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VARIABILITY OF POMOLOGICAL CHARACTERISTICS OF THE ŠUMATOVKA APPLE

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Variability refers to a process by which differences occur among individuals of the same plant species. However, some characteristics change very little, while others, especially quantitative ones, change rather quickly and readily, even when environmental conditions change slightly. This fact has prompted an investigation aimed to establish the variability of pomological characteristics of the Šumatovka cv. apple tree, a rather old and autochthonous cultivar grown widely throughout Eastern Serbia. Its special characteristic is an ability to grow and bear fruit without any particular care and cultivation, and in conditions of especially severe water deficiency and drought. Šumatovka cv. fruits are small- or medium-sized on the average, the length measuring 51.3 ± 6.62 mm (CV 12.9%), width 55.5 ± 6.35 mm (CV 11.4%), pedicel length 19.5 ± 3.2 mm (CV 16.4%) and fruit mass 66.0 ± 20.6 g (CV 31.3%). Total soluble dry matter content of the mesocarp varies between 15.6 and 19.2% (CV 12.31%), total sugars $14.3 \pm 4.7\%$ (CV 32.8%) and total sour substances $0.95 \pm 0.11\%$ (CV 18.6%). Especially examined were the large-sized Šumatovka fruits measuring 72.0 mm in length and width, and 169.4 g in mass.

Key words: apple, Šumatovka, variability, size, mass, quality

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INTRODUCTION

Variability refers to a process by which differences occur among individuals of the same plant species. However, some characteristics change very little, while others, especially quantitative ones, change very quickly and readily, even when environmental conditions change slightly. The fact has prompted an investigation aimed at establishing the variability of pomological characteristics of the Šumatovka cv. apple tree. NIKETIĆ (1950), and STANKOVIĆ and MIŠIĆ (1978) have described it as an old autochthonous cultivar with a long history of cultivation in Serbia. According to MILETIĆ (1997), it is especially frequent across Eastern Serbia. Its chief characteristic is that it grows and bears fruit without any special care and cultivation in an area suffering most severe water deficits and droughts.

The investigation focused on studying the variability of some most important pomological characteristics of Šumatovka cv. under comparatively unfavourable conditions, and possibilities of its revitalization. Many of its characteristics qualify it for a better treatment in terms of maintenance of biodiversity, as well as a gene donor for some desirable breeding characteristics and biologically highly nutrient food suitable for commercial production.

MATERIALS AND METHODS

Twenty-two Šumatovka cv. apple trees were randomly selected in the Timočka krajina region over a wide stretch between Negotin and Knjaževac. The chosen trees grow at different localities and under different conditions. The trees were marked and monitored over the 1998-2002 period. The most important tree characteristics, such as vigour, habit, branching, productivity, and parasite- and pest-related status, were evaluated using the UPOV method. Fruit and kernel sizes were determined by a precision calliper square, while mass was measured on a Mettler precision scale. Total soluble dry matter was determined refractometrically, total sugars by Bertrandt method, total sour substances by neutralization with NaOH. The data presented include average values for the period of investigation. The results were statistically processed, and standard deviation (δx) was calculated, as well as coefficient of variation (CV). The same methodology was applied to characteristics of the tree with large-sized fruits.

RESULTS

Šumatovka trees were found to display different qualities of vigour in relation to all growth-related factors. The tree habit is mostly upright, with medium or intensive branching. The cultivar is characterized by alternating fertility. A year of exceptionally copious yield is normally followed by years of minimal yield or none at all. Fruits have been observed to form on different sides of the crown every other year. On the other hand, in conditions of optimal cultivation and treatment, fertility is stable and high. Consequently, the average results of productivity were unbalanced, low, medium or very high. The cultivar is further characterized by medium or high tolerance to the parasites causing apple scab (*Venturia inaequalis*)

and apple mildew (*Podosphaera leucotricha*). Fruit damage by codling moth (*Carpocapsa pomonella*) was minimal or medium in intensity, which is its special characteristic and value (Table 1).

Table 1. Tree characteristics, productivity and status regarding parasites and pests

No.	Vigour	Habit	Branching	Yield Capacity	Resistance to <i>Podosphaera leucotricha</i>	Resistance to <i>Venturia inaequalis</i>	Resistance to <i>Carpocapsa pomonella</i>
1	Medium (5)	Very upright (1)	Strong (7)	Medium (5)	High resistance (7)	High resistance (7)	High resistance (7)
2	Strong (7)	Upright (3)	Strong (7)	High (7)	High resistance (7)	Medium (5)	High resistance (7)
3	Medium (5)	Upright (3)	Medium (5)	Medium (5)	Medium (5)	High resistance (7)	High resistance (7)
4	Very strong (9)	Spreading (7)	Medium (5)	Medium (5)	High resistance (7)	Medium (5)	High resistance (7)
5	Strong (7)	Very upright (1)	Strong (7)	Very high (9)	High resistance (7)	High resistance (7)	High resistance (7)
6	Weak (3)	Upright (3)	Weak (3)	Medium (5)	High resistance (7)	High resistance (7)	High resistance (7)
7	Strong (7)	Spreading (7)	Strong (7)	High (7)	Medium (5)	Medium (5)	Low resistance (3)
8	Strong (7)	Very upright (1)	Medium (5)	Medium (5)	High resistance (7)	High resistance (7)	High resistance (7)
9	Very weak (1)	Spreading (7)	Weak (3)	Low (3)	High resistance (7)	Medium (5)	High resistance (7)
10	Medium (5)	Upright (3)	Medium (5)	Medium (5)	High resistance (7)	High resistance (7)	High resistance (7)
11	Strong (7)	Upright (3)	Strong (7)	Medium (5)	Medium (5)	High resistance (7)	High resistance (7)
12	Weak (3)	Semi-upright (5)	Weak (3)	High (7)	Medium (5)	High resistance (7)	High resistance (7)
13	Weak (3)	Semi-upright (5)	Weak (3)	Very low (1)	High resistance (7)	High resistance (7)	Medium (5)
14	Very strong (9)	Very upright (1)	Strong (7)	Medium (5)	High resistance (7)	Medium (5)	High resistance (7)
15	Strong (7)	Upright (3)	Medium (5)	High (7)	High resistance (7)	Low resistance (3)	Medium (5)
16	Strong (7)	Very upright (1)	Strong (7)	Very high (9)	Medium (5)	Low resistance (3)	Medium (5)
17	Medium (5)	Upright (3)	Medium (5)	Medium (5)	Medium (5)	High resistance (7)	Medium (5)
18	Weak (3)	Spreading (7)	Medium (5)	Low (3)	High resistance (7)	High resistance (7)	High resistance (7)
19	Very weak (1)	Semi-upright (5)	Weak (3)	Very low (1)	High resistance (7)	Medium (5)	High resistance (7)
20	Medium (5)	Upright (3)	Medium (5)	Medium (5)	High resistance (7)	Medium (5)	High resistance (7)
21	Medium (5)	Upright (3)	Medium (5)	Medium (5)	Medium (5)	High resistance (7)	High resistance (7)
22	Very weak (1)	Upright (3)	Weak (3)	Low (3)	High resistance (7)	High resistance (7)	High resistance (7)

Šumatovka fruits were found to be small or medium in size, 41.6-67.3 mm in length, i.e. 51.3 ± 6.62 mm on the average, with 12.9% coefficient of variance (CV). Fruit width was 44.9-70.1 mm, i.e. 55.5 ± 6.35 mm (CV 11.4%), while pedicel length was 13.0-27.5 mm, or 19.5 ± 3.2 mm (CV 16.4%) on the average. Šumatovka fruit mass in the area of investigation varied widely between 38.7 and 113.4 g, giving an average of 66.0 ± 20.6 g (CV 31.3%) (Table 2).

Table 2. Variability of pomological characteristics of Šumatovka fruits

No.	Fruit length (mm)	Fruit width (mm)	Pedicel length (mm)	Fruit mass (g)	Dry matter (%)	Total sugar (%)	Total sour substance (%)
1	45.3	49.8	21.1	45.1	14.0	12.2	0.50
2	46.0	50.2	22.3	45.0	14.0	11.9	0.53
3	47.7	51.9	18.1	54.8	18.0	17.2	0.77
4	46.2	51.3	16.1	54.5	18.0	16.9	0.79
5	41.6	44.9	21.7	38.7	16.0	14.5	0.60
6	50.0	54.2	23.0	59.2	17.0	16.0	0.65
7	45.8	49.7	20.1	53.6	14.0	12.4	0.54
8	54.5	58.0	18.6	76.7	14.0	11.7	0.51
9	56.0	59.2	13.7	79.8	18.0	17.0	0.74
10	55.4	60.0	17.4	80.2	13.0	11.5	0.44
11	48.0	53.3	17.6	58.5	17.0	16.0	0.68
12	54.3	57.4	20.7	57.7	10.0	8.5	0.32
13	67.3	70.1	27.5	113.4	16.5	15.3	0.63
14	50.6	55.0	18.7	63.9	14.5	13.2	0.55
15	54.3	58.7	20.2	80.0	16.0	14.9	0.58
16	42.7	46.9	18.1	42.8	17.0	15.8	0.65
17	62.0	65.6	23.0	98.0	14.0	12.2	0.44
18	48.5	52.8	21.7	54.0	16.5	15.2	0.63
19	57.1	62.6	21.0	87.7	16.5	15.5	0.63
20	61.3	65.3	13.0	103.4	16.5	15.7	0.60
21	43.1	48.7	16.2	41.0	16.5	15.3	0.61
22	51.1	55.4	19.2	64.0	16.2	15.7	0.59
X	51.3	55.5	19.5	66.0	15.6	14.3	0.59
Δx	± 6.62	± 6.35	± 3.19	± 20.63	± 1.92	± 2.2	± 0.11
CV	12.9	11.4	16.4	31.3	12.3	15.4	18.6

The table shows some basic elements of fruit quality. Dry matter content varied widely between 10.0 and 18.0%, the average being $15.6 \pm 1.92\%$ (CV 12.31%). According to criteria proposed by NENADOVIĆ-MRATINIĆ and VULIĆ (1982), only one sample was found to have low content (9-12%), while seven had medium (13-15%) and 14 high contents (> 15%) of dry matter. Similar ratios were found also regarding total sugar contents. The lowest total sugar content found in the analysed samples was 8.5% while the highest was 17.2%, i.e. $14.3 \pm 2.2\%$ on the average (CV 15.4%). High variability was also found for total sour substance contents. The lowest was 0.32%, and the highest 0.79%, with an average for all samples of $0.59 \pm 0.11\%$ (CV 18.6%). According to the same criteria, no low (0.0-0.3%)

or very high (> 0,9%) contents of total sour substances were found in the analysed samples, which is the cultivar's special characteristic. Most samples (12) had medium contents (0.3-0.6%), while a lower number (10) had high contents of total sour substances (0.6-0.9%).

A Šumatovka tree displaying characteristics different from all others was found in the area of investigation. The tree is vigorous, very upright, medium branched and has high and stable yield. It showed high tolerance to parasites and pests. Its fruits are large, round shaped and 72.0 mm in length and width. The shape diverts from Šumatovka's standard fruit shape, which is typically elongated. Besides, fruit mass is high, 169.4 g on the average, while some of them exceed 200.0 g. Mesocarp contains 14.0% dry matter, 12.8% total sugars and 0.55% total sour substances.

DISCUSSION

Variability refers to a process by which differences develop between individuals of the same biological species. Variability may be uninherited (modified or ecological) or inherited (genetic). Some characteristics change very little, even in cases when individuals are grown under conditions different from those in which their offspring is growing (e.g. flower and fruit colours), while on the other hand there are a number of characteristics, especially quantitative, that change fast and readily even under slight changes of environmental factors (fruit size and mass, vigour, etc.). In the light of these facts, it is evident that variability of the randomly selected samples depended on the characteristics of each Šumatovka apple tree, as well as on agroecological conditions and cultivation practices applied. This primarily refers to soil type, altitude and aspect, but equally to the applied agricultural and pomological practices. Soil cultivation and maintenance systems are not uniform in all cases, and the same applies to pruning, disease and pest protection methods, and particularly to nutrition. Timočka krajina suffers extreme droughts, which additionally affects the characteristics and quality of fruits. All of these facts influence the pomological characteristics of Šumatovka fruits.

As the cultivation of Šumatovka is predominantly extensive in nature, its pomological characteristics, particularly fruits, vary across different regions. NIKETIĆ (1950) had described the Šumatovka tree as vigorous, with branches inclined to vertical growth, and with small fruits (15 to 20 to a kilo), i.e. 66.6-50.0 g per fruit. According to ADAMIĆ (1963), the cultivar is characterized by medium large to large fruits, 70-75 mm in height, 75-80 in width, and 80 g in mass. On the other hand, STANČEVIĆ (1987) said its fruits were medium in size, with 90-100 g mass and a cylindrical egg-like shape. The cultivar was described as tolerant to drought, frost and apple scab. MRATINIĆ-NENADOVIĆ and VULIĆ (1988) described Šumatovka fruits growing at different localities as having 62.08 and 110.23 g mass, 17.10% and 18.90% dry matter content, and 0.64% and 0.88% total sour substances, respectively. All of these data well illustrate the cultivar's characteristics and indicate their marked variability. In the area of investigation, which is

characterised by particularly unfavourable agroecological conditions for apple growth, this variability is especially pronounced.

Autochthonous apple cultivars, such as Šumatovka, are economically less important than some other more recently developed cultivars. The importance, however, lies in the preservation of germ plasm and biodiversity. The cultivar deserves to be considered for breeding projects and in the production of biologically highly nutrient food as one of its characteristics, according to OGNJANOV *et al.* (1998) is a marked tolerance to parasites and pests. Another important feature is its centuries-long cultivation in the area which is increasingly suffering from deficiency in precipitation, a fact especially emphasized by STANČEVIĆ (1987). The available precipitation and the extensive method of cultivation fall short of covering the minimum water requirements. Nevertheless, Šumatovka has survived in this area and bears fruit, which adds to its value.

Especially important is the selected tree with large-sized fruits. Reports by NIKETIĆ (1950), as well as MRATINIĆ-NENADOVIĆ and VULIĆ (1988) consider it a different cultivar, a so-called Large-Sized Šumatovka. In contrast to their results, however, the tree described in this investigation had larger fruits with greater mass. Its economic and biological characteristics deserve more attention as it is suitable for cultivation in organised stands under the principles of integrated and biological production of highly nutrient food.

CONCLUSIONS

The autochthonous apple cultivar Šumatovka, grown in the region of Timočka krajina, shows pronounced variability regarding morphological properties and productivity, particularly size, mass and chemical composition of fruits.

According to all growth factors, the trees were found to have low to extreme vigour, upright growth and medium to high branching. The cultivar is characterised by alternating fertility, which results in unstable yield capacity varying between low and very high. The cultivar is characterised by medium to high tolerance to the parasites causing apple scab (*Venturia inaequalis*) and apple mildew (*Podospheara leucotricha*). Fruit damage by codling moth (*Carpocapsa pomonella*) showed minimum or medium intensity.

Šumatovka fruits are small or medium-sized on the average, 51.3 ± 6.62 mm in length (CV 12.9%), 55.5 ± 6.35 mm (CV 11.4%) in width, with 19.5 ± 3.2 mm pedicel length (CV 16.4%) and 66.0 ± 20.6 g fruit mass (CV 31.3%). Total soluble dry matter content in the mesocarp is $15.6 \pm 1.92\%$ (CV 12.31%), total sugars $14.3 \pm 2.2\%$ (CV 15.4%) and total sour substances $0.59 \pm 0.11\%$ (CV 18.6%).

The large-fruit Šumatovka tree is vigorous, very upright in growth, medium branched, with high yield capacity and tolerant to diseases and pests. Fruits are medium-sized or large, with an average mass of 169.4 g. Some fruits weigh over 200.0 g. It is characterised by favourable content of dry matter (14.0%), total sugars (12.8%) and total sour substances (0.55%). The cultivar is suitable for growing in organised stands according to principles of integrated and biological production of highly nutrient food.

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VARIJABILNOST POMOLOŠKIH OSOBINA ŠUMATOVKE

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Izvod

Autohtona sorta jabuke Šumatovka na području Timočke krajine pokazuje izraženu varijabilnost u pogledu morfoloških osobina stabla i produktivnosti, a posebno u pogledu krupnoće, mase i hemijskog sastava plodova. U zavisnosti od svih činilaca uspevanja stabla su slabe do ekstremne bujnosti, uspravnog porasta sa srednjim ili jakim razgranavanjem. Za ovu sortu karakteristična je alternativna rodnost te je produktivnost neujednačena od niske do veoma visoke. Za ovu sortu karakteristična je srednja ili visoka tolerantnost prema parazitu izazivaču bolesti čađave krastavosti (*Venturia inaequalis*) i pepelnice jabuke (*Podospheara leucotricha*). Oštećenja plodova od jabukinog smotavca (*Carpocapsapomonella*) su minimalna ili srednjeg intenziteta. Plodovi Šumatovke su u proseku sitni ili srednje krupnoće sa dužinom od 51.3 ± 6.62 mm (CV 12.9%), širinom od 55.5 ± 6.35 mm (CV 11.4%), dužinom peteljke 19.5 ± 3.2 mm (CV 16.4%) i masom plodova od 66.0 ± 20.6 g (CV 31.3%). Sadržaj ukupno rastvorljivih suvih materija u mezokarpu je $15.6 \pm 1.92\%$ (CV 12.31%), ukupnih šećera $14.3 \pm 2.2\%$ (CV 15.4%) i ukupnih kiselina $0.59 \pm 0.11\%$ (CV 18.6%). Stablo Šumatovke krupnih plodova je bujno, veoma uspravnog porasta, srednje razgranato, visokog prinosa i otpornosti prema bolestima i štetočinama. Plodovi su srednje krupni ili krupni sa prosečnom masom od 169.4 g. Pojedini plodovi su sa masom od preko 200.0 g. Odlikuje se i povoljnim sadržajem suvih materija (14.0%), ukupnih šećera (12.8%) i ukupnih kiselina (0.55%). Pogodna je za gajenje u organizovanim zasadima po principima integralne i biološke proizvodnje visokovredne hrane.

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