

Morphological and Pomological Characteristics of Wild Pears in the Northwestern Part of the Bosnia and Herzegovina

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Abstract

The aim of this research is to examine the morphological and pomological characteristics of the wild pear population in the northwestern part of Bosnia and Herzegovina with the purpose of allocating genotypes for breeding programs of varieties and rootstocks. During 2012 and 2013, the study of the wild pear characteristics was carried out on the localities of: Banja Luka, Manjača, Potkozarje and Kozara. This research included morphological characterization of vegetative organs and pomological characterization of the fruits of all the selected genotypes. The shape of leaves in all the examined genotypes was elongated. The study of wild pear populations in the Banja Luka region has shown that wild pears are characterized by mostly smaller fruits, rounded form, while a few genotypes had fruits of elongated and flattened shape. Fruit weight varied from 7.44 g to 21.47 g and 73% of genotypes had fruit weight of over 10 g.

Key words: *Pyrus communis* var. *pyraster*, leaf shape index, fruit weight, fruit shape

Introduction

The wild pear (*Pyrus communis* var. *pyraster* (L.) Ehrh.) originates from the Caucasus and the neighboring regions of Asia.

The European wild pear is a companion of deciduous forests and has a wide distribution range. On the Balkan Peninsula, the wild pear grows all the way to the sub-Alpine belt. The Balkan Peninsula, given the richness of the pear population, can be considered as a secondary center of genetic diversity (Mišić, 2002). The Balkan area is rich with a different number of varieties and forms, and this area is already rich with pear germplasm (Mratinić and Kojić, 1998).

Diversity of the wild pear in natural populations provides a possibility to select the starting material in the breeding of pear. The area of northwestern part of B&H is rich in terms of genetic diversity of the wild pear, which has never been rated. Individual trees were used for seed collection for the production of seedlings as rootstocks for grafting of pears.

The loss of gene pool of many species including wild relatives is a serious problem, because genes that carry climate adaptation properties can be lost forever (Đurić et al., 2014). The genetic resources of wild apples and wild pears in Europe are severely endangered (Stephan et al., 2003). From the point of view of conservation and sustainable use of fruit germplasm, indigenous fruit cultivars are an important component of biodiversity, since they are the carriers of the disease resistance, resistance to pests and abiotic stress factors and, as such, are a source of desirable properties in breeding varieties and rootstock in fruit plants.

The wild pear populations were studied worldwide and great genetic diversity of the pear population is observed. Also, the comparative studies of morphometric traits of wild and indigenous varieties of pears were performed, for example, in Switzerland (Rotach and Baume, 2004), Spain (Voltas et al., 2007), Slovakia (Paganova, 2009) and Italy (Marino et al., 2013). The study of phenotypic characteristics of the population is important in understanding their biological heritage and as a potential source of genes for improvement of the cultivated varieties (Marino et al., 2013). Significant comprehensive studies of populations of the wild pear in the former Yugoslavia have so far been conducted in the areas of Bijelo Polje (Jovančević and Božović, 2003), Sarajevo (Kulina, 2001), Western Serbia (Milutinović et al., 2005) and from indigenous populations (Paunović et al., 2012).

The study of natural populations of the wild pear in the northwestern part of the Republic of Srpska and Bosnia and Herzegovina has not been implemented to any significant extent.

The study of wild apple and wild pear populations carried out in the area of Starčevica Park Forest (Banja Luka, BiH) indicated a high degree of polymorphism between the examined trees (Antić et al., 2016). Starting from the assumption that the great variety of pear germplasm exists in this area, there was a need to conduct a study and evaluation of this diversity.

Therefore, the aim of this study is to estimate the genetic diversity of wild pear populations in this area, to collect and preserve them and to be available for pear breeding programs.

The main aim of this study is to examine the morphological and pomological characteristics of wild pear in the northwestern part of the Republic of Srpska (Bosnia and Herzegovina) in the Banja Luka region, with the aim of identifying genotypes with expressing positive characteristics for breeding and cultivation programs.

Material and Methods

Determination of wild pear tree (*Pyrus communis* var. *pyraster* (L.) Ehrh.) of different types and forms was carried out in 2011 in its natural habitat in the wider Banja Luka region and the localities of Kozara, Manjača, lower regions of Banja Luka and Potkozarje. A total of 41 genotypes were selected and all were preserved *in situ*. The selected genotypes are designated with a number assigned to them by the order of sampling.

The criteria for selection of the individuals were: exuberance, type of growth, fruit characteristics (size, shape, number of seeds), yielding and regularity of fruit-bearing. All genotypes were spontaneously found in the nature, where there were favorable conditions. Trees of wild pears are mapped by a handheld GPS receiver (GARMIN Oregon 550, USA).

In the spring of 2012, the pruning of selected trees was carried out in order to cause a more intensive growth of young shoots to obtain material for morphometric analysis of genotypes. The analyses of pear genotypes were performed with the fresh material, collected in June, after a period of intensive growth. The measurement of quantitative parameters was performed on a sample of 10 young shoots, 25 leaves and 25 fruits. The collection and analysis of the material was performed at the Department for Fruit Growing and Viticulture at the Agricultural Institute of the Republic of Srpska, Banja Luka, during the two-year period. UPOV descriptor (UPOV, 2000) was used for the characterization of pears. An overview of the analyzed qualitative and quantitative characteristics of vegetative organs (tree, young shoot, leaf) and wild pear fruit is given in Table 1.

Tab.1. Analyzed characteristics of wild pear population *in situ*
Испитиване особине популације дивље крушке *in situ*

	Acronym	Qualitative traits / Квалитативне особине
Tree Стабло	TV*	vigor: 3-weak, 5-medium, 7-strong / бујност: 3- слаба, 5- средња, 7- јака
	TH	habit: 2-upright, 3-semi-upright, 4-spreading / положај грана: 2- усправан, 3- полуусправан, 4- широк
Young shoot Младар	YSC	predominant color on sunny side: 1-grey-green, 2-grey brown, 3-medium brown, 4-orange brown, 5-brown red, 6-brown purple / доминантна боја на осунчано страни: 1- сиво-зелена, 2- сиво смеђа, 3- средње смеђа, 4- наранџасто смеђа, 5- црвенкасто смеђа, 6- љубичасто смеђа
	YSL	number of lenticels: 3-few, 5-medium, 7-many / број лентицела: 3- мало, 5- средње, 7- много
Leaf blade Листови	LBB	shape of base: 2-right-angled, 3-obtuse, 4-truncate, 5-cordate / облик базе листа: 2- правоугли, 3- туп, 4- заобљен, 5- срџолик
	LBA	shape of apex: 1-acute, 2-right-angled, 3-obtuse, 4-rounded / облик врха листа: 1- шиљат, 2- правоугли, 3- туп, 4- заобљен
	LBM	incisions of margin: 1-absent, 2-entire, 3-serrated, 4-undulating / назубљеност ивице: 1- одсутна, 2- засјечена, 3- зупчаста, 4- тестераста
	PS	presence of stipules: 1-absent, 9-present / присуство лисних зализака: 1- одсутни, 9- присутни
Fruit Плод	FMD	position of maximum diameter: 1-in middle, 2-slightly towards calyx, 3-calyx / положај максималног пречника: 1- у средини, 2- благо ка цвјетној чашици, 3- јасно ка цвјетној чашици
	FCS	ground color of skin: 2-green, 3-yellow green, 4-yellow / основна боја pokožице плода: 2- зелена, 3- жуто-зелена, 4- жута
	FRS	relative area of russet on cheeks: 1-absent, 3-small, 5-medium, 7-large, 9-very large / појава рђе боје на pokožици плода: 1- одсутна или врло мало, 3- мало, 5- средње, 7- велика, 9- врло велика
Quantitative traits/ Квантитативне особине		
Young shoot Младар	YSLI	length of internodes (cm) / дужина интернодија
Leaf blade Листови	LBL	length (cm) / дужина
	LBW	width (cm) / ширина
	RLW	ratio length/width / однос дужина/ширина
	PL	Petiole: length (cm) / дужина петељке
Fruit Плод	FL	length (cm) / висина
	FMD	maximum diameter (cm) / пречник
	RLD	ratio length/diameter / однос висина/пречник
	FS	size (g) / маса
	LS	length of stalk (cm) / дужина петељке
	TS	thickness of stalk (cm) / дебљина петељке

*Note: TV=Tree: vigor; TH=Tree: habit; YSC=Young shoot: predominant color on sunny side; YSL=Young shoot: number of lenticels; LBB-Leaf blade: shape of base; LBA-Leaf blade: shape of apex; LBM-Leaf blade: incisions of margin; PS-Petiole: presence of stipules; FMD-Fruit: position of maximum diameter; FCS-Fruit: ground color of skin; FRS-Fruit: relative area of russet on cheeks; YSL-Young shoot: length of internodes (cm); LBL-Leaf blade: length (cm); LBW-Leaf blade: width (cm); RLW-Leaf blade: ratio length/width; PL-Petiole: length (cm); FS-Fruit size (g); FL-Fruit length (cm); FMD-Fruit maximum diameter (cm); LS-Fruit: length of stalk (cm); TS-Fruit: thickness of stalk (cm); RLD-Fruit: ratio length/diameter.

Measured characteristics of surveyed wild pear genotypes were analyzed using general linear models (GLM).

For those properties found with significant statistical differences between varieties, further testing and grouping was established by Fisher's LSD test. The differences were considered significant in case of $p < 0.05$.

The total effect of a combination of different traits measured in the tested indigenous varieties of pears was analyzed by the method of Principal Component Analysis (Sneath and Sokal, 1973; Williams, 1976; Iezzoni and Pritts, 1991; Peres et al. 2003) by which the classification of the tested varieties was done. The statistical analysis and graphical presentation of results of the statistical analysis were performed in the SPSS Statistics 22 (2013) software.

Results and Discussion

The study during 2012 and 2013 included 41 accessions of wild pear *in situ* on four localities. This material is collected in order to conserve the genetic recourses, as well as its characterization, description and evaluation.

Locations of selected wild pear trees were displayed on a topographic basis using a program package ArcGIS (ArcMap 10.). Quantum-GIS software was used to elucidate plant characteristics, as well as the ecological and geographical patterns of distribution of the genotypes. *In situ* locations of the genotypes selected are presented in Figure 1.

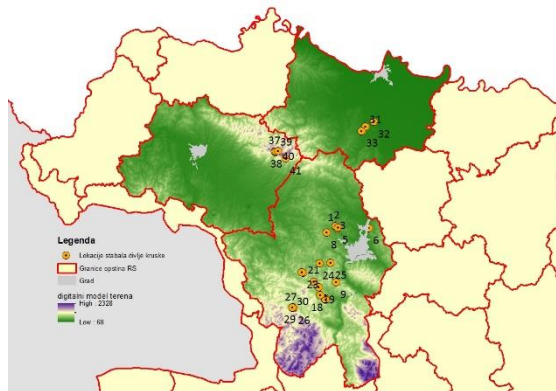


Fig. 1. Locations of the selected genotypes of wild pear
Локације одабраних генотипова дивље крушке

In situ wild pear trees are mostly found at the edges of forests, forest pastures and meadows (Voltas et al., 2007; Antić, 2016), which was the case in all the studied localities. The results of the qualitative morphological characteristics of the selected wild pear genotypes are shown in Table 2.

Tab. 2. Qualitative morphological characteristics of wild pear populations *in situ*
 Квалитативне морфолошке карактеристике популације дивље крушке *in situ*

Locality <i>Lokalitet</i>	Genotype <i>Genotip</i>	Tree / <i>Stablo</i>		Young shoot		Leaf / <i>List</i>				Fruit / <i>Plod</i>		
		TV*	TH	YSC	YSL	LBB	LBA	LBM	PS	FMD	FCS	FRS
Banja Luka	1	5	3	5	3	3	2	3	9	1	4	3
	2	7	4	1	5	4	2	2	9	1	3	1
	3	5	3	1	3	3	2	4	9	1	3	1
	4	5	2	3	3	4	2	2	1	2	2	1
	5	3	3	1	3	5	2	3	9	1	2	1
	6	5	3	1	3	4	3	2	9	1	3	5
	7	5	4	5	5	4	3	3	9	1	4	1
	8	5	5	5	5	4	3	3	1	1	2	3
9	7	3	3	3	4	3	2	1	3	3	1	
10	7	3	1	5	5	3	2	1	3	2	3	
11	5	3	5	3	2	1	1	1	1	3	1	
12	5	3	4	5	5	4	2	9	1	2	5	
13	5	3	5	3	4	3	1	9	1	3	1	
14	3	2	4	3	4	3	1	9	1	2	5	
15	3	3	3	3	3	3	3	9	1	3	3	
16	7	4	1	3	4	3	1	1	2	3	1	
17	3	5	5	3	4	3	3	1	1	4	3	
18	5	2	5	3	5	3	2	9	1	3	5	
Manja- ča	19	3	3	1	5	3	3	2	1	3	2	5
	20	7	4	3	7	4	3	3	1	1	2	1
	21	5	3	1	5	5	2	3	9	3	2	1
	22	7	3	2	3	3	3	2	9	1	3	1
	23	3	4	3	5	5	3	3	1	1	3	5
	24	5	2	2	5	4	3	2	1	1	2	3
	25	7	3	3	3	5	4	3	1	1	2	5
	26	5	4	5	3	4	3	2	9	1	3	1
	27	7	2	1	3	5	3	4	1	2	3	3
	28	5	2	5	3	4	2	2	1	2	3	1
29	5	3	5	5	3	2	2	9	2	4	1	
30	5	3	4	5	4	4	3	1	1	3	1	
Potko- zarje	31	5	4	1	5	4	2	2	1	3	3	1
	32	3	3	5	3	2	1	1	9	1	2	9
	33	7	5	3	3	4	2	2	1	3	4	1
	34	3	5	5	7	4	3	3	1	1	3	1
35	3	2	3	3	5	3	2	1	1	3	3	
36	5	2	3	5	4	3	2	1	1	2	7	
Kozara	37	3	2	5	5	5	2	1	9	1	3	3
	38	5	2	4	5	4	2	3	9	1	4	1
	39	5	2	1	7	3	3	1	1	1	3	3
	40	5	4	5	5	4	3	2	1	1	3	3
	41	5	3	5	5	4	3	2	9	1	2	1

*Note: TV=Tree: vigor; TH=Tree: habit; YSC=Young shoot: predominant color on sunny side; YSL- Young shoot: number of lenticels; LBB- Leaf blade: shape of base; LBA- Leaf blade: shape of apex; LBM- Leaf blade: incisions of margin; PS- Petiole: presence of stipules; FMD- Fruit: position of maximum diameter; FCS- Fruit: ground color of skin; FRS- Fruit: relative area of russet on cheeks.

During the *in situ* examination of wild pear, the presence of weak to highly vigorous trees is noticed and 50% of trees were medium vigorous. Unlike our results where low vigorous trees were also recorded, in other studies in the Balkans vigorous to highly vigorous trees were recorded (Paunović et al., 2012). In our research predominant tree habit was in semi-upright position (44%) and spreading only in 20% of trees. In all examined locations, all types of branch positions in all locations were equal, except Kozara location where 60% of genotypes had upright branch position.

The color of young shoots varies from gray green to brown red. According to the number of lenticels, the genotypes with few and medium number of lenticels are equally distributed. The most important qualitative characteristics of the leaf are the shape of the base, the tip of the apex and its position, incisions of the margin, the presence and position of stipules. The leaf shape depends on the ratio of length and width of the leaf and forms the top and base of lamina. The index of the leaf length and width with all the tested genotypes is greater than 1, which means that the leaves reached higher length values in relation to the width. The shape of leaf base is in most cases truncate (over 50%), and the leaf tip is obtuse (58%) and the specific shape of the leaf tip is typical for the locality. Most of these genotypes have a serrated lamina, and differences exist only in the form of indent and the depth of the notch. Only a few genotypes have leaf margins without indentations.

The evaluated qualitative characteristics of the wild pear fruit are the basic color of the epidermis and the appearance of rust. The color of the fruit skin (FCS) in the majority of genotypes (50%) is yellow-green, and a significant number of genotypes have green skin color. Appearance of russet on the fruit skin (FRS) in 50% of genotypes is absent or very minor. A stronger presence of russet is recorded in three genotypes (14, 32 and 36), where the fruit is almost entirely covered with it.

The results of the quantitative morphological characteristics of the selected wild pear genotypes are shown in Table 3. The length of internodes varies from 1.73 cm to 3.63 cm and this is not specific for the locality. Length of petiole varies from 1.63 cm (genotype 1) to 4.26 cm (genotype 11). Most genotypes have the petiole length in the range of 2-3.5 cm (78%). The presence of stipule was observed in 46% of the genotypes and their presence is associated with the area. Fruit traits were not the aim of the selection process, but they contributed to differentiating the characteristics of genotypes. Most of the researches, who studied populations of wild pear (Jovančević, 2003; Kulin, 2001, Paunović et al., 2012), suggested that the fruits of the wild pears were different in shape, size and weight.

Tab. 3. Quantitative morphological characteristics of wild pear populations *in situ*
Квантитативне морфолошке особине дивље крушке популације in situ

Locality <i>Lokalitet</i>	Genotype <i>Genotip</i>	Shoot	Leaf / <i>List</i>					Fruit / <i>Plod</i>					
		YSLI	LBL	LBW	RLW	PL	FS	FL	FMD	LS	TS	RLD	
Banja Luka	1	2.06	4.70	3.90	1.21	1.63	15.83	2.41	2.77	2.79	1.61	0.87	
	2	2.24	5.98	4.43	1.37	1.95	12.01	2.70	2.73	2.28	1.94	0.99	
	3	2.41	5.09	4.12	1.24	2.03	9.36	2.23	2.52	2.26	1.84	0.88	
	4	1.81	4.53	3.64	1.25	2.67	10.02	2.65	2.58	3.13	1.57	1.02	
	5	1.97	5.48	4.37	1.25	2.94	7.87	2.02	2.47	1.98	1.42	0.81	
	6	2.23	4.77	3.84	1.31	4.16	10.43	2.32	2.61	2.53	1.83	0.89	
	7	1.77	4.50	4.21	1.07	2.90	10.77	2.28	2.64	2.46	1.54	0.86	
	8	1.82	5.47	4.92	1.12	2.68	13.90	2.51	2.94	2.65	2.10	0.86	
	9	2.29	5.22	4.02	1.30	3.48	15.17	3.12	2.91	3.32	1.87	1.07	
	10	1.84	5.27	4.20	1.27	2.59	15.46	2.38	2.94	2.77	2.04	0.81	
Manja- ča	11	2.18	6.25	3.92	1.60	4.26	12.69	2.40	2.82	3.15	1.92	0.85	
	12	1.99	5.49	4.93	1.12	3.62	16.97	2.46	3.28	3.36	1.86	0.75	
	13	2.29	4.49	4.00	1.13	2.95	13.35	2.54	2.83	3.05	1.78	0.90	
	14	1.83	4.42	3.92	1.13	3.31	7.46	1.90	2.41	2.67	1.70	0.80	
	15	2.17	4.21	3.73	1.11	2.74	7.44	2.11	2.38	2.56	2.05	0.89	
	16	2.24	4.87	4.01	1.22	2.54	9.10	2.17	2.50	1.45	1.82	0.87	
	17	2.07	4.58	3.88	1.19	2.76	13.71	2.58	2.81	2.01	1.83	0.92	
	18	2.32	4.57	3.81	1.20	2.89	15.15	2.60	2.93	2.43	1.76	0.89	
	19	2.34	4.74	3.68	1.29	2.84	13.13	2.50	2.90	2.12	1.86	0.86	
	20	2.11	5.68	4.59	1.24	4.08	11.47	2.31	2.57	2.78	1.64	0.90	
	21	2.84	5.91	4.64	1.29	2.41	13.44	2.39	2.95	1.92	2.09	0.81	
22	2.16	5.53	4.11	1.35	3.57	15.01	2.60	2.99	2.87	1.85	0.88		
23	2.17	4.50	4.35	1.04	2.44	18.39	2.43	3.23	1.73	2.02	0.75		
24	2.02	4.16	3.58	1.16	2.92	11.47	2.33	2.75	2.69	1.80	0.85		
25	2.36	5.50	5.39	1.02	3.18	18.25	2.67	3.25	2.80	1.90	0.82		
26	2.24	5.51	4.00	1.39	3.14	13.78	2.49	2.83	2.95	1.98	0.88		
27	3.63	5.49	5.10	1.08	2.95	19.88	3.47	3.09	2.63	1.92	1.13		
28	2.03	4.56	3.66	1.26	2.44	14.80	2.48	2.94	1.76	1.95	0.85		
29	2.41	5.20	4.12	1.27	2.88	20.43	2.70	3.29	2.77	1.69	0.82		
30	3.02	5.02	4.72	1.06	3.48	16.82	2.40	3.13	1.95	2.24	0.77		
Potko- zarje	31	2.12	4.90	3.72	1.32	3.79	8.26	2.03	2.47	2.45	1.69	0.82	
	32	1.94	5.70	3.68	1.58	2.17	12.24	2.53	2.83	1.99	2.20	0.89	
	33	2.09	5.64	4.80	1.19	3.96	13.04	3.00	2.78	3.68	2.03	1.08	
	34	1.73	3.74	3.19	1.17	3.14	8.91	2.22	2.53	2.44	1.70	0.88	
Kozara	35	1.84	5.16	4.38	1.19	2.89	7.76	2.07	2.27	2.29	1.79	0.91	
	36	1.99	5.04	3.89	1.30	2.94	9.51	2.33	1.99	3.13	1.85	1.18	
	37	2.33	6.07	4.22	1.45	3.50	21.47	3.08	3.51	1.62	2.73	0.88	
	38	2.03	5.45	4.44	1.23	3.46	9.42	2.11	2.55	3.02	1.64	0.83	
	39	2.10	5.75	4.52	1.29	2.96	18.60	2.90	3.29	3.20	2.17	0.88	
	40	1.76	4.73	4.49	1.05	2.59	9.04	2.18	2.58	2.54	1.82	0.84	
	41	2.07	5.96	5.00	1.19	3.18	19.51	3.03	3.31	2.89	2.32	0.92	

*Note: YSL-Young shoot: length of internodes (cm); LBL-Leaf blade: length (cm); LBW-Leaf blade: width (cm); RLW-Leaf blade: ratio length/width; PL-Petiole: length (cm); FS-Fruit: size (g); FL-Fruit: length (cm); FMD-Fruit: maximum diameter (cm); LS-Fruit: length of stalk (cm); TS-Fruit: thickness of stalk (cm); RLD-Fruit: ratio length/diameter

Most researchers, who were studying populations of wild pears in the Balkans, state that the wild pear fruits are small, mostly rounded or slightly flattened. According to Mišić (1984), wild pear fruits are pear or ball shaped, strong and tasty. The study of wild pear populations in the Banja Luka region have shown that the pears are characterized mainly by smaller fruits, rounded form, while the smaller part of the fruit has the fruits of elongated and flattened shape.

The shape of the fruit is determined by relations of height and width of the fruit. In essence, all genotypes have oblate or globular shape of the fruit, but only in some genotypes the ratio of the fruit is greater than 1, which means that the fruit is elongated, pear-shaped. At each locality at least one pear-shaped genotype was found. The pear-shaped fruit was observed for trees 4, 9, 27, 33 and 36, which is shown by a fruit shape index > 1 .

All genotypes in our study were fruitful and showed morphological differences. Fruit weight varied from 7.44 g to 21.47 g, and 73% of genotypes had fruit weight of more than 10 g. The average mass of wild pear fruit in the Bijelo Polje population was 15.84 g (Jovančević, 2003). In the studying of the indigenous population of wild pear, Paunović et al. (2012), the average weight of the fruit was 20.05 g, and the largest mass of 31.17 g had the genotype K1.

The length (LS) and thickness (TS) of the fruit stalk are traits which are characteristics of the genotype. The stem length ranged from 1.45 cm to 3.68 cm and the thickness of the stalks ranged from 1.42 mm to 2.73 mm. Most pear genotypes (73%) have a stalk thickness less than 2.00 mm.

The analysis of fruit characteristics (Table 4) showed no statistically significant interactions between studied locations and different years ($p > 0.200$ for all characteristics). Various studied locations influenced fruit mass ($p = 0.049$) revealing significant difference between lowest fruit mass in the Banja Luka region (10.72 ± 1.11 g) and highest in the Manjaca region (14.17 ± 0.67 g). There was also statistically significant difference in fruit stalk width ($p = 0.014$), where the largest width was recorded in the Kozara region (2.05 ± 0.09 mm) and smallest in Banja Luka (1.68 ± 0.05 mm).

A significant effect of different studied years was recorded for length and width of leaf ($p < 0.032$), where the year 2013 was superior for both characteristics. For other recorded characteristics, there was no significant influence of studied locations or years.

Tab. 4. Measured fruit and leaf characteristics of studied pear genotypes per studied locations and years of study with statistical comparisons (GLM p-values)

Просјечне врједности карактеристика плода и листа генотипова дивље крушке по локацијама и годинама истраживања са статистичким поређењима (GLM p-врједности)

Year Год.	Location Локација	Fruit / Плод						Leaf / Лист													
		Mass Маса [g]		Fruit Length Висина плода [cm]		Fruit Diameter Пречник плода [cm]		Fruit Length/Diameter [ratio]		Stalk Length Дужина петељке [cm]		Stalk Thickness Дебљина петељке [mm]		Petiole Length Дужина петељке [cm]		Length/Width [ration] однос дужина/ширина					
		\bar{X}	SE	\bar{X}	SE	\bar{X}	SE	\bar{X}	SE	\bar{X}	SE	\bar{X}	SE	\bar{X}	SE	\bar{X}	SE				
2012	Banja Luka	11.82	0.71	2.48	0.07	2.72	0.06	0.92	0.02	2.59	0.09	1.68	0.05	2.68	0.25	4.84	0.17	3.81	0.13	1.29	0.04
	Manjača	13.61	0.98	2.50	0.08	2.85	0.08	0.88	0.02	2.53	0.14	1.86	0.05	3.12	0.19	4.89	0.17	4.06	0.15	1.22	0.04
	Potkozarje	11.05	0.91	2.53	0.13	2.69	0.07	0.93	0.03	2.55	0.14	1.95	0.06	3.56	0.21	5.31	0.10	4.08	0.12	1.32	0.04
2013	Kozara	11.96	1.10	2.46	0.09	2.68	0.11	0.93	0.02	2.56	0.14	1.96	0.07	2.88	0.12	4.96	0.18	4.08	0.16	1.23	0.03
	Banja Luka	9.64	0.52	2.25	0.05	2.56	0.05	0.88	0.01	2.44	0.10	1.78	0.06	2.56	0.12	5.29	0.12	4.79	0.71	1.16	0.03
	Manjača	14.74	1.03	2.50	0.08	2.94	0.07	0.85	0.02	2.53	0.15	1.92	0.04	3.07	0.31	5.30	0.43	4.40	0.31	1.22	0.09
Pyear	Potkozarje	11.30	0.56	2.50	0.05	2.71	0.05	0.93	0.02	2.86	0.19	2.00	0.05	3.05	0.23	5.52	0.16	4.05	0.17	1.40	0.06
	Kozara	13.49	1.46	2.51	0.10	2.82	0.12	0.90	0.03	2.72	0.12	2.05	0.09	3.17	0.15	5.51	0.20	4.45	0.14	1.23	0.04
		0.88	0.62	0.82	0.35	0.60	0.25	0.58	.03*	.01*	0.89	0.88	0.62	0.82	0.35	0.60	0.25	0.58	.03*	.01*	0.89
Plok		0.05	0.65	0.08	0.19	0.80	0.01	0.07	0.63	0.86	0.15	0.05	0.65	0.08	0.19	0.80	0.01	0.07	0.63	0.86	0.15
Pint		0.60	0.70	0.65	0.98	0.78	0.99	0.62	0.96	0.20	0.31	0.60	0.70	0.65	0.99	0.78	0.99	0.62	0.96	0.20	0.31

In Principal Component Analysis, where all measured characteristics of fruit and leaf were analyzed together for all genotypes, the first two components (54.78% explained variation) are displayed in Figure 2. There are three groups of genotypes that can be observed. Group 1 is formed from genotypes with predominantly large fruit. In this group, Genotype 37 is separated by its largest fruit mass and round fruit shape and also Genotype 27 is separated by its large fruit mass and elongated pear-like shape. In Group 2, genotypes are grouped by their intermediate characteristics with several genotypes which deviate mostly by their vegetative characteristics. In Group 3, the genotypes are separated by their long fruit stalk and elongated pear-like fruit with smaller fruit mass. There was no observed grouping related to different studied locations.

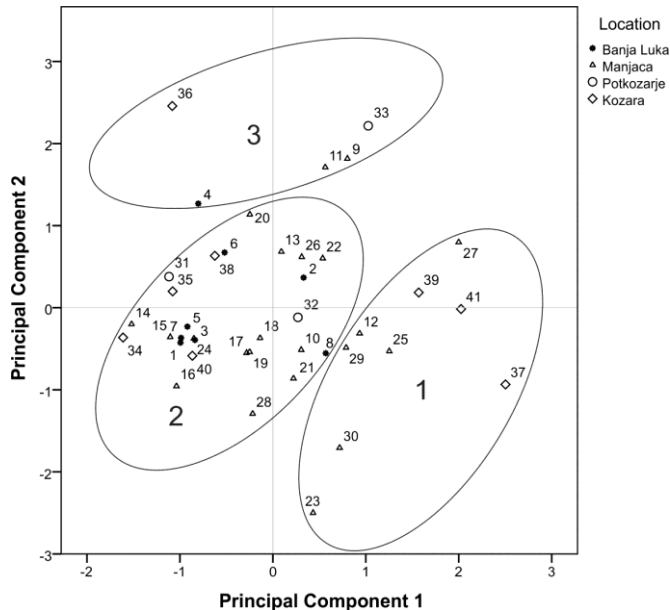


Fig. 2. Analysis of the main components of measuring properties of wild pears *in situ* populations

Анализа главних компоненти мјерених особина генотипова дивље крушке *in situ* популације

Conclusion

These studies confirm the existence of a rich variety of wild pears (*Pyrus communis* var. *pyraster* (L.) Ehrh.) since a significant number of morphologically and pomologically different fruit trees were found in a relatively small area, with a fruit of 7 to 21 g mass, different in skin color, from varying shades of green to yellow, with many, very little or completely without russeting and a fruit stalk from 1.45 cm to 3.68 cm long. The fruits ripen from mid-August to mid-October and mostly taste bitterly.

The analysis of the morphological characteristics of the vegetative organs and fruits of the wild pear population which were studied (*Pyrus communis* subssp. *pyraster* L. Ehrh) in the area of Banja Luka region indicates the great diversity of the population in the area tested. At four tested sites, accessions that meet the requirements for some of the directions for the selection were chosen, and thus created a starting material for further selection and breeding work.

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Морфолошке и помолошке особине дивље крушке у сјеверозападном дијелу Босне и Херцеговине

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Сажетак

Циљ овог истраживања је испитивање морфолошких и помолошких карактеристика популације дивље крушке у сјеверозападном дијелу Босне и Херцеговине са циљем издвајања генотипова за програме оплемењивања сорти и подлога. Током 2012. и 2013. године је обављено проучавање особина дивље крушке на локалитетима: Бања Лука, Мањача, Поткозарје и Козара. Морфолошка карактеризација стабала обухвата особине стабла, младара и листа. Помолошка карактеризација одабраних генотипова је сагледана преко особина: масе, висине и ширине и индекса облика плода, дужине и дебљине петељке, положаја максималног пречника, боје покожице и појаве рђе боје на плоду. Облик листа код свих генотипова је издужен. Спроведена испитивања на подручју бањалучке регије су показала да се дивља крушка одликује углавном ситнијим плодовима, округластог облика. Мањи дио генотипова има плодове издуженог и спљоштеног облика. Тежина плода кретала се од 7,44 g до 21,47 g, а 73% генотипова је имало тежину плода већу од 10 g.

Кључне ријечи: *Pyrus communis* var. *pyraster*, индекс облика листа, маса плода, облик плода

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