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ORGANIC AGRICULTURE IN SERBIA- SHARE OF BARLEY IN IT

SUMMARY

Barley (*Hordeum vulgare* L.) (*Poaceae* family) is the most important type of cereal grown in temperate climate zones worldwide. It was one of the first cultivated grains. The areas under organic plant production are constantly increasing. Organic crop production in Serbia was performed on the area of 23,527 ha. In Serbia, in 2021, compared to other organic crops, organic fruit was produced the most, on 5,615 ha. In organic cereal production, the dominant role belonged to wheat, which was grown on the area of 1,581 ha in 2021. Organic wheat was followed by rye (879 ha) and spelt wheat (492 ha). Barley, with the area of 399 ha, ranked fourth. Based on data from the Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia, the paper analyzed and presented graphically the ten-year barley production in Serbia. Base and chain indices were used. In the 2011-2021 period, areas cultivated with organic barley varied, but not to the extent that could have been expected. The smallest area was recorded in 2014 with only 23 ha, and the largest in 2018 with an area of 445 ha. According to the regional distribution of areas under organic barley production in Serbia in the observed period (2011-2021) the largest areas were located in the Vojvodina region (on average about 260 ha).

Keywords: organic production, cereals, barley, areas

INTRODUCTION

Organic farming stands for a sustainable system of food production that maximises the use of renewable resources produced on the farm itself, does not harm the health of plants, animals and humans and protects the environment

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(Veličković *et al*., 2016). The organic farming sector has been experiencing permanent growth both globally and in Serbia for many years (Popović *et al*., 2017; 2020; Golijan and Živanović, 2017; Golijan *et al*., 2017). The fact that the area under organic crop production has quadrupled in the last ten years also contributes to this (Golijan *et al*., 2021).

One of the most important ancient cereal crops is barley. Since it was first domesticated about 10,000 years ago in the Middle Eastern region known as the Fertile Crescent, barley has played a very important role in the development of agriculture (Civan *et al*., 2021). The ancestor of domestic barley (*Hordeum vulgare* L.) is wild barley (*Hordeum spontaneum*). Today, barley is the fourth most important annual cereal crop in the world after wheat, maize and rice in terms of production volume and harvested area (Gozukirmizi and Karlik, 2017; Lakić *et al*., 2019; 2022; Rakascan *et al*., 2021; Božović *et al*., 2020; 2022). Barley is mainly grown for animal feed and malt for brewing. There are winter and spring barley, hulled and unhulled, and two-row and six-row varieties. Barley is characterised by a wide genetic divergence that provides its production under various agroecological conditions and its utilisations for different purposes (Pržulj and Momčilović, 2003). Compared to other cereals, barley is remarkably capable to adapt and acclimatise, with the ability to be grown at higher altitudes and latitudes, even under desert conditions. Therefore, barley is a primary source of food particularly in the regions where extreme climate conditions prevail, such as in the countries bordering the Himalayas, then in Ethiopia, Marocco, etc. (Lalić *et al*., 2018). Barley grain contains starch (65-68%), proteins (10-17%), β-glucan (4-9%), fats (2-3%) and minerals (1.5-2.5%) (Wang *et al*., 2015). Although barley was initially used as human food, it later began to be increasingly used as livestock feed, as well as in the malting process in the brewing industry. Recently, approximately two-thirds of grown barley are used as livestock feed, one-third in brewing industry, and only about 2% are directly used as food (Lalić *et al*., 2003). According to the FAOSTAT Report (2020) the global use of barley grain was 62% feed, 24% processing, 7% seed, 6% food and 1% other non-food uses. The need for a healthier environment and numerous adverse effects caused by current conventional agriculture have led to alternative movements in the agricultural development, among which are ecological systems, such as organic agriculture (Kovačević *et al*., 2011). Organic production preservers and improves soil biodiversity (Terzic *et al*., 2018; Simić *et al*., 2023; Stupar *et al*., 2023; Sekulić *et al*., 2023; Popović *et al*., 2024). Its methods control and increase soil fertility, protect the environment and apply the highest standards of plant and animal health protection (Ugrenović and Filipović, 2012; Ugrenović *et al*., 2021). According to Oljača *et al*. (2009), the research on the organic farming of barley is of great significance in Serbia, particularly in highland areas.

The objective of this study is to analyze the changes in the areas under organic barley production in the Republic of Serbia during the period 2011–2021, with a particular focus on regional distribution, fluctuations in cultivated areas, and the significance of organic barley production within the overall organic cereal

production. Additionally, the study aims to provide insights into the economic aspects of production, market trends, and challenges in crop certification, highlighting the potentials and limitations of organic barley production in Serbia.

MATERIAL AND METHODS

The available literature data dealing with the issues of organic agriculture and the data provided by the Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia (http://www.minpolj.gov.rs/organska/) were analyzed and graphically presented by the application of the Microsoft Excel 2010 program in order to observe the changes in the areas under organically produced barley in the 2011-2021 period. The following methods were used in the study: desk research, content analysis, comparative analyses and analyses of base and chain indices, and descriptive statistics (mean, standard deviation, coefficient of variation). Base indices express the percentage change in the level of the phenomenon in a given period in relation to its level in a specified base period. The general formula for calculating base indices is as follows: $B_i = \frac{Y_i}{Y_B} \cdot 100(\%)$. Base indices are calculated by dividing the value of the indicator in a given year by its value from the base year. The area cultivated with organic barley in 2011 was used as the base value. In this way, the relative change of the areas in relation to the base value was obtained. Chain indices are relative numbers (in %) that indicate changes in the state of the phenomenon over successive periods of time. Chain indices are calculated by dividing the value of the indicator in the observed year by its value in the previous year: $L_i = \frac{Y_i}{Y_{i-1}} \cdot 100(\%)$. That way, the relative change in the areas cultivated with this field crop was obtained in comparison to the previous year.

RESULTS AND DISCUSSION

According to the 2023 data of the Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia, there was a noticeable trend of growth of areas cultivated with organic crops in the analyzed 2011-2021 period. Nevertheless, their share of the total area of agricultural land is very small - less than one per cent. In the last third of the observation period it fluctuated between 0.6 and 0.7 per cent. Organic crop production was performed on the area of 23,527 ha in Serbia in 2021, which was almost four times more than in 2011 Fig. 1.

In the first half of the analyzed period (2011-2016), the largest areas cultivated with organic crops belonged to cereals. These areas increased over the period from 1,211 ha (2011) to 4,607 ha (2016) (Golijan Pantović *et al*., 2022). The greatest increase was recorded in 2012, when the areas doubled in comparison with in the previous year. The next increases occurred in 2014 (24% greater than in 2013) and in 2016 (50.4% greater than in 2015). However, a change occurred in the 2017-2021 period. In 2017, compared to 2016, areas cultivated with cereals decreased by 946 ha,

hence areas on which organic fruit was produced exceeded the area under cereals and ranked first.

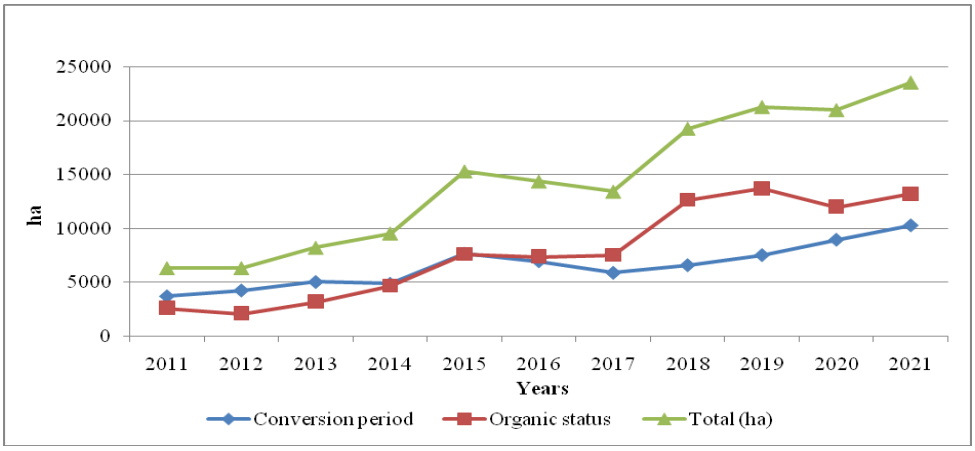

Figure 1. Land areas used for organic production in Serbia, 2011-2021

Observed over years, the areas cultivated with cereals decreased or increased, but they ranked second in the second half of the analyzed period, just behind orchards, except in 2020, when areas under fodder crops ranked second. It is expected that the global organic cereal market will grow at the rate of 9.2% in the period from 2018 to 2026 (Vlahović and Užar, 2021). Observed over regions in Serbia, cereal production was most represented in Vojvodina (Fig. 2).

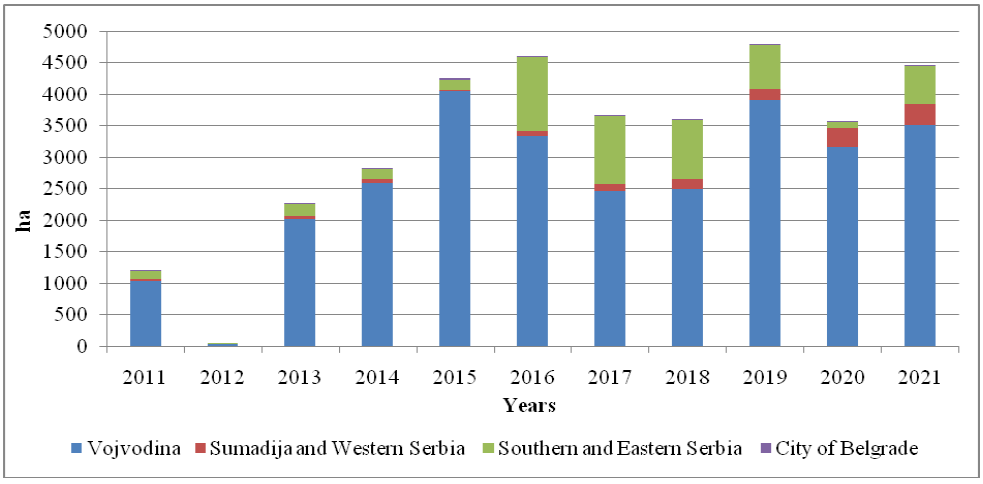

Figure 2. Land areas used for organic cereal production in the regions of Serbia, 2011 - 2021

Organic crop production in Serbia in 2021 was performed on the area of 23,527 ha, of which 17,003 ha were arable land, while 6,524 ha were under meadows/pastures. In 2021, the largest areas were under orchards (5,615 ha), then cereal crops (4,459 ha), fodder crops (3,054 ha), and industrial crops (2,122 ha).

Wheat, which is grown on the area of 1,581 ha, has a dominant role in organic cereal production. It is followed by rye (879 ha) and spelt wheat (492 ha). With the area of 399 ha in 2021, barley ranks fourth in organic cereal production (Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia, 2023). Fig. 3 shows the trends in changes of barley in the total area under organic cereals during the observed period.

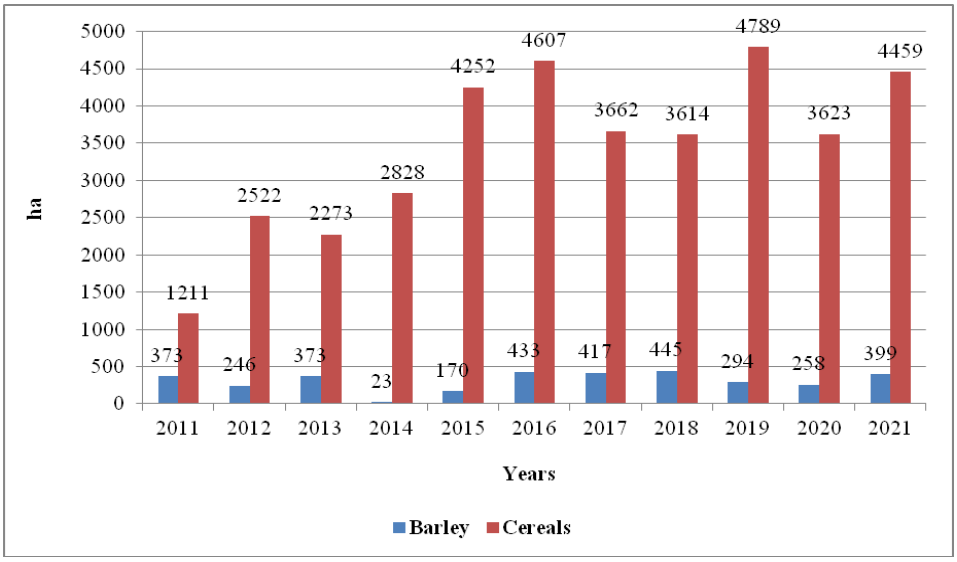

Figure 3. Share of land areas used for organic barley production in total land areas under organic cereals, 2011 - 2021

In the period from 2011 to 2021, areas under organic barley varied from 23 ha in 2014 to 445 ha n 2018. Their participation in the total areas cultivated with cereals also varied - it was highest at the beginning of the analyzed period in 2011, slightly more than 30%, when the areas under barley ranked second after silage maize. In 2014, the area cultivated with barley was the smallest. Back then, barley together with buckwheat, rye and millet, was among the least represented crops with the participation of only about 1%. The average share of areas under barley in the total areas under cereals amounted to about ten percents on average for the entire analyzed period. The changes in the areas under organic barley in Republic of Serbia during the analyzed period (2011-2021) is observable from the values of base and chain indices presented in Tab. 1.

The analysis of base indices shows that the largest reduction of areas in the relation to the base, initial year of 2011 was registered in 2014, when the areas were smaller by 93.9%. However, in the following year, 2015, this reduction was smaller by 54.5%. The highest increase was achieved in the following three years - 2016 (by 15.9%), 2017 (by 11.7%), and 2018 (by 19.3%). In the last year in the investigation period, 2021, the increase in comparison to the initial year of 2011, was of only 6.8%.

Table 1. Base and chain indices for land areas used for barley production, 2012 - 2021

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Areas (ha)	373	246	373	23	170	433	417	445	294	258	399
Base indices	100	66.0	99.9	6.1	45.5	115.9	111.7	119.3	78.8	69.2	106.8
Chain indices	100	66.0	151.3	6.1	748.3	254.9	96.3	106.8	66.0	87.9	154.3

The analysis of chain indices shows the alternating decreases and increases in the areas cultivated with organic barley. The largest decrease (by 93.9%) was recorded in 2014 compared to the previous year of 2013, while remaining decreases varied from 3.7% in 2017 in comparison to 2016, to 34% in 2012 in comparison to 2011, and in 2019 in comparison to 2018. On the other hand, the increases ranged from 6.8% in 2018 compared to 2017, to 648.3% in 2015 compared to 2014, which was also the largest increase in the analyzed period.

Based on the calculations using data from Table 1, it can be stated that the average area under organic barley in the Republic of Serbia, during the analyzed period from 2011 to 2021, was 311.8 hectares. The difference in areas under this cereal crop between the years with the largest areas (445.2 ha in 2018) and the smallest areas (22.7 ha in 2014) amounted to 422.6 hectares.The total areas under organic barley in the Republic of Serbia increased, on average, by 0.66% annually during the same period, while the average deviation from the average area under barley was 124.19 hectares. The variability of areas under barley in the Republic of Serbia was moderate and amounted to 39.83%.

During the entire observed period, the largest areas cultivated with organic barley were located in Vojvodina. Significant areas were cultivated with this crop in Southern and Eastern Serbia only in the 2016-2019 period. The largest areas (141 ha) were recorded in 2018, and the smallest ones in 2019 (66 ha) (Fig. 4).

In organic production, there are large variations in the production of all crops, because in order to obtain the organic standard, an application is made every year to the certification body to check the production method, i.e. whether the conditions for the standard are met (Golijan *et al*., 2017). If something does not comply with the law on organic production, if the documentation is not complete, if residues of pesticides, mineral fertilizers, etc. are found, the certificate is lost and it is then considered conventional production. For example, it can therefore happen that the areas are 1000 ha in one year and 0 in another, because they are lost during the certification process (Golijan and Sečanski, 2021).

In the structure of the total export of organic products, by value, the participation of cereals is very limited. In 2020, only organically produced wheat was exported.

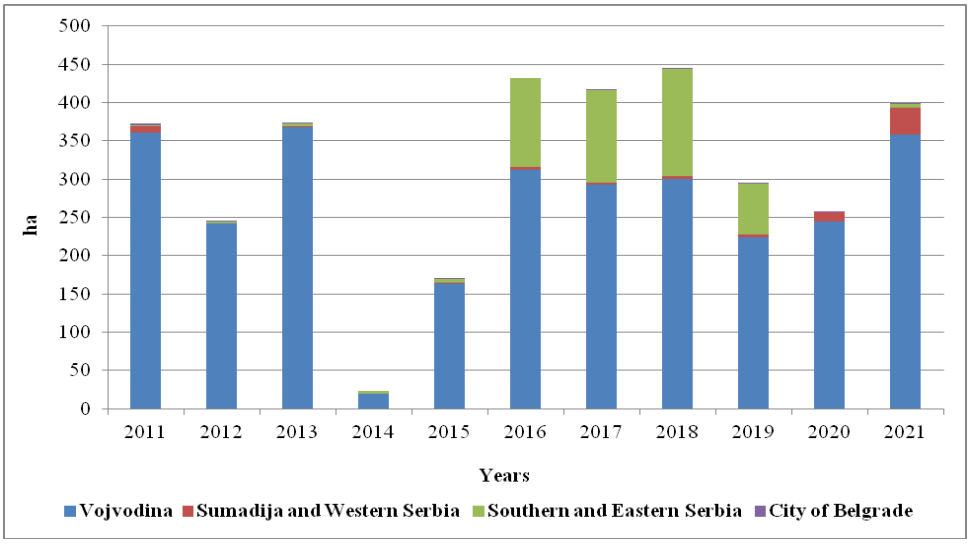

Figure 4. Land areas used for organic barley production in the regions of Serbia, 2011 - 2021

In EU countries, the category of agricultural products or their derivatives accounts for about 40% of imported organic products (1.1 million tonnes). Half of these are oil seeds, cakes and vegetable oils, and the largest category is cakes (mainly soybean meal). Another 0.3 million tonnes are rice, maize, wheat and flour (Willer *et al*., 2022; www.organic-world.net).

In the paper of Miljatović *et al.* (2018), the costs and the results achieved in organic cultivation of wheat, barley and maize in Serbia were analyzed in order to determine the profitability of organic cultivation of these cereals. The market price of organic products is significantly higher than the price of conventional products (barley - 37.9 RSD/kg, wheat - 42.6 RSD/kg and maize - 45.0 RSD/kg). On the other hand, the yields achieved for wheat (5.8 t/ha) and barley (5.5 t/ha) are not far behind conventional production, while maize yields are significantly lower (4.8 t/ha). Income from subsidies is not a significant item of total income. Subsidies in conventional agricultural production amount to RSD 4,000/ha, while subsidies in organic agricultural production are 70% higher, amounting to RSD 6,800/ha. The maximum amount of government incentives is limited to RSD 136,000, i.e. 20 ha in organic farming. The highest profit per unit of capacity (1 ha) is achieved in wheat production (114,196.1 RSD/ha). Maize production comes second (94,726.6 RSD/ha), while barley production (59,450.9 RSD/ha) is the least successful according to this criterion.

It is a well-established opinion that organic farming may be one of the solutions to minimize negative externalities and to reduce agriculture's impacts on environment. Meier *et al.* (2015) and Tuomisto *et al.* (2012) documented that the yield in organic farming is usually lower than the one achieved with traditional cultivation.

CONCLUSIONS

The conducted study highlights the dynamic trends in organic barley production in the Republic of Serbia during the period 2011–2021. Despite fluctuations in cultivated areas, the overall trend indicates significant growth in organic crop production, reflecting the global rise in organic agriculture. Barley, as one of the most important ancient cereal crops, has proven its adaptability to diverse agroecological conditions, making it a valuable candidate for organic farming, particularly in Serbia. The analysis reveals that organic barley production experienced both substantial increases and occasional decreases in cultivated areas over the analyzed period. The largest areas were consistently observed in Vojvodina, emphasizing its role as the primary region for organic cereal production in Serbia. However, the share of barley within the total organic cereal production remained relatively modest, with an average of about 10% during the analyzed period. The largest decrease occurred in 2014, while the most significant growth was recorded in 2015. These variations reflect the challenges of maintaining certification and adhering to organic standards, which can significantly affect production levels year to year. Economic analysis confirms that organic barley production in Serbia faces challenges related to profitability and market trends. Compared to conventional farming, organic barley yields are competitive, but production costs and certification barriers remain significant obstacles. Nevertheless, the premium market prices of organic products and government subsidies for organic farming partially mitigate these challenges, although they are not substantial enough to fully offset the higher costs of organic production. Overall, organic barley production in Serbia demonstrates potential for growth but is constrained by structural and market-related challenges. To maximize its contribution to sustainable agriculture, further efforts should be directed toward improving certification processes, enhancing market access for organic products, and providing greater financial support to organic farmers. Organic farming, including barley cultivation, remains a promising pathway to reducing agriculture's environmental impact and promoting biodiversity while meeting the rising demand for organic products in both domestic and global markets.

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