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ECONOMIC ASPECTS IN THE RASPBERRY PRODUCTION ON THE EXAMPLE OF FARMS FROM POLAND, SERBIA AND UKRAINE

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ABSTRACT

For many years Poland and Serbia have played the dominating roles in European raspberry production. However, the growing production in Ukraine might threaten the relative stability of the raspberry market for both countries. It is projected that in the coming years Ukraine will strengthen its competitive position in relation to the current industrial raspberry production leaders. This justifies the need to conduct comparative analyses of competitive power, and its contributory factors, including production costs in individual countries. The aim of this study was to compare economic viability and cost-effectiveness in raspberry production, using the examples of selected horticultural holdings in Poland, Serbia, and Ukraine. The production volumes of raspberries in Poland, Serbia and Ukraine were analysed. The levels of costs and the financial results generated in raspberry cultivation for processing purposes were also determined, using the example of horticultural holdings in this countries. The results indicated that the direct costs in Ukraine, were just over half lower those in Poland and Serbia. The raspberry crop yields in the three investigated countries were similar, and the sales prices in the analysed years made it possible to obtain a surplus of receipts over direct costs.

Keywords: costs competitiveness, economic efficiency, profitability, raspberry

INTRODUCTION

The efficiency of the activities conducted by an agricultural holding is one of the principal elements contributing to its competitive market standing (Ziętara & Zieliński 2012). Progress in operational activities is therefore essential, as it determines the growth of the holding's value and its production capacities, and also opens up new prospects for gaining a competitive advantage. The importance of competitiveness is growing in all sectors of the economy, including agriculture (Kravčáková Vozárová 2013). Profitable fruit production is a condition for the proper development of a holding and its competitive power, the latter being one of the core principles of the market economy. Farmers are taking up to grow berries because, as Zbanca et al. (2018) claimed, production of berries allows for highest profits and presents a major potential for increasing the income of small farmers and diversifying the sources of income in rural areas. The profitability and competitiveness of raspberry production depends both on an array of economic and climate-related factors and on individual decisions made by producers (Zarzecka et al. 2018; Di Vittori et al. 2018). The fact that the broad meaning of the concept of "competitiveness" determines the consideration of various components in its assessment (Latruffe 2010). The competitive advantage is also determined by several factors, in particular price, quality, and cost levels (Nosecka et al. 2011). Those producers who incur lower production and marketing costs, while ensuring the desirable product quality, stand better chances of entering and surviving on the market (Greblikaite et al. 2019). It is therefore competitive power which reflects the holding's potential and puts it in a more advantageous position in relation to other entities operating in the same market sector.

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It also proves the holding's readiness to pursue further growth, obtain benefits and profits, and gain a competitive edge. However, the competitive edge and market standing cannot be won once and for all (Kraszewska & Pujer 2017). This appears particularly significant in horticultural production, which is very intensive, requires substantial capital, and is cost-consuming.

During recent years Poland has become one of the largest raspberry producers in the world. The high quality of Polish raspberry fruit is a result of a combination of relatively favorable climatic and soil conditions as well as advanced technologies. As stressed by Jabłońska et al. (2017), in Poland the issue of external competition in raspberry production, which is definitely export-oriented, appears of the utmost importance. For many years Poland and Serbia have played the dominating roles in European raspberry production for processing purposes. However, in recent years there has been growth in raspberry plantings and yields in Ukraine, coupled with growing imports of frozen raspberries from that country to Poland. It is projected that in the coming years Ukraine will strengthen its competitive position in relation to the current industrial raspberry production leaders. This situation can be seen as resulting, *inter alia*, from high raspberry procurement prices in Poland in 2012–2016, and growing labor costs. This justifies the need to conduct vertical and horizontal comparative analyses of competitive power, and its contributory factors, including production costs in individual countries. In international comparisons, the competitiveness of agriculture is often assessed in the terms of cost (Nowak & Kaminska 2016). The aim of this study was to compare economic viability and cost-effectiveness in raspberry production, using the examples of selected horticultural holdings in Poland, Serbia, and Ukraine.

MATERIAL AND METHODS

A comparative analysis of the production volumes of raspberries in Poland, Serbia, and Ukraine was conducted, and the levels of cost and financial results were examined in the holdings producing raspberries for processing purposes. To this end, 10 farms in Poland, 6 in Serbia, and 8 in Ukraine were surveyed between 2015 and 2017. The surveys were carried out once a year after the harvest. The choice of the surveyed countries was made deliberately, in view of the need to compare the competitive power of holdings operating in the countries which were the largest raspberry producers in Europe. The economic performance results recorded by the Ukrainian and Serbian holdings were analysed through pilot surveys which are planned to be continued and extended. The economic results were determined on the basis of data resulting from economic events recorded by the surveyed holdings throughout the year, according to standardized principles and accuracy levels.

The average cultivation area in the surveyed holdings in Poland was 1.2 ha, in Serbia 0.8 ha, and in Ukraine 14.0 ha. These differences resulted from the varied size structure of holdings in the analysed countries. In Ukraine, contrary to the other two countries, most commodity crops are obtained from large-area raspberry plantings, exceeding 10 ha, established on the basis of the former State-owned Agricultural Holdings, which were then taken over by private investors. In Poland and Serbia, the cultivation areas tend to be more scattered (Djurkovic 2012; Kraciński 2014; Paraušić & Simeunović 2016). In Serbia, the average plantation area is about 0.50 ha (Paraušić & Simeunović 2016; Vukoje et al. 2017). Over 50% of all the plantations do not exceed 20 acres, 40% fall within the range 0.20–0.50 ha, and only approximately 10% are bigger than 1 ha (Veljkovic et al. 2008). In Poland, the plantation structure is less scattered than in Serbia, but around 40% of the crops are still grown on areas smaller than 0.50 ha. However, there are approximately 30% plantations exceeding 1 ha. The differences in raspberry production technologies between the surveyed holdings in the three countries are also significant. In Poland, most raspberry fruit is obtained from one-year shoots, from August to mid-October, referred to as "autumn raspberries." The plants are grown unsupported, often directly in the ground. The most-popular "autumn" cultivars grown in Poland are 'Polka' and 'Polana', which can be conveniently machine-harvested and used in the processing industry mainly for frozen fruit production (Baranowska & Zarzecka 2013). In Serbia, raspberries

are mainly harvested in early summer, from June to mid-July. Fruit is obtained from two-year shoots, and supports are used in all cases. The most popular cultivar is 'Willamette' (90–95%), and the other 10% include 'Meeker', 'Tulameen', 'Heritage', and others (Sredojević et al. 2013; Paraušić & Simeunović 2016). In Ukraine, both two-year shoots (the summer harvest) and one-year shoots (the autumn harvest) are common in raspberry cultivation, with plant supports being used in all cases. The following fruit cultivars were found in the Ukrainian holdings surveyed: 'Glen Ample', 'Willamette', 'Octavia', 'Meeker', 'Himbo-Top', 'Joan-Jay', 'Polka' and 'Polana'. To sum up, the Polish, Serbian and Ukrainian holdings covered by the survey exhibited certain differences in production technologies, cultivars, and harvesting times, which might have influence their competitive power when it came to the levels of costs, plantation efficiency, and input efficiency.

The cost levels and structures were analysed. The analysis of direct costs covered the costs of planting material, mineral fertilizers, crop-protection products, growth regulators, paid employment, crop insurance, and other specialized costs, whereas indirect costs included farming overheads (electricity, fuel, services, insurance, etc.), taxes, and the costs of external factors. Machine-related costs were also distinguished, comprising machine maintenance and operation costs. The individual types of costs were presented per hectare of plantation. Production value (calculated as the product of yield and sales price) was treated as an economic performance indicator, while production profitability was determined by the gross margin (GM – calculated as the difference between production value and direct cost) and the production profitability index (calculated as the production value to total costs). Production costs were defined on the basis of the cost effectiveness indicator, determined as the quotient of total costs to total yield (expressed in percentage terms). The comparative analysis of the market situation in raspberry production, i.e., cultivation area, harvest times, and yields, covered the years 2006–2017, while the cost analysis was limited to 2015–2017. The presented data were averaged for the three-year period under analysis. The costs were expressed in USD, according to the average rate of exchange over the three-year (2015–2017) period. The average annual exchange rates were calculated as the average rates over a one-year period. In Serbia, the costs recorded in EUR were converted into USD, according to the average annual rate of exchange announced by the National Bank of England (www.bankofengland.co.uk). In Ukraine, the costs recorded in UAH, due to the lack of historical data on the exchange rates of the national currency to USD, were first converted into PLN, and then into USD, according to the average annual rate of exchange announced by the National Bank of England. Despite the seasonal character of raspberry production, the average annual exchange rate of USD over the years 2015–2017 was adopted in the three countries, given the fact that certain production costs were incurred throughout the year.

Descriptive statistics methods were employed in the analyses. The direction and dynamics of raspberry production changes in the analysed countries were determined with the linear regression model, i.e., using the least squares method:

$$y = bx + a,$$

where: b – slope of the trend line (x; y), a – intercept, the y – value when x = 0.

The slope of the trend line (b) was determined for absolute and relative values, reflecting the percentage of the long-term average (100%). Changes were also analysed by employing stratum weights, single-base indices, and Pearson's correlation coefficient.

RESULTS AND DISCUSSION

The raspberry markets in Poland, Serbia and Ukraine

Raspberry production mainly takes place in Europe (Graham & Jennings 2009; Sredojević et al. 2013). For many years Poland and Serbia have been the largest producers of raspberries intended mainly for processing purposes (Baranowska & Zarzecka 2013; Apáti 2014; Paraušić & Simenuović 2016; Subić et al. 2017).

In Serbia, around 90–97% of the produced raspberries are frozen and intended for exports (Paraušić & Simenuović 2016; Kljajić et al. 2017). In addition, the shares of the raspberry production

areas in Poland and Serbia in the total raspberry production area in the world ranged from 11.7% to 16.6%, and from 18.5% to 31.1%, respectively, between 2006 and 2017. The largest volumes of raspberries are harvested in Russia (Sredojević et al. 2013; Kljajić 2017; Kljajić et al. 2017), but the entire raspberry production in that country generally remains on the domestic market (Djurkovic 2012; Paszko et al. 2016), thus having no real impact on the global raspberry market. In turn, such countries as Spain, Germany and the United Kingdom generally produce raspberries exclusively for the fresh market. The production of raspberries for processing purposes is also evident in some smaller countries, including Bosnia and Herzegovina and Kosovo. However, given their relatively small cultivation areas, the supply of fruit from those countries poses no threat to the current raspberry production leaders.

Ukraine is currently one of the largest raspberry producers in Europe. Inhabitants of Ukraine do not consume the amount of produced berries, the most crops is exported. Therefore, growing production in Ukraine may threaten the relative stability of the raspberry market both in Poland and in Serbia (Greblikaite et. al. 2019). The raspberry cultivation area in Ukraine did not expand between 2006 and 2017, but the crop volumes increased by over 30% (Table 1). In average terms, the yield grew by 3.55% (1.03 thousand tonnes) per year in the analysed period. In Serbia, the cultivation area increased by 45.51% and the crops by 37.73%, which corresponded to the average annual growth in the area and crops 2.40% and 2.78%, respectively. In Poland, changes to the cultivation area and crops, as compared to Serbia, were more rapid, as reflected by the growth of 72.20% and 98.87% respectively. Year on year, the raspberry cultivation area in Poland increased by 4.18%, and crops by 5.48%. Changes to the cultivation area and crops were characterized by a strong positive correlation in Serbia and Poland, the correlation coefficients amounting to 0.96 and 0.81 respectively. In Ukraine, however, a negative and low correlation between the changes to the cultivation area and crops was observed, with a correlation coefficient of −0.23. It reflected a faster growth in crops than in cultivation area, and resulted from the growing crop intensity. Between 2006 and 2017 the average raspberry crop yield per hectare increased in all the analysed countries, with the fastest growth rate being recorded in Ukraine (on average, 3.99%, i.e., 0.23 tonne, per year) and in Poland (1.61%, i.e., 0.06 tonne). Relatively, the lowest year-on-year increase in raspberry crops occurred in Serbia (0.04%). Between 2006 and 2017 the average raspberry crops were the lowest in Poland (3.79 $t \cdot ha^{-1}$), while in Serbia they amounted to 5.61 $t \cdot ha^{-1}$, and in Ukraine to 5.81 $t \cdot ha^{-1}$.

Table 1. Changes in the production of raspberries in Poland, Serbia and in Ukraine, 2006–2017

Specification	Poland		Serbia		Ukraine	
	quantity	%	quantity	%	quantity	%
	the slope of the trend line (*b*)					
Cultivation area (in 1000 ha)	1.06	4.18	0.37	2.40	−0.02	−0.43
Crop volumes (in 1000 tonnes)	5.34	5.48	1.94	2.78	1.03	3.55
Yield ($t \cdot ha^{-1}$)	0.06	1.61	0.002	0.04	0.23	3.99
	index 2006 = 100					
Cultivation area (in 1000 ha)	172.20		145.51		98.04	
Crop volumes (in 1000 tonnes)	198.87		137.73		133.39	
Yield ($t \cdot ha^{-1}$)	115.49		94.65		136.05	
Pearson's correlation coefficient	0.81		0.96		−0.23	

Source: Author's own study of data Faostat http://www.fao.org

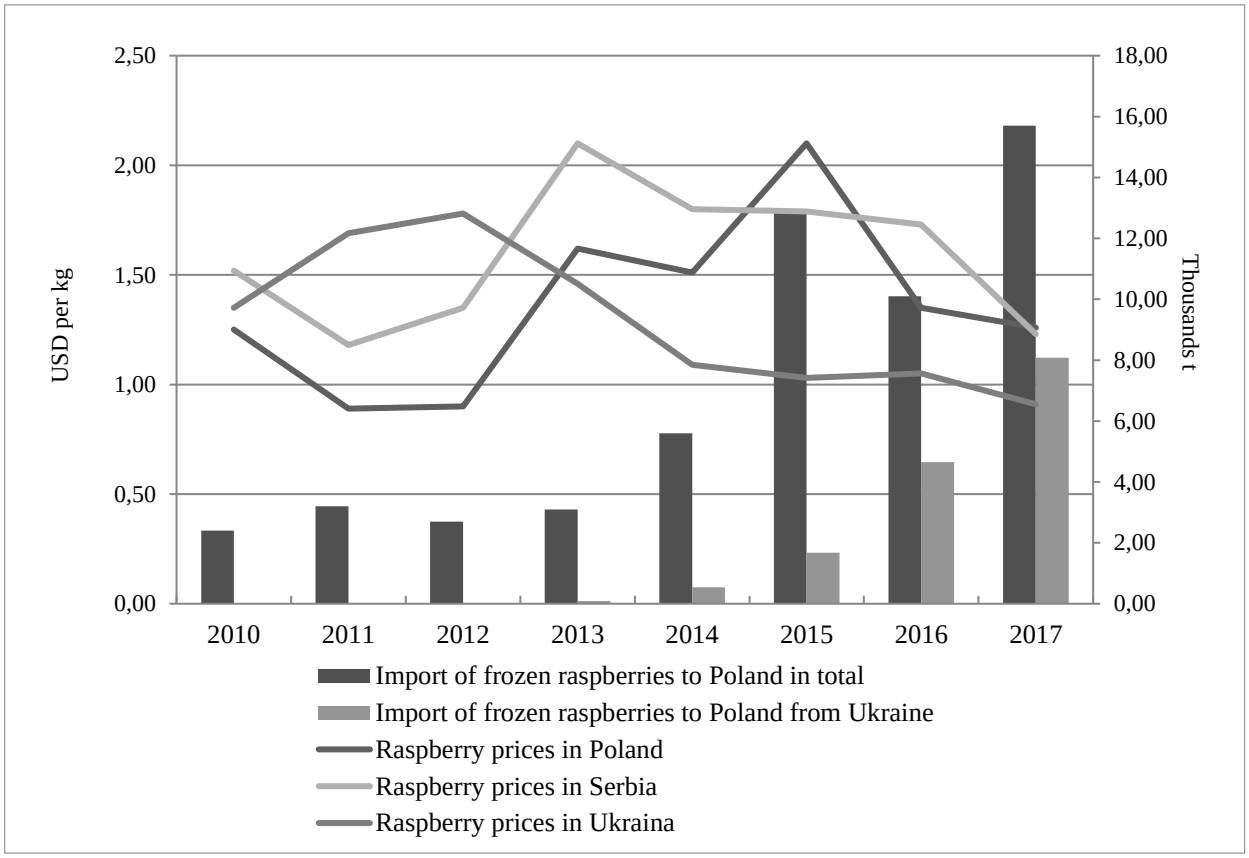

Fig. 1. Import of frozen raspberries to Poland (in 1000 tonnes) and sales prices of raspberries in Poland, Serbia and Ukraine (in USD per kg) average in the years 2010–2017. Source: Author's own study of data Faostat http://www.fao.org and https://comtrade.un.org/Data/

Table 2. Level and structure of raspberry production costs in the analysed farms in individual countries (average of the years 2015–2017)

Specification	Poland		Serbia		Ukraine	
	USD	%	USD	%	USD	%
Material costs, including:	1 462	16.53	1 493	14.37	660	15.65
mineral fertilizers	452	5.11	958	9.22	270	6.40
pesticides	865	9.78	457	4.40	231	5.48
other materials	145	1.64	78	0.75	159	3.77
Human labor, including:	5 390	60.93	6 474	62.33	2 405	57.02
plantation care	475	5.37	1 315	12.66	182	4.32
harvesting	4 915	55.56	5 159	49.67	2 223	52.70
Operating costs of machines	1 145	12.94	1 304	12.55	260	6.16
Depreciation costs	748	8.46	1 081	10.42	740	17.54
Other direct costs	101	1.14	34	0.33	153	3.63
Total direct costs	8 846	100	10 386	100	4 218	100
Indirect costs	974	-	1 281	-	525	-
Total costs	9 820	-	11 667	-	4 743	-

Source: Author's own study

The Polish raspberry market exhibits certain fluctuations characterized by much-longer periods of high prices (4–5 years) and shorter periods of lower prices – not longer than 2–3 years (Paszko et al. 2016). The production level of frozen and concentrated foodstuffs, and the stocks in processing plants, can be seen as contributing to the cyclical fluctuations on the Polish raspberry market. Moreover, in recent years the impact of Ukrainian raspberry production has become noticeable on the Polish market. When the sales price of 1 kg of raspberries in Ukraine was still lower than that in Poland, the imports of frozen fruit from that country were insignificant (Fig. 1). However, in 2013 the price of raspberries in Ukraine reached the same level as in Poland, i.e., approximately USD 1.5 per kg, while in the subsequent years it got lower, and in 2017 corresponded to 72.22% of the domestic price in Poland (only USD 0.91 per kg). In consequence, in 2013 around 100 tonnes of frozen raspberries were imported into Poland, and in 2017 the imports of frozen raspberries attained the level of 8.1 thousand tonnes, a nearly 95-fold increase. The processing plants in Poland, driven by rationality principles, under the circumstances of a long-term growth in the prices of domestic raspberries, have become inclined to look for cheaper imported products. The continuing growth in raspberry production in Ukraine might be therefore expected to pose a serious threat to Polish producers, given especially the competitive prices and lower costs achieved by Ukrainian holdings.

The production efficiency of the surveyed holdings

Plantation efficiency was at a similar level in all the holdings surveyed. In Poland the average crop production was 8.60 $t \cdot ha^{-1}$, in Serbia 10.60 $t \cdot ha^{-1}$, and in Ukraine 9.01 $t \cdot ha^{-1}$ (Table 3). The direct costs of raspberry production in the Ukrainian holdings (USD 4 218 per ha) were half that in Poland (USD 8 846 per ha) and 2.5 times lower than in Serbia (USD 10 386 per ha) (Table 2). Taking into account the average raspberry yield in the holdings surveyed, the product unit cost was the lowest in Ukraine (USD 0.47 per kg), followed by Serbia (USD 0.98 per kg) and Poland (USD 1.03 per kg)

Human labor is of utmost importance in the production of raspberries for processing purposes, and in particular in harvesting. In Serbia, most raspberries are grown manually, unlike the EU countries, where advanced technical and technological practices are employed to this end (Djurkovic 2012; Kljajić 2017). According to many authors, including Paszko (2006), Zarzecka et al. (2018), raspberry production is characterized by the highest labor intensity per hectare among all horticultural crops. The raspberry production automation indicator does not exceed 10%, while for gooseberry and currant production amounts to 47% and 42% respectively (Kowalczyk & Grotkiewicz 2018). As revealed by the surveys, in the holdings from all the analysed countries the element of labor costs in the total direct costs revolved around 60% (Table 2). Also, Kljajić et al. (2017) indicated that labor costs represented the biggest proportion of total costs, i.e., 58%. This implies that the demand for labor was similar, regardless of the production technologies in use. This might have resulted from the fact that the average yields in the holdings surveyed were similar, while the share of the costs of plant maintenance ranged from 4.32% in Ukraine and 5.37% in Poland to 12.66% in Serbia. The average labor costs in Poland per hectare were USD 5 390, and in Serbia USD 6 474. However, the labor costs per 1 kg of fruit were similar in these two countries, at USD 0.63 and USD 0.61 respectively (Table 3). Much lower human labor costs were incurred in the Ukrainian plantations, i.e., USD 2 405 per ha, and USD 0.27 per 1 kg of fruit, in average terms. As a result, the labor costs in the analysed holdings in Ukraine, expressed as cultivation area, were 2.2 and 2.7 times lower than in the holdings in Poland and Serbia respectively, and per 1 kg of fruit over 2.5 times lower than in the holdings operating in these two countries. This was influenced by the lower rates for one working hour in Ukraine (USD 0.65–1.04) and for 1 kg of gathered raspberries (USD 0.13–0.26). To compare, the rate per one working hour in Poland ranged between USD 2.60 and USD 4.16, and the rate for collecting 1 kg of raspberries between USD 0.47 and USD 0.79. Similar rates to those in Poland also applied in the Serbian holdings.

The levels of material costs, as in the case of labor costs, were similar in Poland and Serbia, i.e., USD 1 462 per ha and USD 1 493 per ha respectively. The material costs recorded in the Ukrainian holdings were approximately 2.2 times lower, USD 660 per ha (Table 2), which resulted from lower pesticide costs, both per area (USD 231 per ha) and per product (USD 0.03). In Serbia, the pesticide-use costs per area were twice as high as in Ukraine, and in Poland even three times higher. There were two reasons behind the lower pesticide costs in the Ukrainian holdings. The first reason was the average number of treatments performed to protect the plants against diseases and pests, i.e., 5 treatments in Ukraine, compared to 7 in Serbia and 11 in Poland, and the second reason was the lower prices of pesticides in Ukraine. The highest proportion of pesticide costs in direct costs was recorded in Poland (9.78%), compared to 5.48% and 4.40% in Ukraine and Serbia respectively. Unfortunately, the climatic conditions for raspberry cultivation are the least favorable in Poland (e.g. high precipitation and dampness), which results in higher outlays on crop protection preparations, and a higher frequency of protection treatments, than in Serbia or Ukraine. As revealed by the surveys, the Polish holdings performed, on average, 6 treatments to protect the plants against grey mould, compared to 4 treatments in Serbia, and only 3 in Ukraine.

In turn, as regards outlays on fertilization, the highest costs per area were incurred by the surveyed holdings in Serbia (USD 958 per ha), while in Poland and Ukraine they amounted to USD 452 per ha and USD 270 per ha respectively (Table 2). This resulted from the increased use of fertilizers in the Serbian holdings (960 $kg \cdot ha^{-1}$), as compared to the Polish and Ukrainian holdings (548 $kg \cdot ha^{-1}$ and 440 $kg \cdot ha^{-1}$ respectively). Ukraine could produce berries fruit cheaper because of not so strict growing rules, for example, related to fertilization (Greblikaite et al. 2019). The lower use of fertilizers in Ukraine, as compared to Serbia and Poland, might have been due to the Ukrainian crops' being grown on very-good-quality virgin soils, not degraded by intensive cultivation practices. As noted by Zahrebelny et al. (2016), nearly one-quarter of the global chernozem (black soil) farmland is situated in Ukraine.

Table 3. The unit costs of raspberry production in analysed farms from individual countries (average of the years 2015–2017)

Specification	Poland	Serbia	Ukraine
Average yield ($t \cdot ha^{-1}$)	8.60	10.60	9.01
Total direct costs (USD per kg)	1.03	0.98	0.47
Labor costs (USD per kg)	0.63	0.61	0.27
Production materials (USD per kg) including:	0.17	0.14	0.07
mineral fertilizers	0.05	0.09	0.03
pesticides	0.10	0.04	0.03

Source: Author's own study

Table 4. Selected indicators of economic efficiency in the production of raspberry in chosen farms in Poland, Serbia and Ukraine (average of the years 2015–2017)

Specification	Poland	Serbia	Ukraine
The average sales price (USD per kg)	1.22	1.58	0.78
Production value (USD per kg)	10 499	16 771	7 091
Gross Margin – GM (USD per ha)	1 653	6 385	2 873
Profitability of production (%)	106.91	143.75	149.50
Production costs (%)	93.53	69.57	66.89

Source: Author's own study

In Poland and Serbia, raspberry plantations are located in the regions with long-standing cultivation traditions, which forces much-bigger outlays on fertilization. Significant differences were also recorded in the machine operation and maintenance costs, which in Ukraine were just over half that in Poland and Serbia. This resulted, *inter alia*, from the lower costs of both diesel fuel and tractor-drivers' labor.

Regardless of the country, the production of raspberries for processing purposes between 2015 and 2017 was profitable in the holdings surveyed. In Serbia, given the highest yield (on average, 10.60 $t \cdot ha^{-1}$) and the highest average sales price (USD 1.58 per kg), the GM amounted to USD 6 385 per ha (Table 4). The higher production efficiency of the Serbian holdings, as compared to the horticultural holdings operating in the other two countries, was due to cultivating the high-yield 'Willamette' cultivar, and the much-warmer climate, characterized by longer vegetation periods. However, the higher price of Serbian raspberries, as compared to those in Poland and Ukraine, resulted from multiannual cultivation improvements, and the ability to maintain the high quality of the fruit, both during and after harvesting (fast cooling). In Ukraine, the average yields in the holdings surveyed (9.01 $t \cdot ha^{-1}$), were slightly lower than those in Serbia, but even with the much lower sales price (USD 0.78 per kg), the GM was achieved at the level of USD 2 873 per ha. This resulted from the direct production costs' being much lower. In the surveyed holdings in Poland, with the average yield of 8.60 $t \cdot ha^{-1}$ and the average sales price of USD 1.22 per kg, along with higher costs than in Ukraine, the GM rate was the lowest, i.e., USD 1 653 per ha. At the same time, the production profitability indicator recorded by the Polish holdings was not high (106.91%) and a comparatively high cost effectiveness indicator (93.53%) was recorded. On the farms in Serbia the value of the both indicators was 143.75% and 69.57%, and in the Ukrainian holdings 149.50% and 66.89%.

CONCLUSIONS

The increased competitive power of other countries in relation to the previous leaders on the European market of raspberries intended for processing was confirmed by these surveys. The growing production costs in both Poland and Serbia, and in particular the growing human labor costs, triggered a rise in direct costs and product costs compared to those of raspberry production in Ukraine. It appears that, with a similar technological level, the most important factors determining the level of costs include human labor and natural conditions. Due to the much lower rates for one working hour and for collecting 1 kg of fruit, coupled with the lower number of the essential protection and fertilization treatments resulting from the more favorable natural conditions, the direct costs of raspberry production in Ukraine were just over half those in Poland and Serbia. The varying operating conditions on the raspberry market, determined mainly by the prices of fruit intended for processing, are likely to put Polish producers in a more difficult situation compared to the foreign producers who are subject to relatively lower production costs. With the low supply and high prices of domestic fruit, imports of frozen raspberries to Poland from Ukraine, at much lower prices, are on a notable rise. For this reason, Polish raspberry producers are facing major changes, as regards both improved plantation efficiency and fruit quality, which are indispensable in order for them to effectively compete with both Serbia and Ukraine.

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