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Analysis of the state of organic soybean production in Serbia

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A B S T R A C T

Regardless of the plant species, organic cultivation is carried out according to legally prescribed principles, i.e. according to IFOAM standards. The products produced in this way are of high quality, without residues of pesticides and other chemicals. Soya is a plant of great economic importance, one of the most important field crops. It is used to produce important products for human and domestic animal nutrition as well as for industrial processing. The paper uses data from the Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia for an analysis of the state of organic soya production in the Republic of Serbia. Soybean production based on organic principles has been successfully practised for many years, and the area under cultivation has increased fivefold in the last ten years. The largest production of organic soybeans takes place in Vojvodina (477.04 ha), where the agro-ecological conditions are the most favorable. However, on the entire territory of the Republic of Serbia, organic soybean production is still small, considering the exceptional ecological conditions and market needs.

Keywords: soya bean, organic production, areas, regions

И З В О Д

Органска производња без обзира на биљну врсту одвија се у складу са законски прописаним принципима, односно стандардима IFOAM. Такви производи су високог степена квалитета, без остатака пестицида и других хемикалија. Соја је биљка од великог привредног значаја, једна од најважнијих њивских биљака. Од ње се добијају важни производи за исхрану људи и домаћих животиња и за прераду у индустрији. У раду су коришћени подаци Министарства пољопривреде, шумарства и водопривреде Републике Србије, на основу којих је извршена анализа стања органске производње соје у Републици Србији. Производња соје у складу са органским принципима успешно се одвија већ дуги низ година, при чему су површине петоструко увећане последњих десетак година. Највећа производња органске соје одвија се у Војводини (477,04 ha), где су и агроеколошки услови најповољнији. Међутим, на целокупној територији Републике Србији, производња соје у складу са органским принципима и даље је мала, с обзиром на изузетне агроеколошке услове и потребе тржишта.

Кључне речи: соја, органска производња, површине, региони

1. Introduction

Organic agriculture is an ecological production management system that promotes and improves biodiversity, matter cycle and soil biological activity (Kovačević and Oljača, 2005). Organic agriculture is determined by standards laid down by the IFOAM (International Federation of Organic Agriculture Movements). The IFOAM content guidelines of authorised agencies describe the requirements for certification as an organic food and organic food products (Pawar et al., 2022). Organic production implies production without the use of pesticides, herbicides, artificial (mineral) fertilisers and other chemicals (Vlahović and Užar, 2021). Natural potentials for the development of organic farming in Serbia exist in all agricultural macroregions/production regions (the land is not polluted with heavy metals, nor with residues of pesticides and mineral fertlisers, water quality corresponds to organic farming standards, air pollution is relatively low, etc.) (Ceranić and Paunović, 2010). However, despite favourable climatic and biological conditions in Serbia, organic production is still in its infancy. One reason for this is insufficiently developed awareness of the importance of organic farming and its potentials (ecological, social and economic) (Golijan, 2016; Golijan et al., 2017; Tomaš Simin et al., 2019). The most critical period for organic producers in terms of profitability is the conversion period, i.e. the time needed to switch from conventional to organic production. In Serbia, the duration of the conversion period in crop production according to the Law on Organic Production is: for annual plant species – two years before sowing; for pastures and perennial forage crops – at least two years before use as animal feed from organic production; for perennial plant species that are not forage crops – at least three years before the first harvest of organic products. During this period, the producer invests in production but their product is not certified as organic yet and cannot

command a premium price on the market. On the other hand, yields are lower in this period, but their level increases with the extension of the land utilisation period in the organic production system. In Serbia, producers are not allowed to sell products labelled "in conversion" during the conversion phase, whereas this is possible in many other countries (Tomaš Simin et al., 2019). In organic farming, legumes are an integral part of crop rotation in crop production due to their ability to form a symbiotic bond with nitrogen-fixing bacteria in the soil. This relation results in forming nodules on the plant roots within which bacteria can convert atmospheric nitrogen (Vojnov et al., 2021). Soya bean (Glycine max. (L.) Merr., family Fabaceae) is one of the most important legumes not only in the world but also in our country, primarily because of the exceptional chemical composition of the grain (40% protein and 20% oil). Soya bean in human nutrition is used in the form of soya bean kernels, various types of flour, oil, milk, tofu, tempeh and a variety of other products. Soya bean quality depends on the content of oil and protein, as it is the main source of high-quality protein and oil (Grieshop and Fahey, 2001). Moreover, soya bean is an important source of macro– and microminerals, such as P, K, Ca, Mn, Zn, Fe and B. Soya bean is considered a valuable field crop in organic production because the demands in the food industry and for organically produced feed have constantly been growing (Schori et al., 2003). Organic protein crops, primarily soybeans, which are used to feed organic livestock, have a high import share in Germany and can be an important export item for producers from Serbia (Kalentić et al., 2014).

The aim of this paper was to present the current status of organic soybean production in Serbia based on the relevant literature and data from the Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia.

2. Materials and methods

The object of the present study was an overview of the state/condition of areas used for organic soya bean farming in Serbia. The desk research was used as a method. Literature data dealing with organic agriculture issues, data provided by the Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia (https://www.stips.minpolj.gov.rs/index.php/srl/vest/povecane-povrsine-pod-organskom-biljnom-proizvodnjom), as well as statistical data of the FiBL (Research Institute of Organic Agriculture, German: Forschungsinstitut für biologischen Landbau) and IFOAM were analysed in this study. The Microsoft Excel 2010 program was applied to analyse and graphically present trends in areas and the regional distribution of organically produced soya bean in Serbia in the 2011–2021 period. In order to clearly observe analysed properties, data are presented in tables and figures.

3. Results and discussion

Soya meal is one of the most commonly used protein sources in animal feed worldwide. As organic livestock farming continues to increase, the demand for organic soya is also on the rise (https://www.fibl.org/en/themes/arable-crops/legumes#pdb).

The production of soybeans in Serbia is growing, which is due to the favourable price since 2008 and the fact that the demand for soybeans is high both on the foreign and domestic markets (Živanović and Popović, 2016). In Serbia, soya beans are mainly grown in the Vojvodina region. Soya bean yields depend on variety selection (approx. 50%), agro-ecological conditions, cultivation location and the cultivation technology applied (approx. 50%) (Popović et al., 2016). In Serbia, production mainly takes place under the conditions of a natural water regime (with drought-induced stress as the limiting factor) (Popović et al., 2015). The analysis of agricultural production indices shows that the cyclical occurrence of extreme weather conditions over the last decade has severely affected crop production, and these changes are particularly evident in areas where soya is grown (Popović, 2010; Živanović and Popović, 2016). Popović (2010) emphasised that successful soybean production is achieved through the selection of high-yielding varieties and the timely application of appropriate production technology. The choice of a region with favourable conditions for the cultivation of this plant species is particularly important. The regionalisation of varieties is also desirable in soybean cultivation and a prerequisite for economically viable soybean production (Popović et al., 2016). The regional distribution of soybean production was based on the distribution of municipalities in Vojvodina according to the average yield and harvested area. As an industrial crop, soybean is taking an increasingly important place in the arable land use structure in Vojvodina every year (Bošnjak and Rodić 2006, 2010a). The intensive increase in soybean acreage in Vojvodina was particularly pronounced in the period from 2001 to 2010 (during this period, soybeans were cultivated on an average area of 123,781 ha, which accounted for 93% of the total soybean acreage in Serbia, 8% of the arable land area in Vojvodina and about 32% of total area under industrial crops in Vojvodina). With an average yield of 2,507 kg/ha, slightly more than 500 thousand tonnes of soybeans are produced annually in Vojvodina. The average annual production of soya beans fluctuates considerably, which is due to varying yields and a greater fluctuation in soya bean cultivation areas. Reljin et al. (1997) reported that Bačka was the most favourable region in Vojvodina for soybean cultivation, followed by Banat and Srem. Bošnjak (2012) also stated that the Bačka region is the most favourable for soybean cultivation. Moreover, in this study on the regional distribution of soya bean production (based on the distribution of municipalities in Vojvodina according to average yields and harvested areas for soya beans), the author classified the municipalities of Vojvodina into seven homogeneous groups. The highest yield (over 2.75 tonnes/ha) was achieved in the municipalities of Temerin and Srbobran. Almost 67% of the harvested soya bean areas have a higher yield than the Vojvodina average (2.51 tonnes/ha), with 52% of the areas in the Bačka region, 13% in Srem and 2% in Banat. Regarding the regional distribution of organic soya bean production in Serbia, Golijan et al. (2018) found that the largest organic soya bean cultivation takes place in Vojvodina, with an area of 575.73 ha, followed by the Southern and Eastern Serbia region, with an area of 2.2 ha, while this type of production in the Šumadija and West Serbia region is practised on only 1.66 ha.

Organic farmland increased by 3.0 million ha (4.1%) at the global level in 2020. With more than 13.1 million ha, arable land constituted 18% of organic agricultural land. An increase of 1.0% since 2019 was reported. Most of this category of land was used for cereals, including rice, followed by green fodder from arable land, oilseeds, dry pulses and textile crops. In 2020, industrial crops and oilseeds were grown on the area of 49,742 ha and 1,795,143 ha, respectively. Regarding the global distribution of areas where organic oil crops are grown, the largest share belongs to soya bean (50.9%), and then to sunflower (20.8%). The largest areas where organic oil crops are grown are in Europe (821,708 ha), followed by Asia (577,955 ha), Africa (184,769 ha), North America (134,704 ha) and South America (76,007 ha) (Willer et al., 2022a). Oilseeds recorded by far the highest increase in acreage. Both from 2020 to 2021 and in the period 2012–2021, the largest growth was in oilseeds, which more than tripled in Europe and increased by 400 per cent in Europe, with the Russian Federation (soybeans, sunflower and rapeseed) and Ukraine (soybeans and sunflower) being the largest producers (Willer et al., 2023). The area under organic soya beans is still small, but has doubled within three years to around 560,000 ha or 0.5% of the total soya bean area (fibl.statistics, 2020). The soya sector is also highly concentrated, with cultivation mainly centred on the United States, Brazil and Argentina, with India in the fourth place. The top three countries together accounted for 80% of total production in 2017 and dominated global exports (Voora et al., 2020).

With 240.83 million tonnes (85.63 million hectares), America is the largest soya producer in the world and has a 76.95% share of the global market. Asia is in second place, with an area of 20.69 million hectares and a total production of 27.29 million tonnes, followed by Europe, with an area of 3.18 million hectares and a total production of 5.94 million tonnes (Živanović and Popović, 2016).

Global soya production rose from around 160 million tonnes on 70 million hectares in 1998 to 350 million tonnes on 125 million hectares in 2018 (FAOStat, 2021), with 92% of production coming from the USA, Argentina, Brazil, China and India (Pagano and Miransari, 2016). The certified area continues to increase, but compliance with standards is losing ground. Soya bean acreage grew by 12% in 2019–2020. Certified soya beans (three standards) covered at least 2.1 million hectares, which corresponds to at least 1.7% of the global soya bean area. The area under soya cultivation was 2,061,757 ha, the share of the global area was 1.7%, the area growth in 2019–2020 was 12%, while the area growth in 2016–2020 was 20.1%. In 2020, soya had the strongest growth (12%) and was the only crop with a double-digit growth rate. Although the certified minimum acreage for soybeans declined by a fifth (-20.1%), soybeans grew the most of all crops in 2019–2020. The production volume of certified soya beans grew the most in 2019–2020, namely by 16%. Three of the 14 standards covered in this report certified the production of soya beans, namely Bio, ProTerra Foundation and RTRS. According to their study, the certified minimum acreage for soybeans decreased by 20.1% in 2016–2020; in 2019–2020, the certified minimum acreage for soybeans increased by 12%, and soybeans experienced the strongest growth in that year (Willer et al., 2022b). The European Union imported an average of 14 million tonnes of soybeans and 18 million tonnes of soybean cake per year in the five years to 2019 (EUROStat, 2021), all but 2 million tonnes of which came from other continents (FAOStat, 2021). At the same time, 2.7 million tonnes of soybeans were grown in the EU, while European non-EU countries produced a further 8.4 million tonnes (EUROStat, 2021, FAOStat, 2021). There are therefore many market opportunities for soya beans in Europe (Sibert and Traenkner-Benslimane, 2020), and production for high-value sectors such as food quality or organic can be very profitable (Cox et al., 2019).

The data indicate that Europe is a significant world producer of soybeans, with a total world share of 2.87%. The share of the EU in the total world area under soybeans in 2013 was 0.38%. The share of the Republic of Serbia in the total world area was 0.14%, while the share in relation to the EU was 38.10%. The European Union has also increased its imports of soya beans for feed and fuel purposes (Živanović and Popović, 2016).

The high demand for soya protein in Europe is therefore an important reason for the expansion of soya cultivation to central and northern cultivation areas, where soya beans play a subordinate role, e.g. with only 33 thousand hectares in Germany in 2020 compared to 2.7 million hectares of maize (Destatis, 2021). In order to be self-sufficient in soya in Europe, 9–12% of the arable land would have to be planted with this crop (Guilpart et al., 2020).

Many see the need to diversify cultivation systems in Europe, where they are currently dominated by cereals and rapeseed (Hufnagel et al., 2020). According to the data provided by the Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia (2023a), organic crop production in Serbia in 2021 was performed on the area of 23,527.04 ha, of which 17,003.14 ha belonged to arable land, while meadows/pastures were distributed over 6,523.89 ha. In 2021, the largest area was used to grow organic fruit (5,614.93 ha), followed by cereals (4,458.69 ha), fodder crops (3,054.10 ha), and industrial crops (2,121.61 ha), while in 2020, industrial crops were grown on the area of 1,294.23 ha. According to Simić (2020), in the 10-year period, there was a noticeable trend of the growth of areas under organic production, with the total area increase of 263%, while the arable areas increased by almost 472% in the same period.

Organic soya bean production varied greatly in the period from 2011 to 2021. The initial data on organic farming dates back to 2011, when organic soya bean production was the lowest and spread on only 82.53 ha. In the very next year, 2012, the production areas were almost five-fold greater (388.68 ha). The largest areas in the analysed period from 2011 to 2021 were recorded in 2015, when organic soya bean was produced on the area of 837.16 ha. After 2015, areas increased or decreased; hence, according to the most recent data of the Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia (2023a), the area under organic soya bean production was 481.07 ha, which is almost a double decrease compared to the 2015 production (Fig. 1).

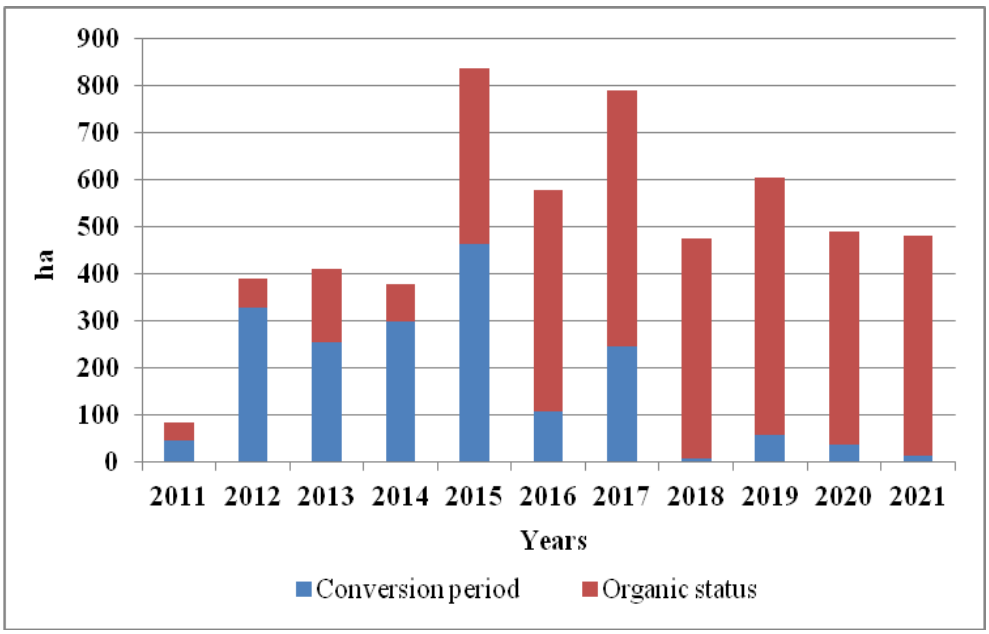

Figure 1. Total area where organic soya bean was grown in Serbia (ha), 2011–2021 period

Table 1 shows the areas under cultivation of certain industrial crops in organic farming, taking into account the organic status and the conversion period. In 2011, the greatest areas (82.53 ha and 82.23 ha) were sown with soya bean and sunflower, respectively, while flax was the least produced (on only 1 ha). Since 2014, the largest areas have been sown with sunflower, with the highest production recorded in 2016 (1,708.06 ha). Sugar beet was grown only in 2014 (2.45 ha), hop only in 2016 and 2018 (0.01 ha and 0.05 ha, respectively), while the production of hemp and mustard was initiated in 2015 and 2017, respectively. In 2021, the largest areas where industrial crops were grown were sown with sunflower (1,165.08 ha), soya bean (481.07 ha), and oilseed rape (453.25 ha), while mustard was sown on only 0.03 ha (Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia, 2023a).

Table 1.
Areas (ha) sown with certain organic industrial crops in the Republic of Serbia in the 2011–2021 period

Crops	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Hemp	-	0.00	0.00	0.00	72.32	59.50	23.00	50.25	4.55	8.69	12.11
Tobacco	0.00	0.00	0.38	0.10	1870.38	0.00	0.00	0.00	43.72	0.00	-
Flax	1.00	3.00	1.80	2.02	239.56	34.38	12.55	25.26	4.83	2.18	5.47
Poppy	1.78	0.99	1.16	1.12	43.11	0.01	2.39	4.69	0.00	2.49	3.22
Sorghum	2.00	0.05	4.80	24.12	7.79	0.00	0.00	0.00	0.00	0.00	-
Soya bean	82.53	388.68	410.27	378.73	837.16	577.40	790.71	476.20	603.72	488.88	481.07
Sunflower	82.23	62.41	187.68	474.91	1180.96	1708.06	869.56	983.63	1455.43	581.38	1165.08
Oilseed rape	0.00	64.00	66.81	341.71	10.48	536.51	581.70	415.04	58.32	154.25	453.25
Oil squash	2.34	21.81	0.00	2.59	146.31	0.97	0.47	0.60	10.84	56.01	1.38
Sugar beet	0.00	0.00	0.00	2.45	0.00	0.00	0.00	0.00	0.00	0.00	-
Hop	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.05	0.00	0.00	-
Mustard	0.00	0.00	0.00	0.00	0.00	0.00	10.06	6.09	48.14	0.36	0.03
Remaining crops	0.00	0.00	0.00	0.00	0.00	1.50	0.00	0.00	0.00	0.00	-

The share of areas where organic soya been was grown in relation to the areas under organic industrial crops in the 2011–2021 period was the lowest (19.79%) and highest (71.85%) in 2016 and 2012, respectively (Fig. 2).

The regional distribution of areas under organic soya bean production in Serbia varied in the 2011–2021 period (Fig. 3): the highest production was recorded in Vojvodina and the smallest, mainly in the region of the Belgrade municipality.

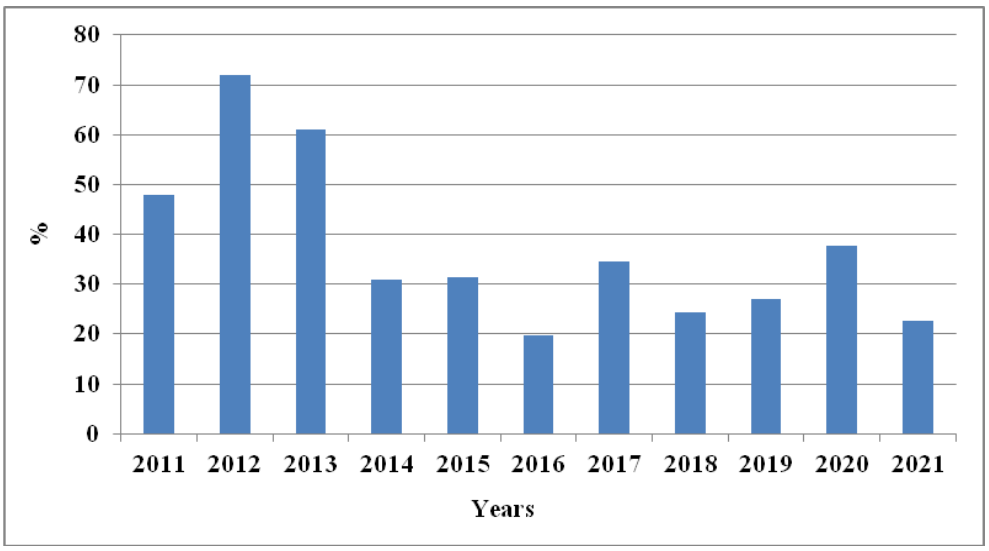

Figure 2. Share of areas where organic soya been was grown in relation to the areas under organic industrial crops in the 2011–2021 period

There is currently a high demand for organically produced soya bean in the food and feed production, beverage industry, cosmetic, pharmaceutical and other industries. The global demand is being increased by a high demand of other soya bean-based products, such as: oil, meal/flour, proteins. An increasing number of health conscious consumers and lifestyle changes have affected the demand, primarily in North America and Western European countries. Organic soya bean can be processed into various types of products, but it can also be consumed as a whole. The key drivers affecting the demand for organic soya bean in the global market are the growth of organic food and feed industry. The demand for organic soya bean in the feed industry is expected to increase due to the growing demand for organic chicken (Vlahović and Užar, 2021).

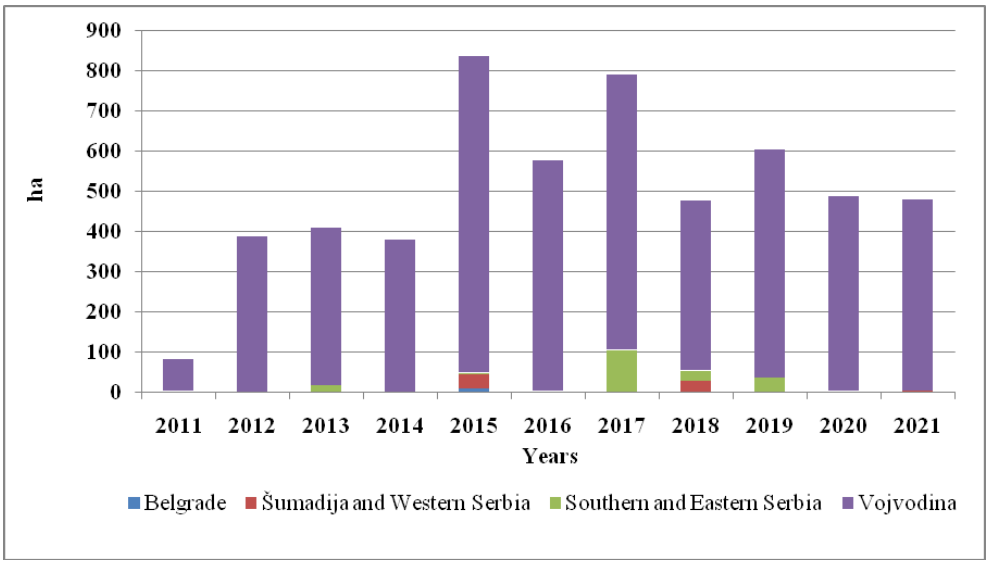

Figure 3. Regional distribution of areas where organic soya bean was grown in the 2011-2021 period

4. Conclusions

The areas under organic soya bean crop varied greatly in the 2011–2021 period. The lowest production was recorded in 2011 (only 82.53 ha) and largest in 2015 (837.16 ha). In 2021, in organic industrial crop production, sunflower was the most produced (1,165.08 ha), followed by soya bean (481.07 ha), while oilseed rape ranked third (453.25 ha). The smallest area was cultivated with mustard (0.03 ha). The regional distribution of organic soya bean production areas varied highly in Serbia. The largest and smallest areas are located in the region of Vojvodina and the Belgrade municipality, respectively. Considering market demands, the production of organic soya bean in Serbia is still insignificant. On the other hand, the production of oil crops at the global level will increase due to their increased use in human nutrition, due to human population growth, as well as due to the increase in the use of vegetable oils in biodiesel production.

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Declaration of competing interests

The authors declare that they have no conflict of interest.

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