

## POPPY (*Papaver somniferum* L.) PRODUCTION IN THE REPUBLIC OF SERBIA

VERA POPOVIĆ<sup>1</sup>, LIVIJA MAKSIMOVIĆ<sup>1</sup>,  
ANA MARJANOVIĆ-JEROMELA<sup>1</sup>, MIRJANA VASIĆ<sup>1</sup>,  
MAJA IGNJATOV<sup>1</sup>, VERA RAJIČIĆ<sup>2</sup>, ZORAN JOVOVIĆ<sup>3</sup>

CORRESPONDING AUTHOR: vera.popovic@ifvcns.ns.ac.rs

# Alternative Crops and Cultivation Practices

**ACKNOWLEDGEMENTS:** Paper is a part of the project TR 31025 (2011-2019) financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia and the bilateral project of Serbia - Montenegro "Alternative cereals and oil crops as a source of healthcare food and an important raw material for the production of biofuel" (2019-2020).

### SUMMARY

Being a source of valuable oils, proteins, carbohydrates and compounds used for pharmaceutical industry, poppy (*Papaver somniferum* L.) is an important alternative plant species. The aim of this study is to characterize the position of the Republic of Serbia's poppy seed production, in the 2010-2014 period. In the Republic of Serbia poppy is grown on small areas. The average yield of poppy was 1,078 kg ha<sup>-1</sup> and it was stable over the period. Average area under poppy amounted to 934 ha while the average production was 1,004 t; the production of poppies in Serbia made 1.21% of the total world production. Variability measured by the coefficient of variation, for the surface under the poppy amounted to 4.52% while for yield of poppy amounted to 4.61%. The area under poppy in the Republic of Serbia accounted for 0.85% of the total world's area.

**KEYWORDS:** area, *Papaver somniferum* L., production, Republic of Serbia, world, yield

POPOVIĆ, V., MAKSIMOVIĆ, L., MARJANOVIĆ-JEROMELA, A., VASIĆ, M., IGNJATOV, M., RAJIČIĆ, V., & JOVOVIĆ, Z. (2019). POPPY (*PAPAVER SOMNIFERUM* L.) PRODUCTION IN THE REPUBLIC OF SERBIA. *ALTERNATIVE CROPS AND CULTIVATION PRACTICES*, 1, 13-17.

### INTRODUCTION

*Papaver somniferum* (L.) is cultivated as an annual crop; among the leading producers are China, India, Czech Republic and Turkey. The seeds are obtained from selected, well-

developed capsules. Seeds vary greatly in color, from grayish white to light brown. Oilseeds are source of fats, proteins, and carbohydrates, and they have potential to be used as nutraceuticals and functional food (Bozan & Temelli, 2008). The seeds are used for traditional pastries and oil extraction (Bozan & Temelli, 2003; Özcan & Atalay, 2006). Poppy seeds contain up to 50% oil and Indian cultivars have high levels of oleic and linoleic acids (Singh et al., 1990). Singh et al. (1995) have indicated the potential of this crop as a source of linoleic acid. Poppy seed oil appears to be of good quality for human consumption since it is generally rich in polyunsaturated fatty acids (Baydar & Turgut, 1999). In Europe, poppy seeds are mostly used for confectionery products, similar to the use of sesame seeds and are used extensively in baking and sprinkling on rolls and bread. Also, they are the source of a drying-oil, used for the manufacturing of paints, varnishes, and soaps. Oil cake is a good fodder for cattle (Guil Guerrero et al., 1998; Glamočlija et al., 2015; Popović et al., 2017; 2018). Poppy is also grown for pharmaceutical purposes. Poppy seed oil contains 73% linoleic, 10% palmitic, and 13% oleic acid as major fatty acids (Gök et al., 2011).

Environmental factors are important for poppy cultivation (Popović, 2010; 2015; Đekić et al., 2014; Filipović et al., 2014; Živanović & Popović, 2016). "Although the crop can be destroyed in dry winters without snow, the plant can withstand temperatures as low as -5 °C for short periods. A protective layer of snow is

<sup>1</sup>Institute of Field and Vegetable Crops, Maksima Gorkog 30, Novi Sad, Serbia

<sup>2</sup>Center for Small Grains, Save Kovačevića 31, Kragujevac, Serbia

<sup>3</sup>University of Montenegro, Faculty of Biotechnology, Mihaila Lalića 1, Podgorica, Montenegro

a favorable factor, and in those conditions the crop can withstand a temperature of  $-10\text{ }^{\circ}\text{C}$ . Spring frosts are dangerous for young plants. At the beginning of growth, the plants need a great deal of moisture in order to take root and develop properly, but at the end of growth period they prefer hot and dry weather; in such conditions the alkaloid content increases. The annual rainfall in Republic of Serbia is between 380 and 650 mm", according to Kušvíc, 1960.

"The poppy is usually sown in the second half of September in two to four furrows, generally after the first autumn rains. Spring sowing is carried out usually in the second half of February or the first half of March. The seeds are very small, and are difficult to sow evenly. For this reason, they can be mixed with sand (4 kg of sand per 1 kg of seed). Sowing with a seeder is carried out usually in rows at intervals of 30 cm to 40 cm. The earth is harrowed, so that the seeds are sown 1 or 2 cm deep. Sowing rate is 5-10 kg per ha. The spring operations are usually carried out in the second half of February and consist of pulling up grass and weeds, thinning (so that one plant should be approximately 10 cm away from the next) and banking up with soil. A second banking-up operation is usually carried out in the first half of March", according to Vajić & Mikić, 1951.

The plant does not need especially good soil and can grow on ground which is unsuitable for most other crops; however, it thrives better in fertilized, crumbly and light soil, exposed to the sun and protected from northern winds. Heavy and clayey soil, as well as waterlogged soil, is not suitable (Glamočlija et al., 2015).

Poppy seed may be useful for the relief in the cases of dysentery, constipation, cough and asthma (Raie & Salma, 1985). Because of its

content of certain major alkaloids (morphine, codeine, papaverine, etc.) poppy is an important raw material for the pharmaceutical industry (Popović et al., 2017). The Czech Republic controls approximately 33% of the world production and about 28% of the value and about 44% of the volume of world trade with poppy seed.

The objective of this study was to determine and analyze the production of poppy seed in world and in the Republic of Serbia.

## MATERIAL AND METHODS

This paper analyses the poppy production parameters in the world and in the Republic of Serbia during the period from 2010 to 2014 (<http://faostat.fao.org/>). Basic statistic parameters (mean and coefficient of variation) were calculated for area, yield and production. In addition, the changes of the values of the studied parameters over the time were estimated using linear regression. The rates of the changes are expressed as the year to year averages for the period.

## RESULTS AND DISCUSSION

### *Area and yield of poppy in the world*

In the 2010-2014 period, poppy seed in the world was annually planted on the average area of 110,183 ha, and it showed an annual  $-10.01\%$  trend of decline, with oscillations (Table 1). The largest area under poppy seed, was in 2010 and 2011 (149,025 ha and 129,903 ha), Figure 1.

In the period of 2010-2014, poppy seed, in the world, had the average yield of  $756\text{ kg ha}^{-1}$  and showed an annual  $3.04\%$  trend of growing, with stability. The highest yield of poppy seed



Picture 1. Poppy; (a) plant and flower, (b) capsule, (c) seed

Table 1. Production of poppy seed in the world and in the Republic of Serbia, 2010-2014

Parameter	Average	Rate of change	CV (%)	Share (%)
World				
Area (ha)	110,183	-10.01	26.83	100
Yield (kg ha <sup>-1</sup> )	756	3.04	9.26	-
Production (t)	82,956	-7.26	25.79	100
Republic of Serbia				
Area (ha)	934	-0.80	4.52	0.85
Yield (kg ha <sup>-1</sup> )	1,078	1.08	4.61	-
Production (t)	1,004	0.36	0.95	1.21

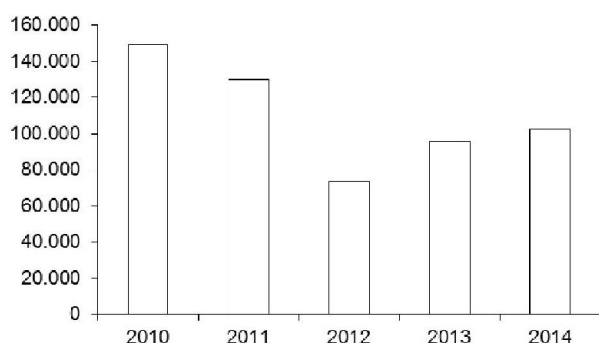


Figure 1. Area under poppy (ha) in the world (2010-2014)

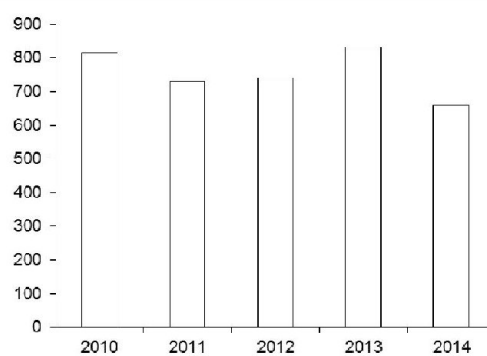
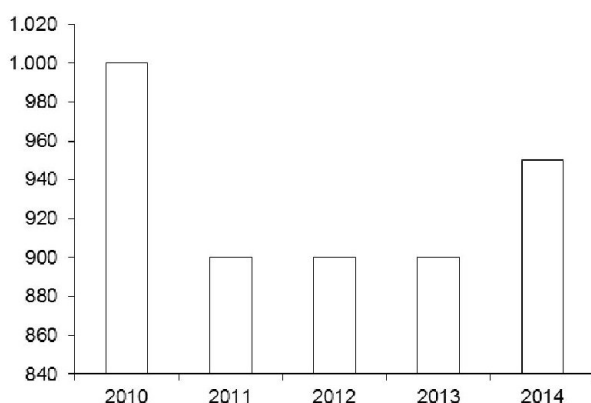
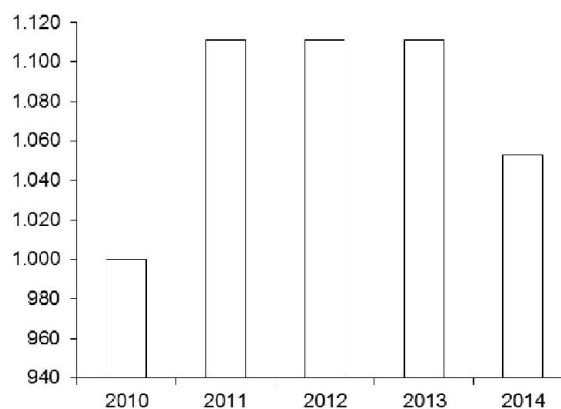
Figure 2. Poppy yield (kg ha<sup>-1</sup>) in the world (2010-2014)

Figure 3. Area under poppy (ha) in the Republic of Serbia (2010-2014)

Figure 4. Poppy yield (kg ha<sup>-1</sup>) in the Republic of Serbia (2010-2014)

in the world was in 2013 and 2010 (832 kg ha<sup>-1</sup> and 816 kg ha<sup>-1</sup>, respectively), Figure 2. Variability measured by coefficient of variation, in the world, for the average yield was 9.26% and for the average area 26.83%.

The average production of poppy seed in the world was 82,956 t and the volume of world production was from 54,606 tons (2012) to 108,111 tons (2011). Variability, measured by the coefficient of variation, for the production of poppy seed was 25.79%.

#### **Area and yield of poppy in the Republic of Serbia**

Average area under poppy in the Republic of Serbia, in the studied period, amounted to 934 ha, or 0.85% of the total world area, Table 1. The largest area of poppy seed in the Republic of Serbia was in 2010 and 2014 (995 ha and 945 ha, respectively), Figure 3.

In the period of 2010-2014 poppy seed in the Republic of Serbia had the average yield of 1,078 kg ha<sup>-1</sup>, and showed an annual 1.08%

trend of growing, with stability. The highest yield of poppy seed in the Republic of Serbia was in 2011, 2012 and 2013 (1,111 t ha<sup>-1</sup>), Figure 4. The highest production of poppy seed was in 2010 and 2013 (1,022 t).

Average production of poppy seed in the Republic of Serbia was 1004 t, or 1.21% of the total world production. Variability, measured by coefficient of variation, in the Republic of Serbia, for the average area was 4.52% and for the yield of poppy seed was 4.61%.

Poppy seed's share in world agricultural production and trade is negligible, but its market character is specific. It is one of the few crops that are produced within the relatively narrow group of countries, which then supply the world with their production. For example, in 2009 the volume of world production of poppy seed reached approximately 100,000 t and the volume of world trade was about 70,000 t, because the volume of trade was affected by stocks from previous years.

In the world, the harvested area of poppy seed is roughly 110,000 ha. It oscillates significantly depending on the world price and other factors such as weather, administrative regulation, stocks, etc. In the years 1961-2009 harvested area of poppy seed oscillated between 30,000 and 160,000 ha. The distribution of harvested areas of poppy seed in the world more or less corresponds to the level of world production. According to FAO (2009), majority of the harvesting areas for the production of poppy seed is located in Europe (about 80%). In terms of the major producers, most of them are currently located in the European Union (about 90,000 ha). In terms of the Europe and the world, the dominant producers are found in the following countries (share of world production in the period 1961-2009): the former Czechoslovakia (30%), France (5%), Hungary (8.5%), Germany (6.2%), Romania (4.4%), and Austria (2%). However, the above data are only averages for the reporting period. Over the past 50 years, the situation has changed and is currently as follows - these countries are dominant, starting with the Czech Republic (33%), Turkey (34.6%), France (6.6%), Hungary (3.5%), Germany (3.33%), Romania

(1.92%), Austria (1.52%) and Slovakia (1%). In terms of growth rate, the highest rate in the years 1993-2009 points to the following producers: Romania (20% year<sup>-1</sup>), Czech Republic (14% year<sup>-1</sup>), Turkey (8.6% year<sup>-1</sup>), Austria (7% year<sup>-1</sup>) and France (6% year<sup>-1</sup>), (Procházka & Smutka, 2012).

## CONCLUSION

Poppy seed is interesting to the global agricultural market. Poppy seed was sown annually worldwide on, about 110,183 ha. Realized poppy seed areas in 2010 (149,025 ha) were higher than in the other studied years. In this period, world average production of poppy seed reached 82,956 t.

In the Republic of Serbia, poppy seed is cultivated in small areas. Poppy seed was sown in the Republic of Serbia with average of 934 ha. Realized poppy seed areas in 2010 (about 1,000 ha) were higher than in the other studied years. In this period, poppy seed had average yield of 1,078 kg ha<sup>-1</sup> and average production of 1,004 t.

## REFERENCES

- Baydar, H., & Turgut, I. (1999). Variations of fatty acid composition ascending to some morphological and physiological properties and ecological regions in oilseed plants. *Turkish Journal of Agriculture and Forestry*, 23(EK1), 81-86.
- Bozan, B., & Temelli, F. (2003). Extraction of poppy seed oil using supercritical CO<sub>2</sub>. *Journal of Food Science*, 68(2), 422-426.
- Bozan B., & Temelli F. (2008). Chemical composition and oxidative stability of flax, safflower and poppy seed and seed oils. *Bioresource Technology*, 99(14), 6354-6359.
- Dekić, V., Milovanović, M., Popović, V., Milivojević, J., Staletić, M., Jelić, M., & Perišić, V. (2014). Effects of fertilization on yield and grain quality in winter triticale. *Romanian Agricultural Research*, 31, 175-183.
- Filipović, V., Popović, V., Glamočlija, Đ., Jaramaz, M., Jaramaz, D., Anđelović, S., & Tabaković, M. (2014). Genotype and soil type influence on morphological characteristics, yield and oil content of oil flax. *Bulgarian Journal of Agricultural Science*, 20(1), 79-86.
- Glamočlija Đ., Janković S., Popović V., Filipović V., Kuzevski J., Ugrenović, V. (2015). *Alternative crops in conventional and organic cropping system*. Belgrade, Serbia: Institut za primenu nauke u poljoprivredi (in Serbian).
- Gök, V., Akkaya, L., Obuz, E., & Bulut, S. (2011). Effect of ground poppy seed as a fat replacer on meat burgers. *Meat Science*, 89(4), 400-404.
- Guil Guerrero, J.L., Gimenez Martinez, J.J., & Torija Isasa, M.E. (1998). Mineral nutrient composition of edible wild plants. *Journal of Food Composition and Analysis*, 11(2), 322-328.



- Kušvić, V. (1960). Cultivation of the opium poppy and opium production in Yugoslavia. *Bulletin on Narcotics*, 2, 5-13.
- FAO (2017). FAOSTAT database. Retrieved on 05/15/2017 from <http://fao.org/faostat>
- Özcan M.M., & Atalay, Ç. (2006). Determination of seed and oil properties of some poppy (*Papaver somniferum* L.) varieties. *Grasas y Aceites*, 57(2), 169-174.
- Popović, V. (2010). *Influence of agro-technical and agro-ecological practices on seed production of wheat, maize and soybean* (Doctoral dissertation). University of Belgrade, Faculty of Agriculture, Belgrade, Serbia (in Serbian).
- Popović, V. (2015). The concept, classification and importance of biological resources in agriculture. In J. Milovanović, S. Đorđević (Eds.), *Conservation and enhancement of biological resources in the service of ecoremediation* (pp. 29-51). Belgrade, Serbia: Futura.
- Popović, V., Marjanović-Jeromela, A., Glamočlija, Đ., Maksimović, L., Čurčić, Ž., Kiproviski, B., & Jakšić, S. (2017). Phenotypic characterization of the Serbian poppy (*Papaver somniferum* L.) population. In Carpentier S., Pieruschka R., Rubiales D., Kondić-Špika A. (Eds.), *Current and future applications of phenotyping for plant breeding, COST WG1 / EPPN2020 workshop, Abstract book* (p. 35). Novi Sad, Serbia: European Cooperation in Science and Technology.
- Popović, V., Maksimović, L., Vasić, M., Marjanović-Jeromela, A., Mihailović, V., Ikanović, J., Stojanović, D., & Filipović, V. (2018). Yield and oil content and total phenol content in seeds of poppy (*Papaver somniferum* L.) in organic cropping system. 59. *Production and Processing of Oilseed Proceeding of the 55<sup>th</sup> Oil Industry Conference* (pp. 85-94). Herceg Novi, Montenegro.
- Procházka, P., & Smutka, L. (2012). Czech Republic as an important producer of poppy seed. Czech Republic. *Agris on-line Papers in Economics and Informatics*, 4(2), 35-47.
- Raie, M.Y., & Salma, I. (1985). *Sesamum indicum* and *Papaver somniferum* oils. *Fette, Seifen, Anstrichmittel* 87(6), 246-247.
- Singh, S.P., Khanna, K.R., Dixit, B.S., & Srivastava, S.N. (1990). Fatty acid composition of opium poppy (*Papaver somniferum* L.) seed oil. *Indian Journal of Agricultural Sciences*, 60(1), 358-359.
- Singh, S.P., Khanna, K.R., Shukla, S., Dixit, B.S., & Banerji, R. (1995). Prospects of breeding opium poppies (*Papaver somniferum* L.) as a high-linoleic-acid crop. *Plant Breeding*, 114(1), 89-91.
- Vajić B., & Mikić F. (1951). *About water content and morphine in Yugoslav opium*. Belgrade, Serbia: Serbian Academy of Sciences (in Serbian).
- Živanović, Lj., & Popović, V. (2016). Proizvodnja soje (*Glycine max*) u svetu i kod nas. *XXI savetovanje o biotehnologiji, Zbornik radova 1, Vol 21(23)* (pp. 129-135). Čačak, Srbija.

## SAŽETAK

### PROIZVODNJA MAKI (*Papaver somniferum* L.) U SRBIJI

VERA POPOVIĆ, LIVIJA MAKSIMOVIĆ, ANA MARJANOVIĆ-JEROMELA, MIRJANA VASIĆ, MAJA IGNJATOV, VERA RAJIČIĆ, ZORAN JOVOVIĆ

Mak (*Papaver somniferum* L.) je izvor ulja, proteina, ugljenih hidrata kao i jedinjenja koja se koriste u farmaceutskoj industriji. Cilj ove studije bio je da se prikaže položaj Republike Srbije u proizvodnji maka, u periodu 2010-2014. U Republici Srbiji mak je gajen na malim površinama. Prosečan prinos maka u Republici Srbiji iznosio je 1078 kg ha<sup>-1</sup> i bio je stabilan. Prosečne površine pod makom, u istraživanom periodu u Republici Srbiji, iznosile su 934 ha, dok je prosečna proizvodnja iznosila 1004 t, odnosno proizvodnja maka u Srbiji činila je 1,21% od ukupne svetske proizvodnje. Varijabilnost, merena koeficijentom varijacije, za površinu pod makom iznosila je 4,51% dok je za prinos maka iznosila 4,61%. Učešće Republike Srbije u ukupnoj svetskoj proizvodnji iznosilo je 0,85%.

**KLJUČNE REČI:** *Papaver somniferum* L., površina, prinos, proizvodnja, svet, Republika Srbija