

**PROFITABILITY OF RASPBERRY PRODUCTION ON HOLDINGS IN
THE TERRITORY OF ARILJE¹***Nataša Kljajić², Jonel Subić³, Zorica Sredojević⁴***Abstract**

Raspberry is the most important kind of berries and specific in many of its characteristics - biological properties, economic importance, agro-ecological, technological and organizational requirements, the market value of the product, as well as very high interdependence and correlation between the individual phases of the reproductive cycle. Due to its extremely pleasant smell and taste and high nutritional value, raspberry represents a very esteemed and sought fruit which has a high price in the world market and is very suitable for processing. In addition to financial effect, the cultivation of raspberries enables recruitment of labour force, which is in our economic situation of great socio-economic importance, especially in the mountainous regions of Serbia. Based on real data examples, this paper analyzes the economic profitability of this production. Investments in the establishment and cultivation of a raspberry plantation under irrigation amount to 12.140 €/ha. In the production of raspberries a very favourable annual financial result (profit) in the amount of 9300 €/ha is achieved, production is very cost-effective, accumulation is significant (about 77%) and return on equity is in the second year of exploitation. The established economic and financial results show that the production of raspberries is very profitable.

Key words: investment, raspberry, production, profitability.

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Introduction

There are over 3.8 million hectares of agricultural land in Serbia, out of which 3.4 million hectares (89%) is arable land. Orchards are spread over an area of 164,062 hectares and account for 4.7% of the total utilized agricultural area (Statistical Office of the Republic of Serbia, 2017). With regard to fruit production, the production of berries (strawberries, raspberries, blackberries, blueberries, etc.) is of the greatest importance for the economy of our country, and among them, raspberry production has the leading position (Galić et al., 2014). In Serbia, raspberry (*Rubus idaeus* L) is grown on an area of 11,041 ha which is actually 6.7% of the total area under orchards in our country, or 0.3% of the total utilized agricultural area. With such small areas planted with raspberries around 200 million euro can be annually generated in revenue in the Republic of Serbia (Cecić et al., 2007). The economic importance of raspberry is determined by several major factors: high and varied use-value of the fruit; a relatively high rate of return in favourable agro-ecological conditions; high merchantability of the product; additional employment of labour force and an indirect impact on the overall socio-economic development; production of honey made from raspberries etc. (Petrovic, Milosevic 2002). It is in the interest of both producers and processors to retain as high share of “rolend” raspberry (the first Class) when freezing it as possible, as it achieves the highest price in the international market. Some major raspberry producers, besides plantations, own cold storage facilities (mini cold storage facilities) for processing, thus rounding off the production cycle with frozen raspberry as a final product. Raspberry producers can successfully develop by joining (connecting to) a cluster and thus maintain the leading position in the global market, but only if a number of assumptions are fulfilled, some of which are: efficiently organized raspberry market chain through vertical and horizontal integration of all stakeholders in this sector; strengthening of specialized cooperatives and associations of raspberry producers; joining a cluster of manufacturers of other berries; a greater role of innovation, scientific knowledge and research and development in the production, processing, packaging, logistics, export of raspberries and the like (Kljajić, 2012; Sredojević et al., 2013).

The research presented in this paper is the economic analysis of growing raspberries on family-owned farms, with a starting hypothesis that the production of raspberries in Serbia provides a relatively secure income for farmers. Therefore, the main objective of this research is to determine the profitability of the production from the viewpoint of the producer (cultivator) on the basis of investments and financial results achieved per unit area, in the representative raspberry growing area in Serbia (ie. Arilje).

Materials and methods

Multiple sources were used for the research in this paper. Current state and trends in the production of raspberry in Serbia and in the world are perceived on the basis of statistical data downloaded from websites and available statistical publications. Economic analysis and financial indicators of raspberry production per unit area were made on the basis of actual data from practice in the region of Arilje. The established parameters are the investment amount during the two-year cultivation period, average annual financial result in regular production, the rate of capital accumulation and the payback period. The results are displayed graphically

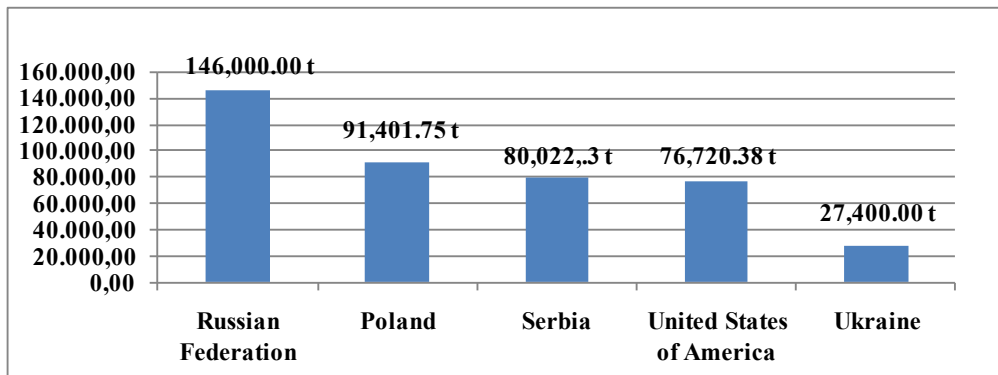
and in tabular form, and the profitability score is based on the criteria for certain indicators.

Research results and discussion

The state of raspberry production in the world and in Serbia

Raspberry is one of the most profitable fruit products. The economic importance of its production is reflected in the high level of merchandising, competitiveness and increasing demand for frozen raspberries in the market of the European Union. Factors that contribute to it are the long tradition of production and specific ecological conditions of the area with specific geomorphologic and pedological features and microclimatic conditions in which Serbian raspberry is grown. The Republic of Serbia is one of the world’s leading producers of raspberries. During the period 2006 - 2015 average annual yield of raspberry production in Serbia amounted to around 80,000 t, according to which Serbia is the third largest producer of raspberries in the world after the Russian Federation and Poland. Other top raspberry producing countries include the United States and Ukraine (Graph 1).

Graph 1. Production of raspberries in leading countries (producers) in the world, 2006-2014



Source: <http://faostat3.fao.org/browse/Q/QC/E>

When observing the areas under raspberry plantations, the total production volume and average yield of raspberry in Serbia in the period 2006-2015, mild oscillations per year can be noticed (Table 1). The largest area under this production was in 2011 (15,354 ha), when the production volume increased by 12.45% compared to 2006. Despite smaller areas under raspberry plantations in 2015 compared to 2006, the average yield increased from 5.3 t/ha to 6 t/ha (Kljajić et al., 2016). This is justified by the fact that in practice old poorly productive plantings are removed and new plantations with productive varieties of raspberry are cultivated.

Table 1. Surface area, production and average yield of raspberry in the Republic of Serbia, 2006-2015

Year	The Republic of Serbia					
	Area harvested		Total production		Average yield	
	(ha)	Index (2006=100)	ton	Index (2006=100)	(t/ha)	Index (2006=100)
2006	15,024	100.00	79,680	100.00	5.3	100.00
2007	14,496	96.48	76,991	96.62	5.3	100.00
2008	14,680	97.71	84,299	105.79	5.7	107.54
2009	14,957	99.55	86,961	109.14	5.8	109.43
2010	15,174	100.99	83,870	105.26	5.5	103.77
2011	15,354	102.19	89,602	112.45	5.8	109.43
2012	11,996	79.84	70,320	88.25	5.9	111.32
2013	12,024	80.03	68,458	85.92	5.7	107.54
2014	11,040	73.48	61,715	77.45	5.6	105.66
2015	11,041	73.48	66,176	83.05	6.0	113.20

Source: SORS, *Statistical Yearbook of the Republic of Serbia, 2007-2016*

In our country, raspberry is an important export product and the largest quantities are exported to the European Union. Benefits of exports to EU countries are primarily due to their deficiency in raspberry and a relatively high living standard that enables a significant level of demand for raspberry as an exclusive and healthy fruit. Over 90% of produced quantity is frozen and exported - in the form of rolend, grits and blocks, while the remainder is sold as fresh fruit or is processes in raspberry concentrates (Paraušić, Simeunović, 2016). About 60% to 70% of domestic raspberry exports are realized by the members of Business Association of Serbian cold storage companies and almost all cold storage companies - members of the Association possess HACCP standards and other standards required by the global market (Kljajić et al., 2013a).

Table 2 provides an overview of raspberry exports by country of import in the period 2013-2015. The largest quantities of frozen raspberry were exported to Germany, a total of 77,128 t in three years, and large quantities were exported to France, Belgium, USA, Great Britain, Sweden as well. The realized average value of exports during the three year period amounted to 230,607 USD.

Table 2. Raspberry export from Serbia by country of import in the period 2013-2015

Raspberry (frozen, no sugar)	Quantity, t			Value, thousands of USD		
	2013	2014	2015	2013	2014	2015
Germany	22,447	24,122	30,559	68,579	78,930	87,007
France	16,215	17,058	21,443	43,781	51,276	56,270
Belgium	7,087	7,276	8,397	24,412	25,045	25,513
USA	1,304	3,554	4,683	4,938	12,733	16,116
Great Britain	1,734	2,296	3,894	5,924	7,124	12,466
Sweden	2,680	3,420	3,162	9,122	12,280	9,626

Other countries	9,951	15,527	21,577	30,602	49,128	60,949
Total:	61,417	73,253	93,714	187,358	236,518	267,945

Source: SORS, 2017, *Statistical Yearbook of the Republic of Serbia, 2016*

The western part of central Serbia is the most important production region where extensive raspberry production is concentrated on a small area famous for its raspberry plantations. The largest and most famous raspberry plantations in Serbia are in: Arilje-Požega region (including Moravica and Dragacevo area) and Valjevo region. The greatest production of raspberry is concentrated in the municipalities of Arilje, Bajina Basta, Brus, Valjevo, Guca, Kosjeric, Krupanj, Ivanjica and Mionica with predominantly small farms relying on human labour.

In these areas indigenous species of raspberry prevails with a variety of types that represent a wealth of genetic resources for this type of fruit. It is of great importance that this indigenous material has an outstanding adaptability to soil and climatic conditions of the environment in which it is located. Various genotypes have some significant characteristics that stand out, such as expressed aroma, specific taste, dietetic and technological value, curative properties and so on (Milivojević et. al., 2005, Sredojević et al., 2015).

Raspberry plantations in the municipality of Arilje cover an area of 1226.05 ha (SORS, 2017, Census of Agriculture, 2012), where an average of 15,000 t of raspberry is produced annually (from 13,500 to 16,500 t). About 15,000 t of raspberry is frozen, processed and exported from the cold storage plants on the territory of the municipality annually.

Raspberry is grown throughout the territory of this municipality and over 95% is grown on family farms, on plots of about 0.3 ha on average (Kljajić, 2014). As a labour-intensive culture it has a major impact on additional employment (<http://arilje.org.rs/>). Raspberry production in Arilje accounts for 19.5% of the total production of raspberries in Serbia. Raspberry production in Zlatibor region covers an area of 3,893 ha, and in the region of Sumadija and Western Serbia 10,513 ha (SORS, 2017, Census of Agriculture, 2012).

Investments in establishing raspberry plantations

Investments in raspberry production are as specific as the production itself owing to the influence of climatic factors, the discrepancy between the production time and working hours, the biological nature of certain working processes and the like. Biological processes, due to their cyclical and seasonal character, have impact on the realization of investments in certain periods of the year (Sredojević et al., 2013; Galić et al., 2014).

Investments in establishing raspberry plantation on a family farm are presented in Table 4. The model is made according to the empirical input-output data received from the producers, experimental results and research (Kljajić, 2012, Kljajić et al. 2013b). Initial assumptions in preparing the economic model of establishing a plantation are as follows:

- suitable climatic and pedological conditions for growing raspberries;

- planting the entire surface area of 1 ha at once;
- the manufacturer has the machinery necessary for the production of raspberries (walk-behind tractor, trailers, spraying accessories, etc.);
- the manufacturer can provide the necessary labour force during the “rush hours” by hiring temporary (seasonal) workers;
- irrigation system is adapted to the plot and the plantation, and its value is taken according to the real average value on the market; raspberry variety “Willamette” is cultivated in standard (conventional) system of vertical row spacing, and the plantation is raised with 2.50 x 0.25 m between-row and in-row spacing; the number of seedlings needed for an area of 1 ha with the required plant spacing is 16,000;
- seedling purchase price is 0.25 €; growing period is two years and “small yield” or “low yield” appears in the second year after planting;
- calculative interest rate is 8%; placement is safe for the planned volume of raspberry production; purchase (sale) price of raspberries is 1.7 €/kg.

Table 3. Investments in raising 1 ha of raspberry (*Area: 1ha; Planting system: Row spacing: 16,000 plants/ha*)

Number	Indicators	The year of plantation establishment (m)			Total (€)
		0	1.	2.	
1	Material	4,000.00	680.00	720.00	5,400.00
2	Labour force	330.00	320.00	240.00	890.00
3	Machine work	250.00	210.00	180.00	640.00
4	Investment in irrigation	-	3,200.00	-	3,200.00
5	Project, supervision and control	220.00	240.00	190.00	650.00
6	Construction of additional facilities, roads, etc.	160.00	140.00	210.00	510.00
I	Total investments	4,960.00	4,790.00	1,540.00	11,290.00
II	The value of “small” yield	-	-	358.00	358.00
III	Adjusted investments (I-II)	4,960.00	4,790.00	1,182.00	10,932.00
IV	The discount factor (1,08 ^m)	1.1664	1.0800	1.0000	-
V	Investments at the beginning of plantation exploitation(A ₀)	5,785.00	5,173.00	1,182.00	12,140.00

Source: Kljajić, 2012.

According to the analysis in Table 3, the total amount of investments along with all the accompanying interest rates (Milojevic, Zekic, 2015), at the end of the period of establishing a raspberry plantation (i.e. at the end of the second year) amounts to 12,140.00 €/ha.

In the previous period in the region of Arilje raspberry production was observed on small family farms where irrigation systems are being introduced. Drip irrigation is becoming a regular agromeliorative measure in the process of raspberry production in this area. Use of irrigation, limited to smaller areas in private hands, gave positive results in terms of high and uniform yield of quality raspberry (Cecić et al., 2007; Gajic et al., 2013).

Based on empirical data, and for the purposes of this study, calculation of investment in establishing a raspberry plantation was made as well as calculation of raspberry production at regular production. Raspberry plantation as an investment should be realized in a form that will ensure the maximum efficiency of exploitation, i.e. as high level of benefit per unit of invested funds as possible. The methods, through which the economic efficiency of investment is expressed in agricultural holdings, hold an important place not only in agriculture but also in the organization of sustainable development of a company at micro level (Subić, 2010).

Raspberry production costs

Raspberry production is characterized by *labour-intensive and seasonal character*. Production takes place mainly on family farms where almost all members of the household are engaged in agricultural activity. During the picking season, seasonal labour force is engaged. Raspberry picking is done repeatedly and lasts from three to four weeks because raspberry fruits do not ripen simultaneously.

Gradual fruit ripening raises the harvest cost, but it enables supplying fresh raspberries to the market. Further analysis, based on the technology map (process planning) for one production cycle, defined total production costs per hectare of raspberries (Table 4).

Considering the fact that in this area raspberry is still harvested by hand, labour costs have a higher share in the structure of the total cost (58%).

Table 4. Costs of exploitation of plantations at regular raspberry production

Type of costs	Unit of measure (u. m.)	Quantity (size)	Price (€/u.m)	Amount (€/ha)
1. Material costs				
Manure	t	15	20.00	300.00
NPK (15:15:15)	kg	700	0.80	560.00
KAN (27 % N)	kg	400	0.60	240.00
Trellis binder	kg	10	5.00	50.00
Pesticides	kg	-	-	180.00
<i>Total (1.):</i>	-	-	-	1,330.00
2. Cost of services (machine work)				
Transport and distribution of manure	hour/tractor	6	35.00	210.00
Transport and distribution of mineral fertilizers	hour/tractor	2	35.00	70.00
Transport of packaging	hour/tractor	1	20.00	20.00

Type of costs	Unit of measure (u. m.)	Quantity (size)	Price (€/u.m)	Amount (€/ha)
Interred processing (4x)	hour/walk behind tractor	30	5.00	600.00
Phytosanitary protection (4x)	hour/walk behind tractor	30	5.00	600.00
Transport of fruit during the harvest	hour/tractor	40	20.00	800.00
Autumn plowing	hour/tractor	1	50.00	50.00
<i>Total (2.):</i>				2,350.00
3. Labour costs				
Loading and unloading of manure	working day	5	15.00	75.00
Loading and unloading of mineral fertilizers				
	working day	5	15.00	75.00
Sprout tying and wire tightening	working day	5	15.00	75.00
Irrigation	working day	50	15.00	750.00
Removal of young shoots (3x)	working day	10	15.00	450.00
Hand hoeing following the row direction (2x)	working day	20	15.00	600.00
Harvest	working day x no. of workers	195	15.00	2.925.00
Pruning and removal of old shoots	working day	10	15.00	150.00
<i>Total (3.):</i>	-	-	-	5,100.00
4. Other costs				620.00
5. Total costs (1.+2.+3.+4.):				9,400.00

Source: Author's calculation based on the calculation data of raspberry production on a family holding

Total costs which include material costs, cost of services or machine work, labour costs and other costs, at regular raspberry production amount to 9,400 €/ha.

Indicators of profitability of raspberry production

The value of production for one production cycle is determined on the basis of average yields achieved in practice on farms in the region of Arilje as well as the purchase price. Economic justification of raspberry production on a farm is assessed by using the static methods. Several selected economic indicators were determined: coefficient of efficiency, financial result, raspberry production cost per 1 kg, the rate of accumulation and the payback period.

For the purpose of analysis, the data for the year 2016 were taken as the representative economic parameters, and according to the relevant criteria, the profitability of raspberry production was assessed (Table 5).

Table 5. Indicators of profitability of raspberry production on a family holding

Ekonomic indicators of raspberry production	Amount
<i>I. Investments during the period of raising a plantation</i>	12,140.00 €
<i>2. Indicators at regular raspberry production</i>	
<i>A. Value of production (11.000 kg * 1,7 €/kg)</i>	18,700,00 €
<i>B. Total costs</i>	9,400.00 €
<i>C. Financial result - profit / loss (A. - B.)</i>	9,300.00 €
<i>D. Raspberry production cost per 1 kg (B./11.000 kg)</i>	0.85 €
<i>E. Coefficient of efficiency (A./B.)</i>	1.98
<i>F. Rate of accumulation (C./I.)</i>	76.60 %
<i>G. Payback period (I./C.)</i>	1.30 year

Source: Author's calculation based on the calculation data of raspberry production on a family holding

The main parameters for determining the achieved production are the capacity (surface area) and intensity of production. In the analyzed year average raspberry yield in the region of Arilje was 11 t/ha, and the average purchase price of raspberries 1.7 €/kg (according to Innovation Center for Agriculture Arilje), which makes the production value of 18.7000 €/ha. The difference between the value of production and total costs generates a positive financial result (profit) in the amount of 9300 €/ha. The production cost is 0.85 €/kg, which is much lower compared to sales (purchase) price, i.e. 1.7 €/kg, which is beneficial to producers of raspberries. Coefficient of efficiency in the amount of 1.98 is well above the minimum amount of 1, and the rate of accumulation shows that for every 100 Euro of invested capital about 77 euros are accumulated. The payback period of the capital invested in the establishment and cultivation of raspberries, is as early as in the second year of exploitation, i.e. in the second year of raspberry production. Based on this analysis and established indicators regarding all the criteria, it can be concluded that raspberry production is economically justified and very profitable.

Raspberry production has certain disadvantages because of high sensitivity of fruits, low durability, and low transportability. It is estimated that almost 40% of the yield is lost during the transportation period between the farm and the final consumer. A large part of this loss occurs due to poor post-harvest handling, including the transport. By reducing the amount of hand contact and applying appropriate packaging techniques, the percentage of loss will be reduced too.

Since the fruit is sensitive, its storage in the fresh state is difficult and short-term. After the harvest, raspberry has to be cooled and deep frozen, which makes it highly dependent on processing. Therefore, the proximity to processing facilities is very important as well as quick and organized transport in order to prevent loss of quality (Sarić, 2009). Fresh raspberry fruit can be stored for 10-14 days in cold storage at -0.6 ° to 0° C and at relative humidity of 85-90%. Today, raspberry is increasingly frozen as individual quick frozen fruit or "rolend" raspberry, and thus prepared it is kept until use. Deep frozen raspberry can be stored for a long time at -18 to -20 ° C. These fruits must be used shortly after defrosting.

Conclusion

According to the established economic indicators, raspberry production on a farm in the region of Arilje is economically viable and highly profitable. Raspberry production provides an average income of 9,300 €/ha. The coefficient of efficiency in raspberry production is 1.98, which means that the production is cost-effective, or acceptable. Rate of accumulation is about 77% and payback period is as early as in the second year of exploitation. By observing the results of the economic analysis of raspberry production it may be concluded that this production achieves good profitability. The level of profitability that is realized through production depends on the achieved volume of production and purchase price, but can be increased by reducing production costs, increasing the yield per unit area, as well as better organization of production and distribution (Mihajlovic, 2014). This production requires greater involvement of labour force, which contributes to the employment of local population, consequently providing positive social effects.

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PROFITABILNOST PROIZVODNJE MALINE NA GAZDINSTVIMA NA PODRUČJU ARILJA⁵

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Apstrakt

Malina je najznačajnija vrsta jagodastog voća i specifična po mnogim svojim karakteristikama - biološkim osobinama, ekonomskom značaju, agro-ekološkim, tehnološko-organizacionim zahtevima, tržišnoj vrednosti proizvoda, kao i vrlo visokoj međuzavisnosti i uslovljenosti između pojedinih faza reprodukcionog ciklusa. Zahvaljujući svom izuzetno prijatnom mirisu i ukusu i velikoj nutritivnoj vrednosti, malina predstavlja jako cenjeno i traženo voće koje na svetskom tržištu ima visoku cenu i veoma je zahvalna za preradu. Pored finansijskog efekta, gajenje maline omogućava uposlenje radne snage, što je u našoj ekonomskoj situaciji od velike socio-ekonomske važnosti, naročito u brdskim rejonima Srbije. Na bazi realnih podataka iz prakse, u radu je ekonomska analiza profitabilnosti ove proizvodnje. Utvrđena su investiciona ulaganja u zasnivanje i uzgoj maline u uslovima navodnjavanja u iznosu od 12.140 €/ha. U proizvodnji maline se godišnje postiže veoma povoljan finansijski rezultat (dobit) u iznosu od 9.300 €/ha, jako je ekonomična proizvodnja, značajna akumulativnost (oko 77%) i povraćaj kapitala već u drugoj godini eksploatacije zasada. Utvrđeni ekonomski i finansijski rezultati u pokazuju da je za uzgajivače, proizvodnja maline jako profitabilna.

Ključne reči: *investiciono ulaganje, malina, proizvodnja, profitabilnost*

5 Rad je deo istraživanja na projektima III-46006 Održiva poljoprivreda i ruralni razvoj Dunavskog regiona u smislu realizacije strateških ciljeva Srbije; 31058 - Sušenje voća i povrća iz integralne i organske proizvodnje kombinovanom tehnologijom; 179028 – Ruralno tržište rada i ruralna ekonomija Srbije - diverzifikacija dohotka i smanjenje siromaštva; i 46009 – Unapređenje i razvoj higijenskih i tehnoloških postupaka u proizvodnji namirnica životinjskog porekla u cilju dobijanja kvalitetnih i bezbednih proizvoda konkurentnih na svetskom tržištu, koje finansira Ministarstvo prosvete, nauke i tehnološkog razvoja Republike Srbije, u period 2011-2017

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