of available descriptions of 31 pear genotypes in the region of Goražde (Kanlić, 2010) and 56 pear genotypes in the region Gradačac (Beširević, 2009), which at the given level of characterization are impossible to compare, as well as by the analysis of the genotypes from "Lubeničarka" groups (Mićić et al., 2012). The characterization of these genotypes is important, especially when it comes to establishing the identity for the further maintenance in collections and nurseries, and because of their use in breeding programs and provision of genetic diversity (Salkić, 2012).

MATERIALS AND METHODS

The study was conducted with 33 genotypes (accessions) of pear between 2009 and 2011. The pear collection is located in Špionica locality in fruit nursery Srebrenik (44°45'6"N; 18°28'17"E, and altitude 166 m). The area has a moderate continental climate and alluvial-diluvia soil. The collection was planted in 2002 with a distance of planting of 4×2 m. Each genotype is represented with 4 trees. The young trees were produced by budding on one-year-seedlings of wild pear (*Pyrus communis* L.). Buds for budding were taken from one mother tree of each accession of the five most important fruit regions in BiH: Bosanska krajina, Posavina, northeastern Bosnia, Podrinje and Herzegovina. Inventory preceded collecting on farms where amateur growers have been doing preservation of traditional genotypes of fruit trees. During the collection of the material, information about genotypes was also collected, and names were taken from the farmers. The fruits for pomological analysis were picked from every tree from all parts of the tree at the physiological maturity stage, which was determined based on the observed number of days from flowering to harvest in the early years of fruiting. The pomological description was adapted from the ECP/GR descriptors for the genus *Pyrus* (ECP/GR/ 1982) to 30 fruits of each genotype.

The average fruit mass was determined by weighing (Tehtnica Exacta 300 EB). Dimensions and shape of the fruit were done by photometric method, photographing the whole fruit and then transverse and longitudinal cross sections. Obtained photo documentation was processed using the Olympus Master 2 software. Normal and empty seeds were defined from all analyzed fruits. Fruit flesh firmness was measured on 4 sides on 3 fruits of every genotype with hand penetrometer Effegi, type FT 327 (cylindrical probe of 8 mm diameter). The content of total soluble solids (% Brix) was determined using a manual refractometer. The full flowering, time of ripening, number of days when the average daily temperature trend crossed the threshold of 5°C until the moment of occurrence of flowering and number of days from full bloom to maturity were observed. The experimental data were processed biometrically by arithmetic mean with related measures of variability, t-test and cluster analysis.

RESULTS AND DISCUSSION

Fruit Mass

The average fruit mass of tested pear genotypes in three years of studying is in the range of 38.2 g for Pucavica accession to 353.0 g for Zimnjača accession. According to the average fruit mass (Table 1), 33 analyzed pear accessions can be classified into 5 groups (Fig. 1): i) the small fruits accession with an average fruit mass of 36.8-51.6 g: 'Takiša', 'Šabuljićka', 'Karamut', 'Mesnjača', 'Lubeničarka crna', 'Hošafnjača', 'Kaličanka' and 'Pucavica'; ii) the medium fine fruits accessions with an average fruit mass of 60.7-87.1 g: 'Takiša bijela', 'Minđušica', 'Crna plana', 'Budaljača', 'Hambarka',

'Okrugljača', 'Bijela dugandža' and 'Sarajka'; iii) the medium large fruits genotypes with an average fruit mass of 105.0-126.0 g: 'Hasanagićka', 'Stambolka', 'Debelkora', 'Huseinbegovača' and 'Urumenka'; iv) the large fruits accession with an average fruit mass of 130.0-206.0 g: 'Crna izmirka', 'Avraška', 'Krakača', 'Begarka', 'Jeribasma', 'Tikvenjača', 'Zelenika', 'Ahmetova', 'Ćopa', 'Kačmorka' and 'Ljeskovača'; and iv) the very large fruits accession with an average fruit mass over 300.0 g ('Zimnjača').

Fruit Shape Index

Fruit shape index for observed pear accessions was calculated based on the average height and width parameters of the fruits in three years (Table 1). The analyses of pear genotypes based on fruit shape index were classified into two main groups: i) the genotypes with round elongated to elongated fruits, with fruit shape coefficient 1.013 to 1.288: 'Ahmetova', 'Avraška', 'Begarka', 'Budaljača', 'Ćopa', 'Debelkora', 'Hambarka', 'Hošafnjača', 'Huseinbegovača', 'Jeribasma', 'Kačmorka', 'Kaličanka', 'Karamut', 'Lubeničarka crna', 'Stambolka', 'Tikvenjača', 'Zelenika', 'Bijela dugandža', 'Urumenka', 'Pucavica', 'Minđušica', 'Šabuljićka', 'Crna plana'; and ii) genotypes with round-flattened to flattened fruit with fruit shape coefficient from 0.967 to 0.633: 'Crna izmirka', 'Hasanagićka', 'Ljeskovača', 'Mesnjača', 'Okrugljača', 'Sarajka', 'Takiša', 'Takiša bijela', 'Zimnjača' and 'Krakača'.

Firmness of Fruit Flesh

According to the mean value of fruit flesh firmness (Table 1 and Fig. 2) analyzed pear accessions are classified into five groups: i) genotypes with soft fruit flesh and mean hardness of 3.68 to 5.32 kg/cm^2: 'Hambarka', 'Avraška', 'Ahmetova', 'Ljeskovača', 'Takiša', 'Tikvenjača', 'Crna izmirka', 'Ćopa', 'Jeribasma', 'Hošafnjača', 'Stambolka', 'Hasanagićka', 'Lubeničarka crna', 'Zelenika' and 'Huseinbegovača'; ii) genotypes with medium-soft fruit flesh and mean hardness of 5.63 to 6.77 kg/cm^2: 'Begarka', 'Crna plana', 'Pucavica', 'Sarajka', 'Debelkora', 'Urumenka' and 'Zimnjača'; iii) genotypes with medium-hard fruit flesh and mean hardness of 7.13 to 7.90 kg/cm^2: 'Krakača', 'Šabuljićka', 'Kačmorka', 'Karamut' and 'Okrugljača'; iv) genotypes with hard fruit flesh and mean hardness of 8.14 to 8.54 kg/cm^2: 'Mesnjača' and 'Takiša bijela'; and v) genotypes with very hard fruit flesh and mean hardness over 10 kg/cm^2: 'Budaljača' and 'Kaličanka'.

Total Soluble Solids Content

The average total soluble solids content in fruit flesh juice of observed pear genotypes (Table 1) ranged from 12.7% in Jeribasma to 18.72% in Debelkora. The observed pear accessions were sorted in three groups (Fig. 3) according to total soluble solids content in fruit flesh juice: i) genotypes with total soluble solids content in fruit flesh juice that is on average level for the species *Pyrus* sp. (from 12.3 to 13.29%): 'Kaličanka', 'Okrugljača', 'Urumenka', 'Hošafnjača', 'Šabuljićka', 'Crna plana', 'Lubeničarka crna', 'Stambolka', 'Ljeskovača', 'Bijela dugandža', 'Tikvenjača', 'Kačmorka', 'Avraška', 'Huseinbegovača', 'Minđušica' and 'Jeribasma'; ii) genotypes with increased total soluble solids content in fruit flesh juice (from 13.76 to 15.90%): 'Ahmetova', 'Budaljača', 'Begarka', 'Crna izmirka', 'Sarajka', 'Pucavica', 'Ćopa', 'Takiša', 'Krakača', 'Zelenika', 'Takiša bijela' and 'Hasanagićka'; and iii) genotypes with high total soluble solids content in fruit flesh juice (from 15.92 to 19.72%): 'Hambarka', 'Zimnjača', 'Karamut', 'Mesnjača' and 'Debelkora'.

Genotypes with high total soluble solids content in fruit flesh juice are also genotypes that are mostly used for liquor (brandy) production, like accession 'Karamut' (16.77%).

Blooming

Number of days from blooming to fruit ripening represents one of the parameters for determination of limited elements in specific region of fruit cultivation. The studied

pear genotypes from the "Špionica" collection, bloom in average range of 15 days (from 1 to 15 April). 'Hasanagićka', 'Kačmorka', 'Karamut' and 'Mesnjača' genotypes have the earliest blooming period, from 1 April to 04 April, while the 'Zimnjača' accession has the latest blooming period, from 12 April to 17 April (Table 2). According to the blooming time most of the studied genotypes are commonly endangered by early spring frosts, which, in BiH, mostly occure in the first ten days of April (Mališević et al., 1987). The established facts about blooming time and blooming dynamics of the studied genotypes, as well as the pollination ratio for each accession that will potentially be used in plantation growing, have to be put in the focus when defining the accession composition (Mićić et al., 1987).

The number of days with mean daily temperature above 5°C up (days ↑5°C) to the beginning of blooming, for the studied genotypes ranges from 13 to 30 days on average (from 13 to 24 days in 2009; from 18 to 30 days in 2010; and from 16 to 26 days in 2011). Based on this parameter the derived cluster analysis (Fig. 4) puts analyzed pear accessions into four groups: i) early blooming genotypes: 'Tikvenjača', 'Bijela dugandža', Ahmetova, Hasanagićka, Takiša bijela, Lubeničarka crna, Kačmorka, 'Mesnjača', 'Karamut'; ii) medium early blooming genotypes: 'Kaličanka', 'Pucavica', 'Crna izmirka', 'Hošafnjača', 'Stambolka', 'Begarka', 'Budaljača', 'Ćopa', 'Jeribasma', 'Minđušica', 'Debelkora', 'Crna plana', 'Okrugljača' and 'Šabuljićka'; iii) medium late blooming genotypes: 'Hambarka', 'Sarajka', 'Ljeskovača', 'Zelenika' and 'Urumenka'; and iv) late blooming genotypes: 'Huseinbegovača', 'Takiša', 'Krakača', 'Avraška' and 'Zimnjača'. The differences noted in the blooming dynamics of the studied genotypes show that this is an important detail which has to be taken into account when being introduced in plantation growing and selecting pollinator genotypes.

Ripening

Fruit ripening time of the studied pear genotypes in the Špionica collection - Srebrenik (Table 2) is represented with average (expected) ripening time and average number of days from full bloom to maturity. The analyzed pear genotypes ripen during the range of 70 days from the beginning of July (23 July) until the beginning of October (2 October). When compared with the 'Williams' cultivar as standard, it is shown that 50% of autochthonous genotypes ripen earlier, and 50% later, which is particularly interesting from the aspect of sales strategy. Bearing in mind the nutritional value of these fruits, such a large range of ripening time can be interesting because it provides a high quality source of vitamins, minerals and carbohydrates for a longer period.

Structure of Seeds

The structure of fruit seeds was analyzed with the aim to evaluate predisposition of these genotypes towards parthenocarpy (Table 3). The highest average presence of normally developed seeds has the 'Sarajka' accession (91.57%); the highest average presence of empty seeds has the 'Jeribasma' accession (57.95%), while the highest average number of initially set ovules in fruits has the 'Ahmetova' accession (78.76%). Based on average structure of normal and empty seeds in fruits the pear accessions are divided into four categories (Fig. 4): i) genotypes with high level of normally developed seeds, that is, the genotypes with strong requirements towards adequately resolved varietal compositions: 'Hasanagićka', 'Mesnjača', 'Okrugljača', 'Lubeničarka crna', 'Huseinbegovača', 'Krakača', 'Hambarka', 'Ćopa', 'Crna izmirka', 'Sarajka', 'Kaličanka', 'Takiša', 'Pucavica', 'Urumenka', and 'Avraška'; ii) genotypes with medium level of normally developed seeds, that is, the genotypes with medium requirements towards high level of ovule fertilization: 'Hošafnjača', 'Ljeskovača', 'Takiša bijela', 'Šabuljićka', 'Bijela dugandža', 'Minđušica', 'Stambolka' and 'Crna plana'; iii) genotypes with expressed predisposition to abortion of fertilized ovules, that is, the genotypes with higher level of empty seeds and mild predisposition to parthenocarpy: 'Jeribasma', 'Kačmorka', 'Zimnjača'; and iv) genotypes with expressed level of empty seeds and predisposition to parthenocarpy: 'Ahmetova', 'Begarka',

'Budaljača', 'Debelkora', 'Karamut', 'Tikvenjača' and 'Zelenika'.

CONCLUSIONS

The pomological characteristics of fruits which are economically important in intensive fruit production are less important characteristics in extensive fruit production, which is the main modality for autochthonous genotypes growing. These characteristics have crucial importance for commercial growing and dissemination of standard assortment. At the same time, these features are not decisive features for the autochthonous genotypes maintenance and preservation. For that reason, there is a huge variability of phenotypic characteristics (autochthonous and foreign) with non commercial genotypes.

Traditionally, autochthonous genotypes of pear fruit are used in making of different products (dried fruit, jam, liquor). Analysis of dry matter content in fruits of analyzed genotypes showed that it is on the average level for *Pyrus* sp. or above that level. The testing of hardness of fruit flesh as a significant pomological characteristic showed that there are significant differences between genotypes. Based on these results, it can be concluded that most of the tested pear accessions show no predisposition for longer storage and transport. The classification of studied genotypes based on structure of seeds in fruits shows that some genotypes have predisposition to abortion of fertilized embryos, while others have expressed predisposition to parthenocarpy. This characteristic represents beneficial biological nature, from the production point of view (parthenocarpy is an important economic characteristic and is desirable with genotypes that have pollination and fertilisation problems).

Based on the number of days with mean daily temperature above 5°C until the ripening period, the cluster analysis shows that this is an important parameter which has to be taken into account when being introduced in plantation growing and when selecting pollinator genotypes. Studied pear genotypes ripen from the beginning of July until the beginning of October. After comparing these data with ripening time of 'Viljamovka' accession, it can be concluded that 50% of autochthonous genotypes ripen earlier, and 50% later, which is particularly interesting from the aspect of sales strategy. Pomological studies of autochthonous pear genotypes in this study show great wealth of forms and genotypic specificities which potentially represent a segment of comparative advantage in production, but also a great source of genes in selection and creation of superior genotypes for specific cultivation conditions.

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Tables

Table 1. Pomological properties of fruit in pear genotypes in collection Špionica-Srebrenik for the 2009-2011 period.

No.	Accession	Fruit mass (g)	Firmness of fruit flesh (kg/cm^2)	Dry soluble matter (°Brix)	Fruit shape index (height/width)
		$\overline{X}$±Sx	$\overline{X}$±Sx	$\overline{X}$±Sx	$\overline{X}$±Sx
1	Ahmetova	140.0±3.25	4.87±0.14	14.51±0.56	1.226±0.027
2	Avraška	201.0±5.32	7.15±0.85	11.12±0.38	1.234±0.036
3	Begarka	161.0±3.39	5.95±0.19	14.40±0.43	1.167±0.032
4	Bijela dugandža	75.0±1.26	4.23±0.11	12.51±0.39	1.270±0.021
5	Budaljača	79.2±1.86	10.07±0.38	13.89±0.44	1.039±0.02
6	Crna izmirka	205.0±4.97	4.02±0.17	14.05±0.32	1.138±0.035
7	Crna plana	66.5±1.27	5.22±0.18	12.00±0.53	0.967±0.025
8	Ćopa	136.0±2.29	4.33±0.18	13.76±0.39	1.107±0.031
9	Debelkora	115.0±2.31	5.63±0.19	18.72±0.51	1.030±0.042
10	Hambarka	78.8±2.16	4.77±0.12	17.78±0.96	1.159±0.033
11	Hasanagićka	105.0±3.10	4.31±0.19	15.98±0.83	0.889±0.02
12	Hošafnjača	41.3±1.04	3.71±0.11	12.72±0.71	1.117±0.027
13	Huseinbegovača	118.0±2.86	4.44±0.20	13.08±0.60	1.247±0.046
14	Jeribasma	150.0±3.79	3.68±0.12	12.70±0.62	1.175±0.019
15	Kačmorka	130.0±2.88	7.13±0.26	12.03±0.53	1.288±0.022
16	Kaličanka	43.6±1.01	10.35±0.34	12.40±0.44	1.109±0.036
17	Karamut	48.1±1.12	7.90±0.26	16.77±0.79	1.091±0.029
18	Krakača	205.9±4.54	6.84±0.23	15.28±0.64	0.960±0.017
19	Lubeničarka crna	55.3±1.45	4.26±0.12	12.92±0.51	0.958±0.02
20	Ljeskovača	139.0±2.95	5.04±0.19	13.07±0.59	1.071±0.04
21	Mesnjača	47.2±1.53	8.14±0.30	15.92±0.75	0.819±0.021
22	Minđušica	60.7±1.61	6.57±0.21	11.67±0.46	1.084±0.021
23	Okrugljača	72.9±2.32	7.71±0.29	12.46±0.46	0.752±0.034
24	Pucavica	38.2±1.65	4.43±0.15	13.78±0.47	1.016±0.03
25	Sarajka	87.1±2.61	6.01±0.21	14.51±0.53	0.987±0.022
26	Stambolka	108.0±2.96	3.92±0.11	12.84±0.38	1.168±0.043
27	Šabuljićka	50.7±1.64	6.93±0.22	12.90±0.42	1.032±0.036
28	Takiša	51.5±1.74	5.21±0.16	15.00±0.49	0.633±0.015
29	Takiša bijela	61.7±2.06	8.54±0.25	15.89±0.56	0.688±0.016
30	Tikvenjača	146.0±4.74	5.32±0.15	13.29±0.54	1.152±0.033
31	Urumenka	126.0±3.03	6.50±0.18	12.40±0.36	1.173±0.041
32	Zelenika	141.0±3.39	4.40±0.12	15.43±0.48	1.151±0.026
33	Zimnjača	353.0±9.59	6.77±0.19	17.84±0.61	0.906±0.018

Table 2. Ecophysiological characteristics for pear genotypes in collection Špionica-Srebrenik for 2009-2011 period.

No.	Accession	Full blooming period	Average number of days ↑5°C until full blooming	Ripening period	Average number of days from full blooming to ripening
			$\overline{X}$±Sx		$\overline{X}$±Sx
1	Ahmetova	02.-07.04.	17±2.16	23.08-02.09.	146±8.42
2	Avraška	03.-08.04.	18±1.57	04.08-10.08.	122±7.04
3	Begarka	04.-09.04.	19±1.09	14.08-17.08.	131±9.07
4	Bijela dugandža	02.-07.04.	17±2.06	13.08-15.08.	163±6.58
5	Budaljača	04.-09.04.	19±1.97	14.08-18.08.	163±9.41
6	Ćopa	04.-09.04.	19±3.07	02.09-08.09.	124±4.29
7	Crna izmirka	03.-08.04.	17±1.76	07.08-15.08.	152±7.9
8	Crna plana	06.-11.04.	21±2.42	06.08-10.08.	124±5.73
9	Debelkora	05.-10.04.	20±2.31	21.09-05.10.	175±6.06
10	Hambarka	07.-12.04.	22±1.91	30.08-05.09.	144±7.48
11	Hasanagićka	01.-06.04.	16±2.12	25.08-18.09.	157±9.97
12	Hošafnjača	02.-07.04.	19±1.97	28.08-30.08.	145±5.03
13	Huseinbegovača	02.-07.04.	25±3.75	03.08-07.08.	115±4.65
14	Jeribasma	06.-11.04.	21±1.69	12.09-16.09.	160±4.62
15	Kačmorka	02.-04.04.	16±1.48	18.08-22.08.	139±6.37
16	Kaličanka	03.-08.04.	18±2.91	18.08-25.08.	139±4.01
17	Karamut	02.-04.04.	16±1.38	10.09-04.10.	175±5.42
18	Krakača	02.-07.04.	17±0.98	13.09-18.09.	158±3.89
19	Ljeskovača	08.-13.04.	23±1.99	28.08-05.09.	143±6.22
20	Lubeničarka	01.-06.04.	16±0.83	20.07-27.07.	111±5.41
21	Mesnjača	02.-04.04.	16±1.66	18.08-24.08.	134±5.65
22	Minđušica	06.-11.04.	21±1.69	06.08-11.08.	123±4.33
23	Okrugljača	05.-10.04.	20±1.38	28.08-01.09.	145±6.12
24	Pucavica	05.-10.04.	20±1.96	24.08-02.09.	132±6.01
25	Šabuljićka	03.-07.04.	18±1.97	24.08-28.08.	128±4.15
26	Sarajka	07.-12.04.	22±2.67	01.08-05.08.	139±5.23
27	Stambolka	04.-09.04.	19±1.76	07.08-15.08.	119±5.66
28	Takiša	09.-14.04.	24±2.77	01.10-05.10.	172±7.13
29	Takiša bjela	01.-06.04.	16±0.74	21.08-24.08.	142±4.96
30	Tikvenjača	02.-07.04.	17±1.48	04.09-07.09.	154±5.58
31	Urumenka	07.-10.04.	21±1.94	07.08-15.08.	122±5.02
32	Zelenika	06.-11.04.	22±1.27	04.09-07.09.	150±6.19
33	Zimnjača	12.-17.04.	27±3.12	01.10-05.10.	171±7.01

Table 3. Seeds structure (%) in the fruit of pear genotypes in collection Špionica-Srebrenik for 2009-2011 period.

No.	Accession	Normal seeds	Empty seeds	Shell – initially developed integuments
		$\overline{X}$±Sx	$\overline{X}$±Sx	$\overline{X}$±Sx
1	Ahmetova	15.93±0.49	5.31±0.14	78.76±2.59
2	Avraška	31.45±0.46	27.95±0.52	41.60±0.77
3	Begarka	0.84±0.01	26.89±0.45	72.27±1.23
4	Bijela dugandza	50.77±1.06	18.46±0.34	30.77±0.63
5	Budaljača	30.85±0.45	10.0±0.14	59.15±0.84
6	Crna izmirka	33.33±0.49	29.91±0.44	36.75±0.57
7	Crna plana	58.65±0.92	3.01±0.06	38.35±0.72
8	Ćopa	89.47±1.49	4.51±0.13	6.02±0.15
9	Debelkora	17.65±0.46	15.44±0.41	66.91±1.83
10	Hambarka	80.51±2.06	1.69±0.05	17.8±0.53
11	Hasanagićka	86.67±1.08	3.33±0.06	10.0±0.18
12	Hošafnjača	45.45±0.51	13.64±0.23	40.91±0.94
13	Huseinbegovača	79.83±1.88	7.56±0.16	12.61±0.28
14	Jeribasma	18.18±0.45	57.95±1.59	23.86±0.63
15	Kačmorka	47.62±1.31	51.43±1.43	0.95±0.04
16	Kaličanka	96.08±2.68	0.98±0.03	2.94±0.1
17	Karamut	27.27±0.75	17.17±0.42	55.56±1.29
18	Krakača	76.15±1.97	7.34±0.63	16.51±0.49
19	Lubrničarka crna	84.5±2.32	7.8±0.51	7.7±0.23
20	Ljeskovača	36.94±0.53	14.41±0.77	48.65±0.96
21	Mesnjača	85.19±1.96	4.94±0.06	9.88±0.18
22	Minđušica	43.62±0.62	31.43±0.19	26.95±0.33
23	Okrugljača	84.06±1.59	2.9±0.01	13.04±0.21
24	Pucavica	52.94±1.31	12.95±0.31	34.11±0.35
25	Sarajka	91.57±3.15	3.61±0.08	4.82±0.06
26	Stambolka	66.05±2.29	11.11±0.22	22.84±0.88
27	Šabuljićka	38.94±0.46	24.41±0.49	36.65±0.62
28	Takiša	65.65±0.81	26.72±1.37	7.63±0.1
29	Takiša bijela	57.94±1.01	14.95±0.66	27.1±0.73
30	Tikvenjača	43.24±0.59	5.41±0.07	51.35±2.22
31	Urumenka	79.38±2.53	14.43±0.42	6.19±0.03
32	Zelenika	46.67±1.48	2.22±0.01	51.11±2.68
33	Zimnjača	51.69±1.76	38.14±1.26	10.17±1.01

Figures

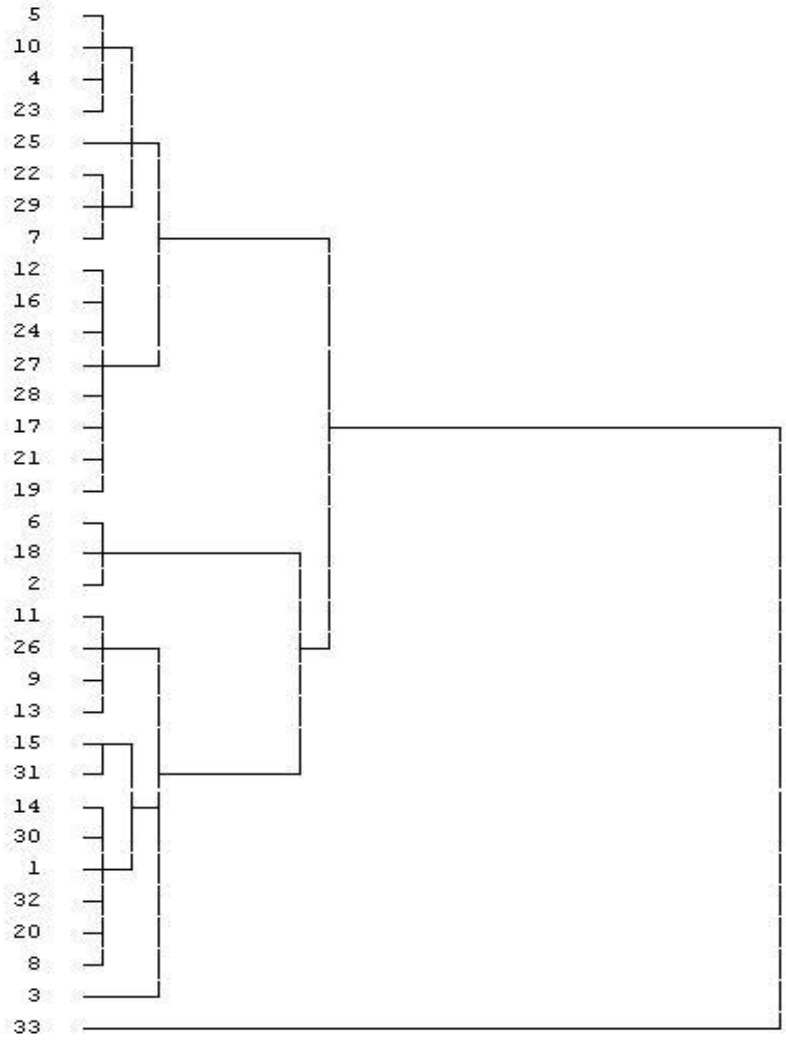

Fig. 1. Cluster analysis of 33 pear genotypes according to the average fruit mass in collection Špionica-Srebrenik for 2009-2011 period.

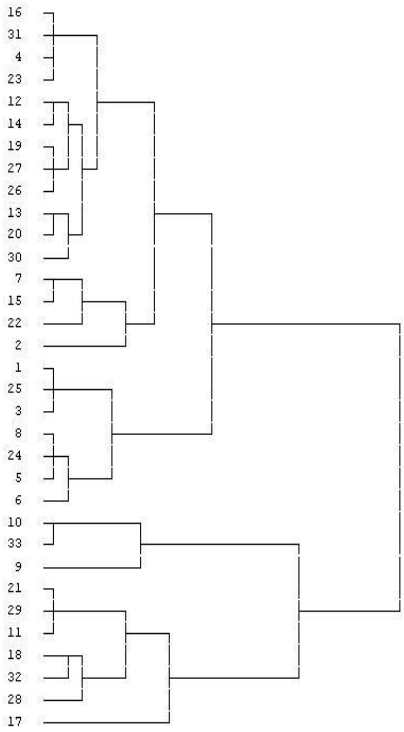

Fig. 2. Cluster analysis of 33 pear genotypes according to the average fruit flesh firmness in collection Špionica-Srebrenik for 2009-2011 period.

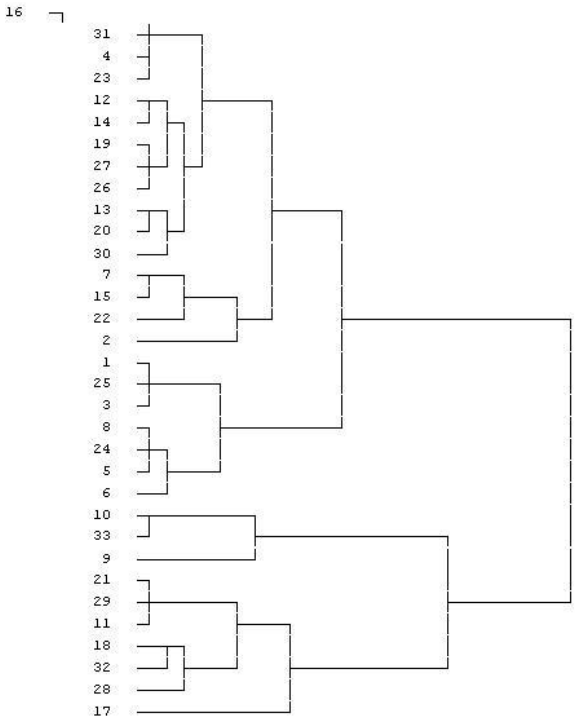

Fig. 3. Cluster analysis of 33 pear genotypes according to the average dry matter content in fruit flesh juice in collection Špionica-Srebrenik for 2009-2011 period.

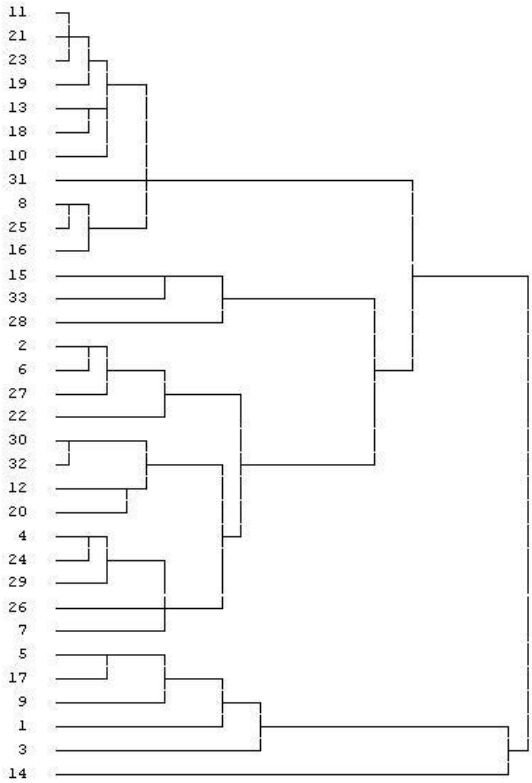

Fig. 4. Cluster analysis of 33 pear genotypes according to dynamics of phenophase flowering in collection Špionica-Srebrenik for 2009-2011 period.