

Production-economic indicators of plum growing in the Republic of Serbia

Производно-економски показатељи узгоја шљиве у Републици Србији

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Abstract

Purpose: The aim of this paper is to analyze the trend of plum production in the Republic of Serbia in the period from 2014 to 2023, with a special focus on the dynamics of planted areas, total yield and yield per unit area. These parameters show the development of fruit growing and its economic importance for agriculture.

Methodology: the approach includes the analysis of official statistics and the application of comparative analysis to identify production trends in the plum sector, both at the national and global levels.

Findings: The research results indicate that the Republic of Serbia, with an average annual plum production of 441,420 tons, is positioned as the third largest producer globally, with a share of 3.86% in total world production. Within the structure of Serbian fruit production, plum occupies a dominant position - it is represented on 37.44% of the total area under fruit (behind apple as the leading fruit species in terms of production volume), while its share in total fruit production is 29.23%.

Originality/value: This paper contributes to a better understanding of plum production dynamics and its position in international competition, the identification of key factors influencing production outcomes, as well as proposals for measures to improve fruit production in Serbia.

Practical implications: It is relevant for experts, decision-makers, and producers in planning and developing the sector. From an economic perspective, it provides indicators for assessing the success and potential of plum production as a basis for long-term strategies.

Limitations: A limitation of this research is that it is based primarily on available official statistical data, without a more in-depth analysis of local specificities and individual production practices.

Keywords: Plum, production, yield, economic indicators, the measures to improve plum production.

JEL classification: Q100, Q110

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Сажетак

Циљ: Циљ овог рада је анализа кретања производње шљиве у Републици Србији у периоду од 2014. до 2023. године, са посебним освртом на динамику површина под засадима, укупан принос и принос по јединици површине. Ови параметри показују развој воћарства и његов економски значај за пољопривреду.

Методологија обухвата анализу званичних статистичких извора и примену компаративне анализе ради идентификације производних трендова у сектору шљиве, како на националном, тако и на глобалном нивоу.

Резултати: Резултати истраживања указују на то да се Република Србија, са просечном годишњом производњом шљиве од 441.420 тона, позиционира као трећи највећи произвођач на глобалном нивоу, са учешћем од 3,86% у укупној светској производњи. У оквиру структуре воћарства Србије, шљива заузима доминантну позицију – заступљена је на 37,44% укупних површина под воћем (иза јабуке као водеће воћне врсте по обиму производње), док њено учешће у укупној производњи воћа износи 29,23%.

Оригиналност/вредност: Овај рад доприноси бољем разумевању динамике производње шљива и њеног положаја у међународној конкуренцији, идентификацији кључних фактора који утичу на резултате производње, као и предлаже мера за унапређење воћарске производње у Србији.

Практична примена: Релевантан је за стручњаке, доносиоце одлука и произвођаче у планирању и развоју сектора. У економском смислу, пружа показатеље за оцену успешности и потенцијала производње шљива, као основу за дугорочне стратегије.

Ограничења истраживања: Ограничење овог истраживања огледа се у томе што је засновано првенствено на доступним званичним статистичким подацима, без дубље разраде локалних специфичности и индивидуалних произвођачких пракси.

Кључне речи: Шљива, производња, принос, економски индикатори, мере за унапређење производње шљиве

ЈЕЛ класификација: Q100, Q110

Introduction

The importance of the agricultural sector in the Republic of Serbia is commonly measured by indicators such as the sector's share in GDP, employment in agriculture, the gross value of agricultural production, and the value of agricultural exports. According to these indicators, agriculture represents a significant part of Serbia's economy, directly contributing about 6.5% to the GDP (Ševkušić et al, 2024). However, agriculture becomes far more significant when related activities are included. Compared to other countries in the Western Balkans, these indicators provide a clear insight into the relative importance of this sector and its role in the national economy (Dimitrijević et al, 2023). Fruit farming is a very important part of agriculture, with plum production holding a prominent place as one of the major branches. Fruit growing is an important branch of agriculture in the Republic of Serbia. Areas planted with orchards account for 5.2% of the total agricultural land in Serbia (Sredojević et al, 2024).

The subject of this paper is a detailed analysis of the production and economic indicators of plum cultivation in the Republic of Serbia during the period from 2014 to 2023. The aim is to identify key trends and factors affecting the productivity and economic sustainability of plum production through systematic collection and processing of relevant statistical data, as well as critical analysis of the literature. Furthermore, the paper seeks to evaluate the position and significance of this fruit crop within the national agricultural sector, with particular emphasis on its export potential and opportunities for improving

competitiveness in both domestic and international markets. The analysis of production and economic indicators enables a better understanding of trends in production, challenges, and sector potential, which is of crucial importance for making informed decisions in agricultural policy and planning. In a time of intense global competition, improving productivity and competitiveness in plum production contributes to sustainable development and increased economic stability for domestic producers. This paper provides a foundation for creating strategies that will support the development of this important agro-economic sector.

The structure of the paper is as follows: Section 1 provides a review of the relevant literature. Section 2 presents the data and research methodology. Section 3 discusses the results and provides an analysis. Finally, the paper concludes with key findings and offers recommendations for future research.

1. Literature Review

Plums represent a botanically diverse group of stone fruits, comprising up to 40 different species originating from Europe, Asia, and the Americas. The most commercially important species are the hexaploid European plum (*Prunus domestica*) and the diploid Japanese plums (*Prunus salicina* and *Prunus simonii*), all belonging to the genus *Prunus* within the family *Rosaceae* (Antanyiene et al, 2025). Plums have been cultivated worldwide for over 2,500 years (Duralija, 2002), and more than 6,000 cultivars are currently known (Milošević et al., 2021). The European plum (*Prunus domestica* L.), as the most significant species, was historically confined to Europe and Western Asia, but today it is grown globally due to its adaptability to various soil types and climatic conditions (Dimitrijević et al., 2022; Grujić & Nedeljković, 2023; Gazdić et al., 2024).

Stone fruits make up more than two thirds of fruit plantations in Serbia, and plums are the most dominant one (Milić et al, 2018). As the most important fruit species in Serbia (Matković, 2015; Subić et al, 2021), plums have a significant economic impact. Additionally, there is a long tradition and favorable agro-ecological conditions for the production of the plum in Serbia, making it an important national fruit (Keserović et al, 2017). When it comes to growing conditions, plums are well-suited to temperate-continental climate, and very adaptable to different climatic conditions. Plums can be grown at altitudes ranging from 200 m to 1,250 m, as well as on soils of different types (Tomić et al, 2006). However, it thrives best on terrains at an altitude of 200 m to 750 m and on deep, permeable soils, of easier mechanical composition, rich in phosphorus, potassium and humus, with a pH value in the range from 6.0 to 7.5.

Plum fruits have a refreshing, diuretic, energetic and anti-infective effect (Maglakelidze et al, 2017). They are rich in carbohydrates, organic acids, various minerals, vitamins and phenolic compounds (Molnar et al, 2016). Provitamin A and vitamins B and C are more significant vitamins found in plums (Blagojević and Božić, 2012). According to the authors Maglakelidze et al, 2017, plum has a higher vitamin content than pear, cherry, strawberry, raspberry, and apple, but lower energy value than grapes and cherries.

In villages, plums are used fresh and in the form of various products (dried plums, plum juice, compote, jam, brandy, etc.). In terms of nutritional value, the dried plum is the most important plum product (Mihailović, 2006; Kandić et al, 2007; Zlatanović 2017; Milatović et al, 2018; Nedeljković et al, 2024). About 65% of plums are used to manufacture plum brandy, 21% of plums are processed, 8% are used fresh, and only 2% are used for making plum jam (Lukač-Bulatović et al, 2017; Glišić et al., 2018). In Serbia, the most important plum varieties are Stanley, "Čačak beauty" and "Čačanska rodna", which represent about 65% of the production (Milošević et al, 2017). Many factors affect the economics of plum production, including key factors such as variety, microclimate parameters, agro-technical measures, production costs, and market prices, that should be optimized (Prodanović et al, 2017).

Although Serbian agricultural producers face strong competition, they have the ability to enter foreign markets, where higher-quality and more competitive products are needed. It is necessary to strengthen the sector's competitiveness through resource conservation, revitalization of cooperatives, and support for small farms (Aničić et al, 2025). The cost of establishing an orchard depends on numerous factors, including the area, type of plantation, cultivation system, variety, rootstock, and investment dynamics. The cultivation value of the orchard represents its initial value and serves as the basis for depreciation, which varies depending on the type of fruit crop and cultivation system. Estimating the value based on the total establishment costs is of great importance, especially in market-oriented operations (Lukač-Bulatović et al, 2024).

2. Data and Methodology

The research in the paper refers to the period 2014-2023. The databases of the Statistical Office of the Republic of Serbia (SORS) and the Food and Agriculture Organization of the United Nation (FAO) were used as data sources. Plum production in the world is shown through average production values in tons and average yield values expressed in t/ha, at the level of world production and for the top ten largest plum producers in the world. The evaluation of the statistical indicators of plum production in Serbia is given through the analysis of the areas under plum plantations expressed in ha, through the total production expressed in t and through the yield in t/ha. Standard indicators of descriptive statistics (average, standard deviation and coefficient of variation) were used.

The literature review included scientific and professional research papers that addressed the same or similar topics, with tables and graphs interpreting the data.

The main objective of the research in this paper is to examine the position of Serbia in global plum production. Additionally, tracking plum production throughout the Republic of Serbia and by region serves to emphasize how important it is to preserve this production for Serbian agriculture. In accordance with yield variations over the years, measures for its improvement are provided at the end of the paper.

3. Results and discussion

Plum production in the world

The average world production of plums for the period 2014-2023 was 11,914,111 tons (FAO). China dominates world production with 55.39% participation. Romania ranked second, with an average production of 621,562 t and a share of 5.22%. The Republic of Serbia ranks third with an average production of 460,025 tons, which is 3.86% of the total world production of plums. Chile, USA, Turkey, Iran, Italy, Ukraine, France, etc. follow in order of participation (Table 1).

Table 1: Average production/yield and share of leading plum producers worldwide in the period 2014–2023

Production (t)		Participation in production (%)	Yield (t/ha)
World (total)	11,914,111	100.00	
China	6,599,066	55.39	3.42
Romania	621,562	5.22	9.36
Serbia	460,025	3.86	5.82
Chile	370,764	3.11	22.06
USA	331,873	2.79	14.65
Turkey	306,533	2.57	13.82
Iran	305,981	2.57	16.86
Italy	194,710	1.63	15.71
Ukraine	181,886	1.53	10.13
France	178,600	1.50	11.61
Other countries	2,363,111	19.84	

Source: Authors' calculations based on the FAO database, 2024

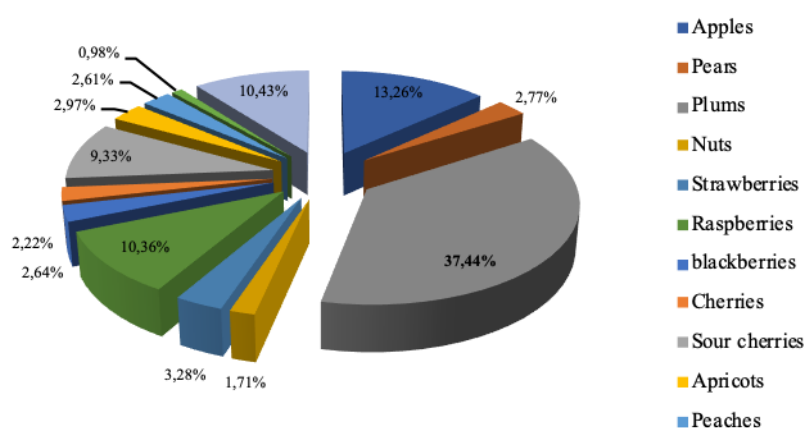
The highest yield is achieved by Chile with 22.06 t/ha, and the lowest by China with 3.42 t/ha. Serbia achieves an average yield of 5.82 t/ha (Table 1). Yield differences reflect the differences in production and application of agrotechnical measures. Several factors determine yield (certified and high-quality planting material, use of the necessary means of protection, application of adequate irrigation in terms of the type of system and adequate watering norms in combination with feeding, application of modern technologies in the process of growing plums). Within the European Union, agriculture is a long-term strategic priority, which is evidenced by consistent financial support and its priority placement in common policies. Analyzing agricultural performance in EU member states is crucial due to existing regional disparities and varying levels of sectoral development. One of the key objectives of the Common Agricultural Policy is to reduce these inequalities and to stimulate the overall growth of agricultural productivity across the Union (Radenović et al, 2022).

Plum production in the Republic of Serbia

Serbian plums and their products, especially plum brandy (šljivovica), have long symbolized Serbia internationally, recognized for their high quality (Simonović, 2006).

According to the data of the Statistical Office of the Republic of Serbia, the average values for the examined ten-year period (2014-2023) show that the plum occupies the first place in terms of the area on which it is grown, which is 37.44%. It is followed by apples (13.26%), grapes (10.43%), raspberries (10.36%), cherries (9.33%), etc. (Figure 1). According to the total yield in t achieved in production, apples and plums are ranked first and second, respectively, while according to the average yield, with 6.1 t/ha, plums are at the seventh place, behind apples, pears, peaches, grapes, cherries and quinces (SORS).

Figure 1: Average prevalence in the Republic of Serbia in the period 2014–2023. yr (unit in %)



Source: Authors' calculation based on The Statistical Office of the Republic of Serbia, 2024

According to the Statistical Office of the Republic of Serbia, the average area of plum plantations in Serbia was 73,200 ha for the 2014-2023 period covered by this paper. The smallest area of 72,024 ha was recorded in 2017, while the largest area of 75,626 ha was recorded in 2014 (Table 2).

According to the base index calculated using 2014 as the base year, the area under plum plantations decreased when compared to the base year, but from 2020 the situation changes slightly and we see a slight increase in the area under plum plantations.

The largest areas under plum plantations are located in the region of Šumadija and Western Serbia, where plums are traditionally grown very successfully. This region's plum production areas account for 69.0% of areas under plum in Serbia as a whole. The region of Southern and Eastern Serbia participates with 23.5% with its production areas, the Belgrade region with 4.6% and the Vojvodina region with only 2.9%. The coefficient of variation ranges from 1.33% to 6.33%, so it can be concluded that the variability of the areas under plum plantations is very weak.

Table 2: Annual changes in areas devoted to plums in Serbia by region in the period 2014–2023 (unit in ha)

Years of research	SERBIA NORTH		SERBIA SOUTH		Republic of Serbia (TOTAL)	Base index (2014=100)
	Belgrade region	Region of Vojvodina	Region of Šumadija and Western Serbia	Region of Southern and Eastern Serbia		
2014	3,582	2,432	51,719	17,893	75,626	100.0
2015	3,367	2,316	50,973	17,516	74,172	98.1
2016	3,194	2,207	50,593	17,325	73,319	96.9
2017	3,182	2,181	49,773	16,888	72,024	95.2
2018	3,229	2,192	49,863	16,940	72,224	95.5
2019	3,313	2,168	49,908	16,927	72,316	95.6
2020	3,483	2,080	50,401	17,046	73,010	96.5
2021	3,372	2,046	50,188	16,963	72,569	96.0
2022	3,354	1,974	50,043	16,952	72,323	95.6
2023	3,366	1,985	51,596	17,471	74,418	98.4
Arithmetic mean	3,344	2,158	50,506	17,192	73,200	
Standard deviation	118.66	136.62	672.31	323.95	1124.65	
Coefficient of variation (%)	3.55	6.33	1.33	1.88	1.54	
Participation structure (%)	4.6	2.9	69.0	23.5	100.0	

Source: The Statistical Office of the Republic of Serbia, Statistical yearbooks, 2014–2023

Plum production in this period varied according to the volume of production. The largest production was achieved in 2020 (582,547 t), and the smallest in 2017 (330,582 t). The largest production takes place in the Region of Šumadija and Western Serbia, with a participation in the total production of 63.7%, while the smallest production is realized in the Belgrade Region with a participation of 5.7%. The region of Vojvodina has a smaller area under plum plantations compared to the Belgrade Region, but on that smaller area, greater production is achieved (Table 3). Plum production varies on an annual basis. The coefficient of variation ranges from 14.07% to 27.14%, so it can be concluded that the variability of plum production is relatively weak.

Table 3: Statistical indicators of plum production in Serbia by region in the period 2014–2023 (unit in tons)

Years of research	SERBIA NORTH		SERBIA SOUTH		Republic of Serbia (TOTAL)	Base index (2014=100)
	Belgrade region	Region of Vojvodina	Region of Šumadija and Western Serbia	Region of Southern and Eastern Serbia		
2014	28,781	37,992	249,027	105,729	421,529	100.0

2015	23,724	23,053	218,623	89,490	354,890	84.2
2016	30,161	33,776	278,464	129,041	471,442	111.8
2017	22,945	30,352	198,047	79,238	330,582	78.4
2018	25,829	32,816	267,665	103,890	430,199	102.1
2019	27,695	32,865	363,380	134,991	558,930	132.6
2020	28,254	28,619	388,894	136,780	582,547	138.2
2021	20,644	20,219	275,532	96,383	412,778	97.9
2022	25,195	18,644	329,683	115,071	488,593	115.9
2023	18,553	14,083	244,617	85,461	362,713	86.0
Arithmetic mean	25,178	27,242	281,393	107,607	441,420	
Standard deviation	3,543.74	7,392.34	58,419.44	19,704.99	80,100.73	
Coefficient of variation (%)	14.07	27.14	20.76	18.31	18.15	
Participation structure (%)	5.7	6.2	63.7	24.4	100.0	

Source: The Statistical Office of the Republic of Serbia, Statistical yearbooks, 2014–2023

Average yield of plums at the level of Serbia for the period 2014–2023 is 6.1 t/ha (Table 4), which is significantly below the maximum reproductive potential. In well-managed local plum plantations, yields range between 20 and 30 t/ha (Mišić, 2006).

Table 4: Statistical indicators of plum yields in Serbia by region in the period 2014–2023 (unit in t/ha)

Years of research	SERBIA NORTH		SERBIA SOUTH		Republic of Serbia (TOTAL)	Base index (2014=100)
	Belgrade region	Region of Vojvodina	Region of Šumadija and Western Serbia	Region of Southern and Eastern Serbia		
2014	8.0	15.6	4.8	5.9	5.6	100.0
2015	7.0	10.0	4.3	5.1	4.8	85.7
2016	9.4	15.3	5.5	7.4	6.4	114.3
2017	7.2	13.9	4.0	4.7	4.6	82.1
2018	8.0	15.0	5.4	6.1	6.0	107.1
2019	8.4	15.2	7.3	8.0	7.7	137.5
2020	8.1	13.8	7.7	8.0	8.0	142.9
2021	6.1	9.9	5.5	5.7	5.7	101.8
2022	7.5	9.4	6.6	6.8	6.8	121.4
2023	5.5	7.1	4.7	4.9	4.9	87.5
Arithmetic mean	7.5	12.5	5.6	6.3	6.1	
Standard deviation	1.08	2.94	1.19	1.17	1.12	
Coefficient of variation (%)	14.31	23.48	21.25	18.73	18.50	

Source: The Statistical Office of the Republic of Serbia, Statistical yearbooks, 2014–2023

The highest percentage values in the yield are shown in the territory of the Vojvodina Region (12.5 t/ha), followed by the Belgrade Region (7.5), Region of Southern and Eastern Serbia (6.3%), and Region of Šumadija and Western Serbia (5.6 t/ha). The coefficient of variation ranges from 14.31% to 23.48%, so it can be concluded that the variability of the plum yield is relatively weak.

Risks and threats in plum production and measures to improve production

In the production of plums there are certain risks or threats related to the following:

- dependence of production on the occurrence of droughts or frosts as extreme climatic conditions;
- fight against viruses due to the use of non-certified planting material;
- unstable and underdeveloped market;
- fierce export competition;
- mistrust of agricultural producers in accepting new production technologies and innovations, etc.

Accordingly, some of the measures to improve plum production in the Republic of Serbia should be:

- revitalization of old and planting of new plum plantations with certified planting material, high-yielding varieties that can achieve high and high-quality yields for the domestic and foreign markets;
- regionalization of fruit production, which would identify areas suitable for plum cultivation (Prodanović et al., 2017);
- improvement of plum cultivation technology, with the application of modern and innovative technologies;
- intensive involvement in the protection of plums from diseases and pests;
- association of plum producers and formation of purchase stations;
- stimulating agricultural producers with various agricultural policy measures through loans, incentives, etc.
- to the greatest extent possible implementation of scientific achievements, etc.

Conclusion

This paper made an analysis of plum production trends in the Republic of Serbia for the period 2014-2023. All relevant indicators and statistical data for the Republic of Serbia indicate a slight variation in production. Variations that occur in certain years can be linked to changing climatic conditions and unstable markets, both domestic and foreign. Based on research, the plum is the top-ranked fruit in Republic of Serbia by area 73,200 ha. The region of Šumadija and Western Serbia (69.0%) has the largest share of plum areas followed by the region of Southern and Eastern Serbia (23.5%), the Belgrade region (4.6%)

and finally the Vojvodina region (2.9%). The area variation coefficient ranges from 1.33% to 6.33%.

The average production of plums is 441,420 t, with a share of 63.7% in the region of Šumadija and Western Serbia, and the smallest share of 5.7% in the Belgrade region. The coefficient of variation ranges from 14.07% to 27.14%.

The average yield per unit area (6.1 t/ha) shows annual fluctuations and a downward trend, with a coefficient of variation by region ranging from 14.31% to 23.48%. The lowest yield per unit area was achieved in the region of Šumadija and Western Serbia (5.6 t/ha), while the highest yield was achieved in the region of Vojvodina (12.5 t/ha).

In order to encourage the production of plums in Serbia, it is necessary to revitalize the existing (old) plantations and raise new perennial plantations, which requires significant investments. Production needs to be improved on old plantations by implementing agrotechnical measures with more intensive application of modern, contemporary and innovative technologies, use of certified planting material, adaptation of production to market requirements (domestic and foreign), preparation of plum products, association of plum producers, product promotion, etc.

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