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**MORPHOLOGICAL CHARACTERISTICS OF FRUITS OF
SELECTED TYPES OF WILD APPLES (*MALUS SILVESTRIS* L.)
IN THE AREA OF BIJELO POLJE**

SUMMARY

Wild fruits represent an important natural resource and inexhaustible geofund of extremely important species that have not been sufficiently explored. The wild apple is the most important generative rootstock in the world. The aim of this paper is to describe morphological characteristics of fruits of selected types of wild apple in the area of Bijelo Polje, which in addition to the general biological importance also have practical value from the aspect of generative rootstock production. Type 9 has the least mass of fruits (8.95 g), then type 5 (11.34 g), type 8 (12.75 g) and type 3 (12.81 g). From the aspect of reserve material necessary for germination, respectively of seed mass, the best characteristics are possessed by the type 8 (3.832g) and the type 6 (3.668g).

Keywords: wild apples, fruit mass, fruit length, fruit width, mass of seed.

INTRODUCTION

Apple generative rootstocks are used world-wide due to better adaption of different species of the genus *Malus* to various environmental conditions, very often to extremely harsh conditions (Galot, G.J., Lamb, C.R., Aldwinckle, S.H., 1985). Generative rootstocks of pome fruits are in principle less exposed to virus attacks, since they cannot be transmitted during seed reproduction (Mišić, 1984).

Wild apples of Montenegro have never been a subject of a comprehensive research work, neither of collecting and studying. Nowadays, the topical issue is how to preserve it, especially since many local populations have vanished during its development or are reduced to a rather limited number of genotypes. Nevertheless, germ-plasma of wild apple in less urban areas, such as the area of Bijelo Polje, is rather preserved.

MATERIAL AND METHODS

During the fall of 2009, from the population of wild apple (*Malus silvestris* L.) nine types were selected which were of moderate vigor in comparison to other types existing in this population. Particular attention was given to the fact that they were to be located on different sites, namely different altitudes and that they were to be healthy individual trees of full productivity with fruits having more

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than 6 well developed seeds. Trees of 4 autochthonous apple varieties were considered as comparative parameters.

Fruit mass and mass of 100 pieces of dry seeds were determined by measuring by the electric scale „METLER 1200“. The result is shown in grams with the accuracy of 0.01g.

Fruit dimensions – length and width were measured by vernier scale. The results are shown in mm.

Selection of seeds is conducted according to the method of Stanković and Jovanović (1987).

Extraction of seeds was performed manually. The method according to Mišić (1984) stipulates for small amounts of seeds to be extracted manually.

Drying and storage of seeds were performed in shade with good air circulation.

Obtained results were statistically processed by the method of variance analysis and checked by LSD tests.

RESULTS AND DISCUSSION

Fruit mass is an inherited genetic characteristic. Differences were noticed in respect to types and controlled autochthonous varieties, while the fruit mass differences in respect to years are negligible (tab.1). The highest average fruit mass of selected types of wild apples was recorded with the type 2 (33.65 g) and the lowest with the type 9 (8.95 g). The analysis of variance for the fruit mass parameter, where the source of variation is types and varieties, recorded statistically very significant difference. This means that we can expect such fruit mass with the observed types and varieties in future, with the probability of 99 %. The analysis of variance for the fruit mass parameter, where the source of variation is interaction type x year did not show statistically significant differences. This means that years of researches, respectively their climate characteristics do not have statistically significant or relevant impact. Therefore, the mentioned parameter is conditioned by the genotype and years do not impact the differences between the observed types or controlled varieties.

During the research period, the variance ratio for the fruit mass parameter, which was calculated on the basis of registered individual measurement indicators, was at the level of 5.29 %.

In terms of generative rootstock production, wild apple with generally smaller fruit mass is more commercial in comparison to the autochthonous apple varieties. The most commercial types are: type 9 (8.95 g), type 5 (11.34 g), type 8 (12.75 g) and the type 3 (12.81 g).

Fruit length and width (tab.2) are biological characteristics that mostly depend on genotypes. The longest average fruit length of selected types of wild apples amounts to 38.19 mm (type 6) and the shortest is 22.12 mm (type 9). The widest average fruit width of selected types of wild apples amounts to 42.81 mm (type 2) and the narrowest is 27.78 mm (type 9).

Tab.1. Average fruit mass of selected types of wild apples (g)

Type/Cultivars	Fruit mass(g)				LSD	0.05	0.01
	2009	2010	2011	Mx	Type	2.78	3.69
MS-1	18.04	17.52	17.83	17.79	Year	1.34	1.77
MS-2	33.62	33.51	33.82	33.65	Type x Year	4.82	6.39
MS-3	13.03	12.26	13.11	12.81	**) P<0.01		
MS-4	17.25	17.02	17.41	17.22	*) P<0.05		
MS-5	11.31	11.02	11.69	11.34	Ns) P>0.05		
MS-6	24.17	26.22	27.14	25.84	CV= 5.29%		
MS-7	29.51	27.62	30.35	29.16	Variation source	DF	SS
MS-8	13.41	12.82	12.02	12.75	Type	12	380.634
MS-9	9.05	7.78	10.02	8.95	Year	2	14.207
Senabija	164.8	165.8	160.91	163.8	Type x Year	24	146.26
Arapka	116.4	121.1	119.31	118.9	Deviation	78	686,256
Pašinka	122.9	127.7	126.21	125.6	Total	116	8.798
Šarenika	148.5	150.2	151.51	150.1	F		
					3605.24	**	
					0.80738	ns	
					0.69266	ns	

The analysis of variance for the fruit length and width in respect to types and varieties, being the source of variance, determined a statistically very significant difference. This means that we can expect such fruit length and fruit width with the observed types and varieties in future, with the probability of 99 %. In respect to years, as to the source of variation, there were no statistically significant differences in both cases, namely regarding the fruit length parameter and fruit width parameter. Therefore, fruit length and width are genetic characteristics of a type or a variety, not influenced by the climate characteristics of years.

Researches of Krgović (1990) show that fruit height and width are not directly proportional to the fruit mass, while, according to Brown (1966) and Mišić (1972), the shape of fruit and its size indicate a polygenetic mode of inheritance. Rudloff and Schmidt (1953) determined that there is no link between the fruit weight and number of seeds.

Mass of dry seed (100 pieces) was 2.076g with the type 3 up to 3.832g with the type 8 (tab 3). Regarding the volume of reserve material necessary for germination, the best predispositions are with the type 8 (3.832g) and the type 6 (3.668g). Variation ratio for the dry seed parameter amounted to 4.62 %, which indicates material homogeneity in observed types.

Analysis of variance for the seed mass parameter in respect to types and varieties, as to the source of variation, determined a statistically significant difference. This means that we can expect such seed mass with the observed types and varieties in future, with the probability of 99 %. In respect to the years, as to the source of variations, there were no statistically significant differences.

This means that the seed mass is a genetic characteristic of a variety, not influenced by characteristics of years. Data on the average number of seeds in 1 kg of dry seeds were obtained on the basis of the mass of 100 pieces of dry seeds and weight calculations regarding 1 kg (tab.3). The average number of seeds in 1 kg of seeds fluctuates from around 22725 with the cultivar Senabija (controlled variety) to 48189 with the type 3.

Tab.2. Average fruit length and fruit width of selected types of wild apples (mm)

Type/Cultivars	Fruit length (mm)				Fruit width (mm)			
	2009	2010	2011	Mxsr	2009	2010	2011	Mxsr
Type 1	31.72	31.64	31.71	31.68	37.24	37.17	37.21	37.21
Type 2	36.37	35.82	36.45	36.21	44.07	40.15	44.21	42.81
Type 3	27.02	26.81	26.69	26.83	31.35	31.42	31.39	31.35
Type 4	33.72	33.63	33.81	33.72	35.19	35.03	35.24	35.15
Type 5	26.15	26.13	26.31	26.21	30.61	30.39	30.11	30.69
Type 6	37.52	38.35	38.69	38.19	39.85	40.17	40.16	40.06
Type 7	35.91	35.53	37.02	36.15	44.02	42.96	43.02	43.33
Type 8	27.15	26.82	23.84	25.94	34.05	33.68	32.81	33.51
Type 9	22.15	21.73	22.49	22.12	27.91	27.35	28.09	27.78
Senabija	61.91	61.11	62.01	61.61	73.51	74.41	69.91	72.61
Arapka	55.91	57.11	57.41	56.81	48.61	50.31	49.41	49.43
Pašinka	66.81	67.51	67.91	67.41	68.51	69.41	69.01	68.97
Šarenika	77.91	79.25	80.05	79.06	81.51	81.95	81.91	81.78

Fruit length (mm)

LSD	0.05	0.01
Type	0.85	1.13
Year	0.41	0.54
Type x Year	1.47	1.95

**) P<0.01

*) P<0.05

Ns) P>0.05

CV= 2.17 %

Variation source	DF	SS	MS	F
Type	12	36115.1	3009.59	3669.31 **
Year	2	1.981	0.99057	1.208 ns
Type x Year	24	390.053	162.522	1.981 *
Deviation	78	63.976	0.82021	
Total	116	36220.1		

Fruit length (mm)

LSD	0.05	0.01
Type	0.82	1.1.09
Year	0.39	0.52
Type x Year	1.42	1.88

**) P<0.01

*) P<0.05

Ns) P>0.05

CV= 1.91 %

variation source	DF	SS	MS	F
Type	12	33.757	2813.08	3683.69 **
Year	2	1.708	0.85388	111.815 ns
Type x Year	24	76..313	3.179	416.377 *
Deviation	78	59..565	0.76366	
Total	116			

Tab.3. Mass of dry seed and number of seed in 1 kg of the fruit

Type/ Cultivars	Mass of dry seed (100 piece)				number of seed in 1 kg			
	2009	2010	2011	Mx	2009	2010	2011	Mx
Type 1	2.715	2.783	2.811	2.769	36832	35932	35574	36113
Type 2	2.653	2.705	2.715	2.691	37679	36969	36832	37160
Type 3	2.105	2.007	2.117	2.076	47506	49826	47237	48189
Type 4	3.015	3.102	3.125	3.081	33167	32237	32000	32468
Type 5	3.076	3.104	3.117	3.099	32509	32216	32082	32269
Type 6	3.716	3.866	3.422	3.668	26911	25867	29223	27334
Type 7	3.236	3.322	3.389	3.315	30902	30102	29507	30170
Type 8	3.942	3.887	3.667	3.832	25368	25726	27271	26122
Type 9	3.219	3.261	3.342	3.274	31065	30665	29922	30551
Senabija	4.808	4.219	4.224	4.417	20799	23702	23674	22725
Arapka	3.775	3.704	3.358	3.612	26491	26998	29779	27756
Pašinka	3.607	3.629	3.885	3.707	27724	27556	25741	27007
Šarenika	4.258	4.535	4.325	4.372	23485	22051	23121	22886
LSD	0.05	0.01	**) P<0.01 *) P<0.05 Ns) P>0.05					
Type	0.26	0.36						
Year	0.13	0.17						
CV= 4.62%								
Variation source		DF		SS		MS		F
Type		12		15.718		1.309		53.815
Year		2		0.02019		0.0101		0.4148
Deviation		24		0.58417		0.02434		ns
Total		38		16.323				

Apple seeds can be: small, medium, and large (Adamič et al.1963). Stanković (1955) states that the seed quality is resembled in its morphological and biological characteristics, where the seed size is the most important morphological characteristic, but equal development of seedlings and their resistance depend on biological characteristics (potentials). Seed germination, growing of seedlings and their normal development are also influenced by the seed size, since cotyledons of larger seeds contain more reserve organic materials, Kirkinska (1935 quotation of Stanković and Jovanović, 1977).

1 kg of seeds contains 30000-50000 pieces of seeds, states Kurindin (1955), but according to Slović (1953) such number is 30000-35000.

According to Mišić (1978), 100 kg of medium-sized wild apple fruits give around 1.1 kg of seeds. 1 kg of seeds contains 20000-40000, or in average 30000, seeds. Our results correspond to the average of previously quoted authors.

CONCLUSIONS

1. Fruit mass is an inherited genetic characteristic. The largest fruit mass of selected types of wild apple was recorded with the type 2 (33.65 g) and the least with the type 9 (8.95 g). Regarding the generative rootstock production, wild apple with the least fruit mass is more commercial than the controlled

autochthonous apple varieties. The most commercial ones are: type 9 (8.95 g), type 5 (11.34 g), type 8 (12.75 g) and type 3 (12.81 g).

2. Fruit length and width are biological characteristics that depend on genotype. The longest average fruit length of selected types of wild apple amounts to 38.19 mm (type 6) and the shortest is 22.12 mm (type 9). The widest average fruit width of selected types of wild apple amounts to 42.81 mm (type 2) and the narrowest is 27.78 mm (type 9).

3. Dry seed mass (100 pieces) varied from 2.076g with the type 3 to 3.832g with the type 8 (tab 3). From the aspect of reserve material volume necessary for germination, the best predispositions are attributed to the type 8 (3.832g) and type 6 (3.668g).

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**MORFOLOŠKE OSOBINE PLODA ODABRANIH TIPOVA ŠUMSKE
JABUKE (*MALUS SILVESTRIS* L.) SA PODRUČJA BIJELOG POLJA**

SAŽETAK

Samonikle vrste voćaka predstavljaju značajne prirodne resurse i neiscrpan genofond izuzetno važnih vrsta koje su nedovoljno proučene. Šumska jabuka je najvažnija generativna podloga u svetu. Cilj ovog rada je da se opišu morfološke osobine ploda odabranih tipova šumske jabuke sa područja Bijelog Polja što pored opšte biološkog značaja ima i praktičnu vrednost sa aspekta proizvodnje generativnih podloga. Najmanju masu ploda imaju tip 9 (8,95 g), tip 5 (11.34 g), Tip 8 (12,75 g) i tip 3 (12,81 g). Sa aspekta količine rezervnih materija potrebnih za klijanje odnosno mase semena najbolje osobine ima tip 8 (3.832g) i tip 6 (3.668g).

Ključne riječi: šumska jabuka, masa ploda, dužina ploda, širina ploda, masa semena