PRODUCTION AND ECONOMIC CHARACTERISTICS OF SOUR CHERRY CULTIVATION IN THE REPUBLIC OF SERBIA[1]

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Abstract

Fruit production is very important for the overall development of agriculture, where cherries, have become a very popular fruit species especially in recent years. For Serbia, cherries represent not only an important export product, but also a symbol of quality and a long production tradition.

The paper analyzes the production of sour cherries in the Republic of Serbia in the period 2014-2023. Research focuses annual changes in areas under sour cherries in Serbia by regions, different statistical indicators of sour cherries production, or achieved yields. Observing the average values for the examined period, it was shown that Serbia is ranked as the sixth worldwide, towards to level of sour cherry production (128,712 t), while participates in global production with 9.04% (period 2013-2022., in line to FAO data). In average, areas under sour cherry trees in Serbia for the observed period 2014-2023., amounted around 18,240 ha. The average production for the same period was 125,214 t, while the average yield was 6.8 t/ha (period 2014-2023., in line to SORS data). The key factors for the improvement of sour cherry production are state subsidies for plantations establishment, credit support to agricultural farms, as well as the readiness of agricultural producers to advance current production and introduce modern and innovative technologies into production.

Key words: Sour cherry, production, yield, economic indicators, Serbia.

JEL[5]: Q10, Q13, Q19

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Introduction

Fruit growing represents significant sector of agriculture in the Republic of Serbia, while the most significant fruit species are plums, apples, and sour cherries, both due to production area with native trees, or due to total production achieved (Milić et al., 2011; Kljajić et al., 2022; Kljajić et al., 2023; Korićanac et al., 2023; Sredojević et al., 2024).

Sour cherry (*Prunus cerasus L.*) originates from Europe (it was spreading out the territory between Caspian Sea and Istanbul), while it represents one of the most valued fruits among consumers (Vukoje et al., 2013; Casedas et al., 2016; Vasylyshyna, 2018). In practice, many calls it a sour the cherry (Wang et al., 2021). There is assumed that sour cherry was created by spontaneous, or natural hybridization between steppe cherry (*Prunus fruticosa L.*) and wild cherry (*Prunus avium L.*), (Radičević et al., 2012).

Sour cherry is characterized by simple cultivation. It is extremely resistant to low temperatures and can be successfully grown at higher altitudes, up to 1,500 m. Tillage and land cultivation is simple. Cherry trees come into fruit yielding very quickly, while pruning is not so complicated. Consequently, a large number of protective treatments with pesticides are not required during the production process. This is in favor to its resistance to many diseases and pests, where all previously mentioned give sour cherry a certain advantage compared to other fruits (Nenadović Mratinić et al., 2006; Milić et al., 2016).

The color of sour cherry fruit is red to dark red, juicy and sour. It is rich in carbohydrates, organic acids, while it also contains pectin, proteins, tannins and various vitamins, as well as other important nutrients. As a high-quality fruit, sour cherries have significant nutritional, dietary, medicinal and technological value (Janković et al., 2013; Savić et al, 2017). Sour cherries are mostly processed (as a raw material in the confectionery industry, in alcoholic beverages, such as brandy and liqueur, dairy products, such as fruit yogurt, etc., pharmaceuticals, energy generating, etc.), while rarely they are consumed as fresh (Radosavljević, 2008; Yaman, 2022). Sour cherry processing leaves certain volume of by-products (pomace and pits), for which there has been great interest in recent years. Sour cherry pomace has a high content of phenolic compounds, while the pit contains oil that has antioxidant, antimicrobial and anti-inflammatory properties, having the beneficial effect on human health (Yilmaz et al., 2019). Besides, sour cherry blossoming has a significant impact on honey production (Bukovics et al., 2003).

The most represented sour cherry varieties in Serbia are Oblačinska, with the highest share in overall number of sour cherry trees, and Cigančica, with a much smaller share. Oblačinska variety, dominantly grown in the southeastern part of Serbia, involves a mixture of numerous genotypes thanks to its cultivation in different agro-ecological circumstances, as well as the application of both vegetative and generative propagation methods (Radičević et al., 2012; Narandžić, Ljubojevic, 2022). Other existing sour cherry varieties in Serbia that belong to group of cherries with larger size of fruits are Heimanns Konservenveichsel, Rekelle, Šumadinka, and Schattenmorelle. The varieties Schattenmorelle and Heimanns Konservenveichsel have been also grown in several countries worldwide, as the highly valued varieties (Janković et al., 2013; Radičević et al., 2018; Blando, Oomah, 2019).

Sour cherries are represented in the following fruit-growing regions of Serbia: Subotica-Horgoš, Fruška gora, South Banat, Danube region, Timočka krajina, Šumadija, Rasina region, South Morava, and Kosovo and Metohija (Jeločnik et al., 2021). There are favorable agro-ecological conditions for the production of cherries in Serbia, but also good prospects for their export (Sredojević et al., 2011, Keserović et al, 2016).

The main goal of the paper is to analyze sour cherry production with its annual variations within the territory of the Republic of Serbia, further exposing the support tendencies and production advancement needed to better ranking of Serbian sour cherry at international market.

Material and Methods

The main research method used was desk-research method. Observed period was 2014-2023[6]. Databases of the Statistical Office of the Republic of Serbia (SORS) and the Food and Agriculture Organization of the United Nations (FAO) were used to obtain analyzed statistical data. Publications that are also served as data sources were Statistical yearbooks and bulletins for the observed years or certain months, as well as annual market reports of the Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia (MAFWM) for cherries. Statistical indicators for sour cherry production in Serbia are given through the area under cherry plantations (in ha), total production (in t), and obtained yield (in t/ha). The research was also based on statistical and computational methods. Standard indicators of descriptive

6 Mentioned period does not refer to observation of sour cherry production worldwide, or to global ranking of Serbia as the sour cherry producers, where the observation period is 2013-2022., as there is lack of data at the time of research for 2023. Same period of research is also applied to observation of purchase prices of cherries.

statistics, such are average, standard deviation, or coefficient of variation, were used for the analysis of production, while the data interpretation is done through adequate tables and graphs. Extensive literature review included scientific and professional papers (domestic and foreign) that target similar or same topic as is the subject of performed research.

Research Results and Discussion

Sour cherry production in the world

Average world sour cherry production for the period 2013-2022. was 1,423,838 tons. The largest production was realized in Russian Federation, Ukraine, or Turkey. Serbia is ranked as the sixth on the list of world producers with an average annual production of 128,712 t, representing the 9.04% of the global cherry production (Table 1.).

Table 1. Average production, achieved yields and share of leading sour cherry producers worldwide (period 2013-2022., in t)

Production (t)		Participation in production (%)	Yield (t/ha)
World (total)	**1,423,838**	**100.00**	
Russian Federation	230,250	16.17	5.88
Ukraine	184,006	12.92	9.31
Turkey	183,625	12.90	8.68
Poland	166,900	11.72	5.87
Serbia	128,712	9.04	7.08
USA	115,197	8.09	8.11
Iran	99,178	6.97	4.90
Hungary	71,651	5.03	5.38
Other countries	244,319	17.16	-

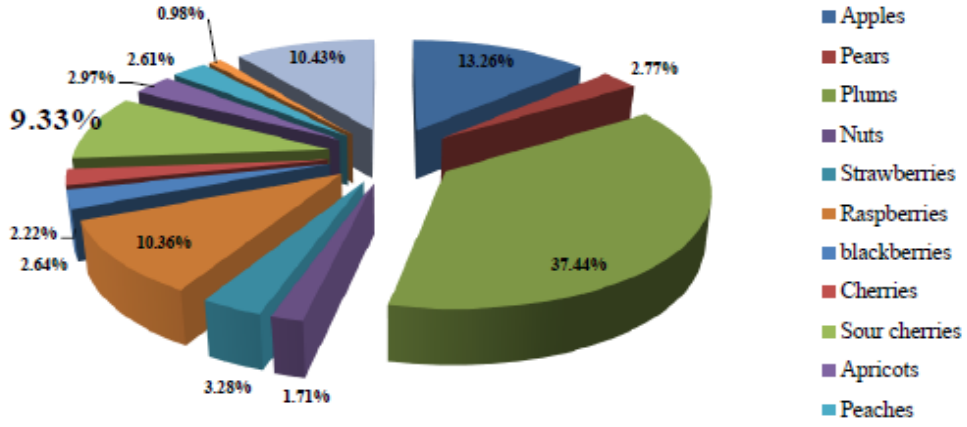
Source: Authors' calculations according to FAO, 2024.

The highest average yield is achieved in Ukraine (9.31 t/ha), followed by Turkey (8.68 t/ha), and USA (8.11 t/ha). The average yield of sour cherries in Serbia is 7.08 t/ha, what is far from the possible genetic potential of this fruit species (15 to 20 t/ha).

Sour cherry production in the Republic of Serbia

Out the twelve-fruit species whose production is monitored by SORS, sour cherries are ranked as the fifth in terms of volume of production. They participate with 9.33% in total fruit production in Serbia (Chart 1.).

Chart 1. Average prevalence of sour cherries and other fruits in Serbia (period 2014-2023., in %)



Source: Authors' calculation according to SORS, 2024.

Based on available SORS data for observed period, the average area under sour cherry plantations in Serbia was 18,240 ha. The largest area, 19,875 ha was harvested in 2022., while the lowest was harvested in 2014., 15,405 ha.

Table 2. Yearly changes in areas under sour cherries in Serbia by regions (period 2014-2023., in ha)

Year	Serbia North		Serbia South		Republic of Serbia (total)	Base index (2014=100)
	Belgrade region	Region of Vojvodina	Šumadija region and West Serbia	Region South and East Serbia		
2014.	744	1,319	2,993	10,349	15,405	100.00
2015.	794	1,385	3,142	10,713	16,034	104.08
2016.	881	1,486	3,273	11,157	16,797	109.04
2017.	986	1,629	3,426	11,525	17,566	114.03
2018.	1,104	2,049	3,637	12,051	18,841	122.30
2019.	1,170	2,034	3,683	12,227	19,114	124.08
2020.	1,204	2,079	3,815	12,503	19,601	127.24
2021.	1,194	2,019	3,804	12,534	19,551	126.91
2022.	1,233	2,112	3,865	12,665	19,875	129.02
2023.	1,245	2,042	3,806	12,521	19,614	127.32
Arithmetic mean	1,056	1,815	3,544	11,825	18,240	-
Standard deviation	180.22	304.55	298.88	794.76	1,571.54	
Coefficient of variation (%)	17.07	16.78	8.43	6.72	8.62	
Participation structure (%)	5.79	9.95	19.43	64.83	100.00	

Source: SORS, 2024. (Statistical yearbooks 2014-2023.).

Defining 2014. as the base for the trends in areas under sour cherry plantations, it can be seen that the areas have been slightly increased until 2022., while in 2023. there came to slight decrease. Observing the growing area by regions, the largest plantations under sour cherry are concentrated in South and Eastern Serbia regions, in average 11,825 ha, with share of 64.83%, while the smallest areas under cherry plantations are in Belgrade region, around 1,056 ha, with share of 5.79%. The coefficient of variation is the most pronounced in Belgrade region (17.07%), while it is the least pronounced in the South and Eastern Serbia region (6.72%), (Table 2.).

The average production of sour cherries in Serbia in researched period was 125,214 t. The highest production was achieved in 2020. (165,738 t), while the lowest was in 2017. (91,660 t). The largest production occurs in Southern and Eastern Serbia, with the share in total production of 67.71%, while the smallest production was realized in Belgrade region, with a participation of 6.14%. In same time, the region of Vojvodina participates with 8.69%, while the region of Šumadija and Western Serbia participate with 17.46% in overall cherry production. There are certain annual variations in overall production. The coefficient of variation ranges from 15.18% (for Belgrade region) to 29.06% (for region of Southern and Eastern Serbia), what could be seen in Table 3.

Table 3. Statistical indicators of sour cherries' production in Serbia by regions (period 2014-2023., in t)

Year	Serbia North		Serbia South		Republic of Serbia (total)	Base index (2014=100)
	Belgrade region	Region of Vojvodina	Šumadija region and West Serbia	Region South and East Serbia		
2014.	5,718	11,933	19,737	66,016	103,404	100.00
2015.	6,641	11,541	19,957	67,010	105,150	101.69
2016.	6,949	11,396	17,439	60,986	96,769	93.58
2017.	7,214	10,903	17,085	56,457	91,660	88.64
2018.	8,811	15,527	24,408	79,277	128,023	123.81
2019.	6,570	10,559	16,549	63,287	96,965	629.44
2020.	9,341	7,929	26,877	121,592	165,738	160.28
2021.	8,516	7,344	25,775	113,502	155,137	150.03
2022.	9,023	11,126	27,163	117,134	164,446	159.03
2023.	8,066	10,563	23,666	102,554	144,849	140.08
Arithmetic mean	7685	10882	21866	84782	125,214	
Standard deviation	1,166.27	2,118.56	3,963.00	24,639.83	28,427.78	
Coefficient of variation (%)	15.18	19.47	18.12	29.06	22.70	-
Participation structure (%)	6.14	8.69	17.46	67.71	100.00	

Source: SORS, 2024. (Statistical yearbooks, 2014-2023.).

The average yield of sour cherries in Serbia for the observed period was 6.8 t/ha. The highest yield was gained in 2020., 8.5 t/ha, while the lowest yield was gained in 2019., 5.1 t/ha. The coefficient of variation ranges from 10.53% to 28.68%, leading to conclusion that the variability of sour cherry yields is relatively weak (Table 4.).

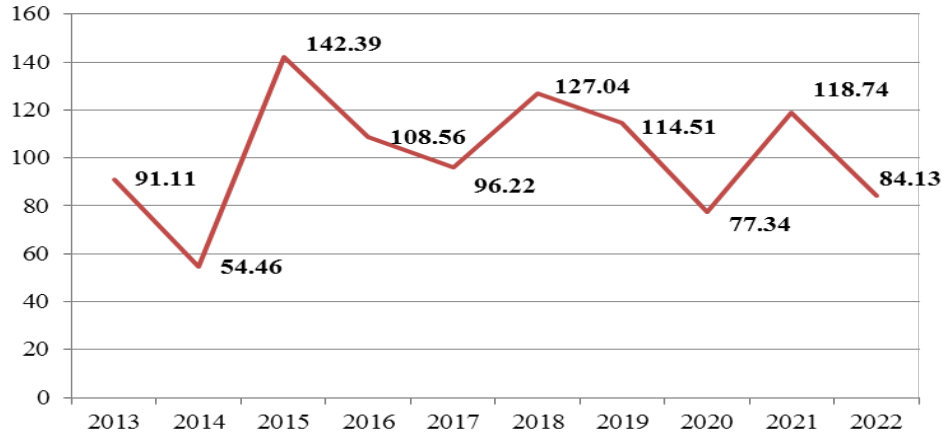
Table 4. Statistical indicators of sour cherries' yield in Serbia by region (period 2014-2023., in t/ha)

Year	Serbia North		Serbia South		Republic of Serbia (total)	Base index (2014=100)
	Belgrade region	Region of Vojvodina	Šumadija region and West Serbia	Region South and East Serbia		
2014.	7.7	9.0	6.6	6.4	6.7	100.00
2015.	8.4	8.3	6.4	6.3	6.6	98.51
2016.	7.9	7.7	5.3	5.5	5.8	86.57
2017.	7.3	6.7	5.0	4.9	5.2	77.61
2018.	8.0	7.6	6.7	6.6	6.8	101.49
2019.	5.6	5.2	4.5	5.2	5.1	76.12
2020.	7.8	3.8	7.0	9.7	8.5	126.87
2021.	7.1	3.6	6.8	9.1	7.9	117.91
2022.	7.3	5.3	7.0	9.2	8.3	123.88
2023.	6.5	5.2	6.2	8.2	7.4	110.45
Arithmetic mean	7.4	6.2	6.2	7.1	6.8	-
Standard deviation	0.77	1.79	0.85	1.70	1.15	
Coefficient of variation (%)	10.53	28.68	13.80	23.86	16.82	

Source: SORS, 2024. (Statistical yearbooks, 2014-2023.).

The purchase price of sour cherries is mainly determined by the unstable market of agricultural products at national level.

Chart 2. Purchase prices of sour cherries (period 2013-2022., in RSD/kg)



Source: MAFWM, 2024.

The largest quantities of purchased sour cherries are stored in cold storage, while later exported. Very small quantities are used fresh (for consumption, or sale at the markets). Purchase prices of sour cherries for the period 2013-2022. are shown in Chart 2. The average purchase price for the observed period is 100.00 RSD/kg, with the highest value achieved in 2018. (127.04 RSD/kg). In contrast, the lowest price was in 2014., only 54.46 RSD/kg.

Issues and measures towards improvement of sour cherry production in Serbia

As the main problems in the production of sour cherries, as well as in their marketing in Serbia, next could be singled out:

- fragmentation of plots under sour cherry plantations;
- extensive production;
- use of outdated machinery and technology;
- lack of irrigation system and anti-hail nets;
- rather high investments in the revitalization of old, than in raising new plantations;
- the lack of sufficient associations of sour cherry producers or agricultural cooperatives, leads to that producers act on the market independently and without connection with other producers;
- low and uncertainty in repurchase price and unregulated national market;
- only first-class fruits have guaranteed placement;
- lack of pickers (labor issues) during the pick of harvest season;
- the absence of a common strategy for the export of sour cherries to foreign markets, etc.

As the measure to improve sour cherry production, it is necessary to introduce new, modern technology into the production process in order to reduce costs. Producers must join together in order to provide mechanization for common picking, which would save the time and reduce the number of pickers. The associated producers would more easily provide irrigation systems, and further increase the yields. As was retained, producers can apply to the Ministry of Agriculture for funds intended for underdeveloped areas for the purchase of cold storages. This is important in order to decrease the impact of monopolists (certain wholesalers and processors).

The renewal of cooperatives is an opportunity for small scale producers to self-organize and establish control over the produced output. Joint performance after joining their production capacities is a chance to sustain the monopoly of large producers and extremely demanding market. Besides, it is so important to protect the Oblačinska sour cherry as the Serbian brand, which can be achieved by unifying the quality of produced sour cherries throughout Serbia.

Among the most important measures due to improvement sour cherry production within the national fruit production provided by the MAFWM, next could be underlined: incentives for establishment of new plantations through reimbursement of costs of purchased seedlings, support for chemical analysis of soil with recommendation how to fertilize, i.e. examination of the soil mechanical composition, as well as preparation and treatment of the soil, etc.

Conclusion

Sour cherry is one of the most significant fruit species in Serbia. It has great importance for population in rural areas, where the growing of sour cherries represents the main source of income for many families. Growth in production volume and exports can ensure a better living standard for many family farms engaged in mentioned production. On the other hand, given that Serbia is one of the main exporters of sour cherries to Europe, its production can significantly contribute to further strengthening of national agriculture and overall economy, as well as increasing the competitiveness of Serbian agriculture on the international market.

Serbia is ranked as the sixth among world producers of sour cherry, having a share in global production of 9.04%. At national level, sour cherries participate with 9.33% in total fruit production. The average production of 125,214 t is realized, in average on 18,240 ha under sour cherry plantations, while the realized production was being the highest in the Šumadija and Western Serbia region, or the lowest in the Belgrade region. On other hand, the highest yield was achieved in Belgrade region (7.4 t/ha). In average, the annual yield has been reaching around 6.8 t/ha, which is far below the yield that can be theoretically achieved. The coefficient of variation towards the production areas, volume of production and obtained yields is relatively small, meaning that production is currently stable, but needs to be improved and increased. In observed period, sour cherries were purchased at average price of 100.00 RSD/kg, reflecting the relatively lower prices, while describing the market generally uncertain and unstable.

The key factor for advancement of sour cherry production is its modernization in terms of introducing the new and innovative technologies, together with strong market focus. To fight for market position that is becoming increasingly demanding due to products' safety and quality, usually involves going in direction of modern trends in fruit growing development. Therefore, it is necessary to invest in modern technology with the application of EU standards. Besides, it is necessary to unite small scale producers with the provision of financial and institutional support, then to promote sour cherry products, as well as to enable joint exit to the (inter)national market.

State support, primarily through the Ministry of Agriculture plays a significant role towards previously mentioned activities. In line to above mentioned, further research steps will be focused to innovative technologies occurred in sour cherry production in those regions in Serbia where it is intensively grown.

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