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Dragan Terzić[1], Vera Popović[2*], Mladen Tatić[2], Viliana Vasileva[3], Vera Đekić[4], Vladan Ugrenović[5], Slobodan Popović[6], Pašaga Avdić[7]
[1]Institute for Forage Crops, Globoder, Kruševac, Serbia;
[2]Institute of Field and Vegetable Crops, Maksima Gorkog 30, 21000 Novi Sad, Serbia;
[3]Institute of Forage Crops, BG-5800 Pleven, Bulgaria
[4]Small Grains Research Centre, Save Kovacevica 31, Kragujevac, Serbia
[5]Institute of Tamiš Pančevo, Novonaseljski put 33, Pančevo, Serbia
[5]Faculty of Economics and Engineering Management, Cvećarska 2, Novi Sad, Serbia
[7]University of Business Academy, Faculty of Economics and Management, Novi Sad,Serbia
*Corresponding authors: E-mail: dragan.terzic@ikbks.com; bravera@eunet.rs;

SOYBEAN AREA, YIELD AND PRODUCTION IN WORLD

Abstract

The average area under soybean in the world was 121.53 million ha, yield was 2.76 t ha^{-1} and production 334.89 million t. The largest areas in the world were in the Americas, followed by Asia, Europe and Africa. The Americas is the top soybean producing continent and which provides 87.1% of global soybean production. The average area under soybean in Europe was 5.038 mil.ha, the average yield 2.08 t ha^{-1} and soybean production was 10,488,759 t. The highest yields of soybeans in Europe had: Serbia (3.16 t ha^{-1}), Croatia (3.11 t ha^{-1}), Austria (3.06 t ha^{-1}), Slovenia (2.99 t ha^{-1}), Germany (2.73 t ha^{-1}), Switzerland (2.54 t ha^{-1}), France (2.48t ha^{-1}), etc. Serbia's average soybean production in 2016 was 576,446 tons and the yields were higher than the World yield by 0.4 t. Serbia has excellent conditions for soybeans production.

Key words: soybean, production, area, World, Europe, Serbia

INTRODUCTION

Modern nutrition of livestock, particularly pigs and poultry, is focused on satisfying the nutritional requirements of farm animals. Proteins in diet for farm animals nowadays are provided from the nutrients of plant origin. In this regard, soybean and its products have a significant role. According to Tielen (2007), soy meal is the main source of protein used for animal feeding in EU (65% in 2005/2006). Soybean was (Kovcin et al., 1988) and still is the main source of protein in the diet of all farm animals in Serbia, too. Due to high protein content (35-50%) (Clarke and Wiseman 2000, Popović et al., 2013; 2016; Terzić et al., 2016a; 2016b; 2017; Stevanović et al., 2017; Tatić at al., 2018) and its efficient use, worldwide consumption of soybean for feeding of livestock has reached 160 million tons, which is about 2/3 of the total amount of all products used as a protein source in farm animal nutrition (Anonymous, 2011). Soybean and soy products, particularly soybean meal, have become increasingly important commodities. China and EU have the dominant place in the total soybean world import (47% and 22%, respectively) (Anonymous, 2011), while EU accounts for 44% of the total soybean meal import. To reach the level of consumption of EU-27 resident, more than 270 000 ha of soybean would be required, which is twice more than achieved in the period 2000-2009. Consequently, the participation of soybean in the sowing structure would be increased to 8%, which is acceptable in terms of proper crop rotation (Bosnjak et al., 2012). As legume species an annually formation of root and nodule biomass and their decomposition contributed to soil fertility improvement (Vasileva et al., 2016). According to Basic et al. (2007), there are insufficiently used capacities for soybean processing in Serbia of about 745 000 tons annually. This is an additional reason for the above-mentioned statement that there is stillroom for increasing of soybean production, regardless of the fact that the soybean acreages has already increased by 88 times in the last 50 years.

The dependence of soybean on the duration of day resulted in geographic distribution in 13 maturity group (MG) zones, starting from 000 - varieties which can thrive in higher geographic latitudes, to X - varieties which are grown in lower latitudes (Hartwig, 1973). The differences between maturity groups are caused by caused by variety of photoperiodic, ranging from 10 to 18 days between the different groups. Maturity group zones represent defined areas where a variety is best adapted without implying that MG-specific varieties cannot be grown elsewhere (Mourtzinis and Conley, 2017; Glamočlija et al., 2015). There is an optimum variety maturity group for each soybean growing region (Popović et al., 2018). The current assortment in Serbia, of NS varieties of soybeans, consists of twenty varieties from five maturity groups - MG (Popovic et al., 2018): very early NS soybean varieties are: Favorit and NS Kaća (000 MG), Fortuna, Merkur, Tajfun and new variety NS Zoja (00 MG); Medium-early varieties of soybean are: Valjevka, Galina, NS Princeza, NS Vulkan and NS Atlas (0 MG); medium maturity variety, genotype from first maturity group (I MG) are: Sava, NS Maximus, Victoria, NS Apolo, NS Romansa and new variety NS Ventis and NS Hogar (I MG), while late varieties of soybeans from II MG: Rubin, Trijumf, Venera, NS

Zita, NS Fantast and new variety NS Kolos. In this paper, the soybean production in Serbia will be calculated and compared to the current soybean producing areas in the world.

MATERIALS AND METHODS

Production parameters of soybean in 2016 are analysed in this paper. Data on soybean production are taken from the FAO website 2018, Tatić et al., 2018. The soybean production is presented in tables and graphs. The data on the Quantity and distribution of precipitation in the area of Serbia, 2016 are shown. The mean value, as a measure of the central tendency, was used to show the characteristic average value of the selected indicators. However, since the mean value little suggests how different data from the statistical series are different, the variation coefficients as a measure of the variability of the indicators are calculated. The data were statistically processed using the coefficient of variation method: $C_V = \sigma \cdot 100 / \overline{X}$. The mean value shows basic information about where the concentrated values are.

Meteorological data. Serbia is characterized by changing climatic conditions both in terms of atmospheric precipitation and in terms of oscillations in air temperature. These changing climatic conditions are the most common cause of crop yield losses. The average precipitation for the vegetation period 2016 was 340.4 mm, while the average temperatures were 19.6ºC, which is by 25.9 mm and 1.2ºC higher than long-term average according to data from meteorological station at Serbia (Figure 1).

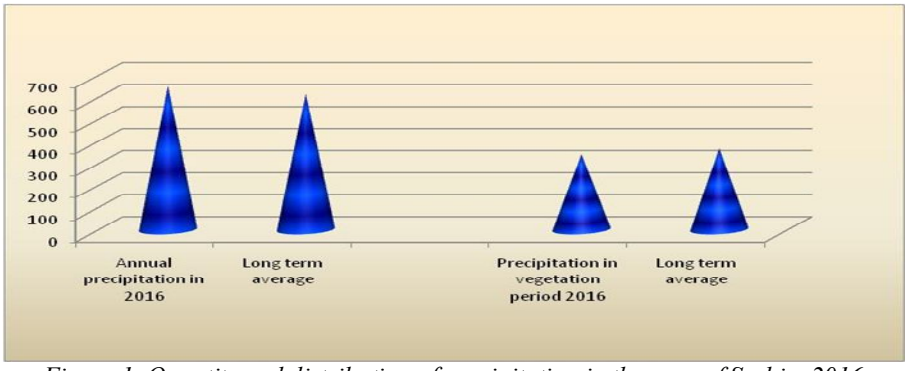

Figure 1. Quantity and distribution of precipitation in the area of Serbia, 2016

Based on the data, an average of 340.3 mm of precipitation in the vegetation period in 2016 was recorded, and according to a large number of studies (Popović et al., 2015; Glamočlija et al., 2015) the water requirements of soybean are 450 mm, it can be argued

that the production of soybeans in the territory of Serbia is faced with a water deficiency issue.

RESULTS AND DISCUSSION

The average soybean area in the World, in 2016, was 121.532 mil. ha. The average soybean yield in the world was 2.76 t ha^{-1} while soybean production in the world was 334,894,085 t, Table 1. Yields varied widely across continents, Cv = 39.34%.

Table 1. Soybean production parameters in the world and in European countries, 2016

No	Parameter	Area, ha	Yield, t ha^{-1}	Production, t	Share of production, %
World		**121,532,432**	**2.76**	**334,894,085**	**100**
1.	America	94,550,853	3.10	293,414,006	87.61
2.	Asia	19,935,221	1.45	28,808,950	8.60
3.	Europe	5,038,132	2.08	10,488,759	3.12
5.	Africa	1,979,024	1.07	2,119,814	0.63
6.	Oceania	29,202	2.14	62,556	0.02
Cv			39.34		
Country		**Area, ha**	**Yield, t ha^{-1}**	**Production, t**	**Share, %****
Some countries of Europe and Ukraine					
1.	Ukraine	1,859,400	2.30	4,276,990	1.28
2.	Russian Fed.	2,120,014	1.47	3,135,177	0.93
3.	EU	831,360	2.93	2,434,195	0.72
1.	Serbia*	182,362	3.16	576,446	0.172
2.	France	136,370	2.48	338,864	0.10
3.	Romania	125,148	2.10	263,380	0.08
4.	Croatia	78,614	3.11	244,075	0.07
5.	Austria	49,791	3.06	152,599	0.05
6.	Hungary	66,851	2.18	146,217	0.04
7.	Germany	15,000	2.73	41,000	0.012
8.	B&H	7,022	2.66	18,662	0.006
9.	Poland	7,514	1.96	14,744	0.004
10.	Bulgaria	12,923	1.29	18,301	0.005
11.	Slovenia	2,466	2.99	7,387	0.002
12.	Greece	1,198	3.11	3,728	0.001
13.	Switzerland	176	2.54	4,500	0.001

Source: FAO for 2016; downloaded 22.12.2017; * Tatić et al., 2018; **Calculated of authors

The largest areas under soybean in the world are in America, Asia, Europe and Africa, Table 1, Graph. 2. The average area under soybean in America was 94.551 mil. ha and the soybean production in America 334,894,085 t, or 87.71% of the world production. The average yield of soybean in America was 3.10 t ha^{-1}, Table 1 and Figure 2 and 4.

The average area under soybean in Asia was 19.935 mil. ha, the soybean production in Asia 28,808,950 t, or 8.60% of the world production. The average yield of soybean in Asia was 1.45t ha^{-1}, Table 1.

The average area under soybean in Europe was 5.038 mil. ha, the average yield of soybean in Europe was 2.08 t $ha^{-1}$and production of soybean in Europe was 10,488,759 t, Table 1, Figure 2 and 4.

The average area under soybean in the Russian Federation was 2.120 mil. ha, soybean production was 3,135,177 t and the average yield of soybean 1.47t ha^{-1}, Table 1.

The average area under soybean in Ukraine was 1.859 mil. ha, soybean production 4,276,990 t, or 1.28% of the world production. The average yield of soybean in Ukraine was 2.30 t ha^{-1}, Table 1.

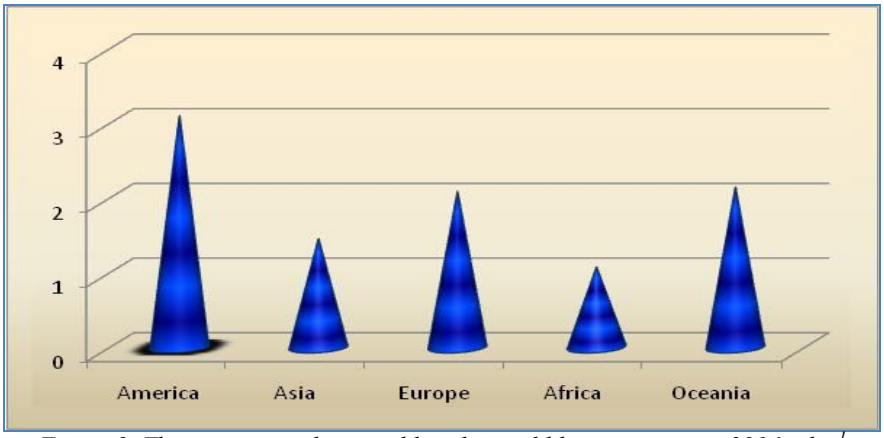

Figure 2. The average soybean yield in the world by continents in 2016, t ha^{-1}

The average area under soybean in EU was 831,360 ha, soybean production in EU was 2,434,195 t, or 0.72 % of the world production. The average yield of soybean in EU was 2.93 t ha^{-1}, Table 1.

The Average area under soybean in the Republic of Serbia in 2016 was 182.362 ha. The average grain yield of soybean in Serbia was 3.16 t ha^{-1}. Yield in Serbia in 2016 was by 0.4 t higher than the world average with an annual growth rate of 14.49% (Tab. 1, Figure 3). Thus, Serbia's current average soybean production is 576,446 tons, Tatić et al., 2018 (Table 1).

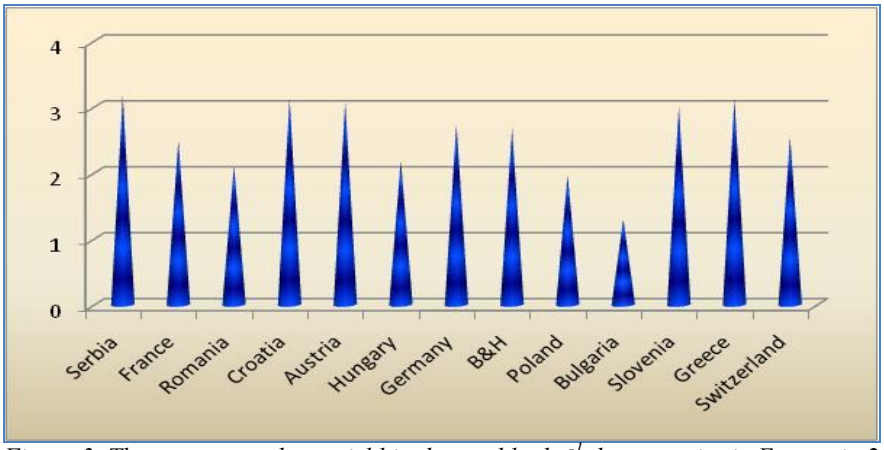

Figure 3. The average soybean yield in the world, t ha^{-1}, by countries in Europe in 2016

The average area under soybean in France was 136,370 ha. The average yield of was 2.48t ha^{-1}and soybean production was 338,864 t, Table 1, Figure 3.

The average area under soybean in Croatia was 78,614 ha. The average yield of soybean was 3.11 t ha^{-1} and soybean production was 244,075 t, Table 1, Figure 3.

The average area under soybean in Austria was 49,791 ha. The average yield of soybean was 3.06 t ha^{-1} and soybean production was 152,599 t, Table 1, Figure 3.

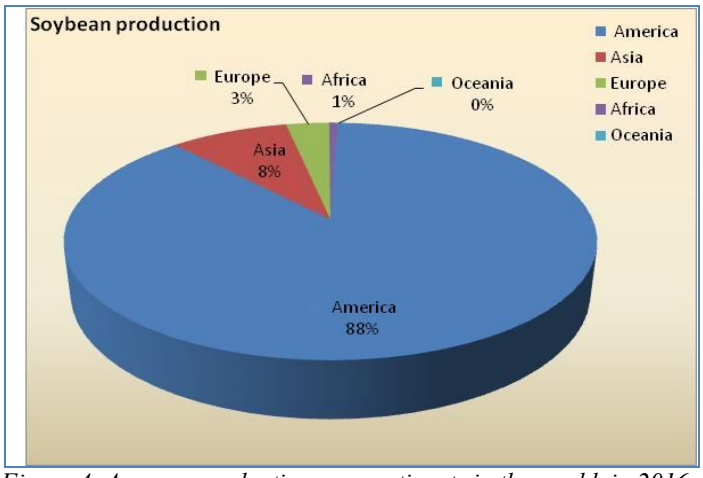

Figure 4. Average production per continents in the world, in 2016

In the World, in 2016, 89.05% of production is located in five countries: USA (34.99%); Brazil (28.75%), Argentina (17.56%), China (3.57%) and India (4,18%). The largest grain yields of the five top world producers were in the USA (3.51 t ha^{-1}), followed by Argentina (3.02 t ha^{-1}), Brazil (2.91 t ha^{-1}) and China (1.8 t ha^{-1}) while the lowest yields were recorded in India (1.22 t ha^{-1}), Tatić et al., 2018.

Soybean production in Serbia has had a strong expansion in the last half of century. From 1955 to 2005 soybean acreage increased 88 times, the yield 2,6 times and the total production 230 times (Bosnjak and Rodic, 2010). Positive trends have continued during the last decade (1995-2007). A significant increase of acreages (growth rate 12.62%) and yield (growth rate 1.44%) in this period has been determined. Consequently, the total production has also increased, growth rate 9.72% (Popović, 2010; Popović et al., 2011).

Simultaneously with the production, the consumption of soybeans in the industry has increased. The average growth rate of soybean consumption in the period 2000–2009 was 7.09%. Serbia exports and imports significant quantities of soybean and soy products.

However, soybean import in the analyzed period was much higher than soybean export i.e. trade balance was negative (Bosnjak et al., 2012). This indicates the necessity of further development of soybean production and its processing.

The starting point for determining the necessary acreages is the equivalent of soybean and soybean meal. Data on the quantity of soybean meal, which could be obtained from the extraction of 1 000 kg of soybean, vary in the range from750 kg (Furman et al., 2002) to 780 kg (Lucic and Krstic, 2000). Van Gelder et al. (2008) has used (1: 0.771), as well as their figures for soybean meal needed per unit of basic livestock products (Table 2).

Table 2. Soybean meal needed for production of one unit of the most important livestock products

Type of livestock products	Beef, g/kg	Pork, g/kg	Poultry meat, g/kg	Milk, g/l	Eggs, g/peace
Necessary amount of soybean meal	232	648	967	21	32
Source: Van Gelder et al., 2008					

Such high yields in Serbia are due to cultivation of crops domestic NS soybean cultivars, with high yield potential, good adaptability and yield stability. Soybean production showed a permanent growth trend. Increased production of soybean resulted from permanent increase in area and yield. The production of soybean, in addition to the genotype and cultivation technologies, is strongly influenced also by the meteorological conditions. Annual variations of weather conditions significantly affected soybean growth and development, resulting in significantly different yields during the research period. Soybean seed yield varied according to precipitation quantity and distribution. NS soybean production increase is caused by technical and technological developments which have

facilitated the production of NS soybean seed in a time unit, as well as the production of new quality cultivars. Seed quality is the most important aspect that influences a positive image of the product in the minds of consumers and represents a vital element of competitiveness (Popović, 2010; Popović et al., 2013; 2015; 2016; Živanović & Popović, 2016; Tatić et al., 2018).

CONCLUSION

According to the obtained results of research, the following conclusions were made:

- The average area under soybean in the world was 121.532 mil ha in 2016. The largest areas in the world were in the America, followed by Asia, Europe and Africa.
- The top soybean producing continent which provides 87.1% of global soybean production was America. The average area under soybean in America was 94.551 mil. ha, in Asia 19.935 mil. ha and in Europe 5.038 mil. ha.
- The average area under soybean in the Republic of Serbia in 2016 was 182.362 ha. The average grain yield of soybean in Serbia was 3.16 t ha^{-1}. Yield in Serbia in 2016 was by 0.4 t higher than the world. Serbia's current average soybean production.

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28.

Оригинални научни рад

Драган Терзић[1*], Вера Поповић[2*], Младен Татић[2], Вилиана Василева[3], Вера Ђекић[4], Владан Угреновић[5], Слободан Поповић[6], Пашага Авдић[7]

[1]Институт за крмно биље, Глободер, Крушевац, Србија;
[2]Институт за ратарство и повртарство, Максима Горког 30, 21000 Нови Сад, Србија;
[3]Институт за крмно биље, БГ-5800 Плевен, Бугарска
[4]Центар за стрна жита, Саве Ковачевића 31, Крагујевац, Србија;
[5]Институт Тамиш Панчево, Новонасељски пут 33, Панчево, Србија
[6]Економски факултет и Менаџмент, Цвећарска 2, Нови Сад, Србија;
[7] Универзитет за Привредну комору, Економски факултет и инд. менаџмент, Нови Сад, Србија
* Одговорни аутор: E-mail: vera.popovic@nsseme.com;

ПОВРШИНЕ, ПРИНОСИ И ПРОИЗВОДЊА СОЈЕ У СВЕТУ

Сажетак

Просечне површине соје у свету износиле су 121,53 милиона ha, принос 2,76 t ha^{-1} а производња 334,89 милиона тона. Највеће површине у свету биле су у: Америци, затим Азији, Европи и Африци. Америка је континент који је у врху по производње соје и обезбеђује 87,1% глобалне производње соје. Просечна површина соје у Европи била је 5,038 мил. ha, просечни принос 2,08 t ha^{-1} док је производња соје износила 10.488.759 t. Највеће приносе соје у Европи имале су: Србија (3,16 t ha^{-1}), Хрватска (3,11 t ha^{-1}), Аустрија (3,06 t ha^{-1}), Словенија (2,99 t ha^{-1}), Немачка (2.73 t ha^{-1}), Швајцарска (2.54 t ha^{-1}), Француска (2,48 t ha^{-1}), итд. Просечна производња соје у

Србији у 2016. години износила је 576.446 тона, док су приноси били виши у односу на просечне светске приносе за 0,4 t. Србија има одличне услове за производњу соје.
Кључне речи: соја, производња, површине, свет, Европа, Србија