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Economic evaluation (efficiency) of investment in organically grown immortelle [*Helichrysum italicum* ssp. *italicum*] in Bosnia and Herzegovina. The first report from Mediterranean

Ekonomska analiza (učinkovitost) ulaganja u ekološki uzgoj smilja [*Helichrysum italicum* ssp. *italicum*] u Bosni i Hercegovini. Prvo izvješće s Mediterana

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Abstract

The immortelle (*Helichrysum italicum*/Roth/G. Don), native to the Mediterranean region grew up and is prevalent on the rockery and rocky grasslands in Bosnia and Herzegovina. The long tradition of growing and collecting the medicinal plants in Herzegovina is the reason of its usage in folk medicine according to its antibacterial, antifungal and antioxidant properties. In the last decade the interest of the scientific community and the market demand for this medicinal herb increased, and the present study evaluated two different rows spacing (0.9 x 0.4 m and 0.8 x 0.4 m) to reveal the economic performance of organically grown immortelle. Results of the research for the both organic immortelle planting spaces revealed that they are economically profitable for producers. Sensitivity analysis with 10% lower yields and with 30% lower retail price revealed that investment is economically efficient.

Keywords: economic evaluation, immortelle, investment, medicinal plant

Sažetak

Smilje (*Helichrysum italicum* / Roth / G. Don), autohtona biljka mediteranskog područja, raste i prevladava na kršu i stjenovitim travnjacima u Bosni i Hercegovini. Razlog dugogodišnje tradicije uzgoja i sakupljanja ljekovitih biljaka u Hercegovini leži

u činjenici da se upotrebljava u tzv. narodnoj medicini obzirom na antibakterijska, antifungalna i antioksidativna svojstva ljekovitog bilja. U posljednjem desetljeću svjedoci smo povećanom interesu znanstvene zajednice i potražnji na tržištu za smiljem, a ova studija evaluira dva najčešća razmaka sadnje pri uzgoju smilja (0,9 x 0,4 m i 0,8 x 0,4 m) u svrhu dobivanja rezultata ekonomske učinkovitosti ekološki uzgajanog smilja. Rezultati istraživanja za oba razmaka pri ekološkom uzgoju smilja pokazuju da su za proizvođače ekonomski profitabilni. Analizom osjetljivosti s 10% nižim prinosima, te 30% nižoj otkupnoj cijeni, utvrđeno je da je ulaganje u podizanje i ekološki uzgoj nasada smilja ekonomski učinkovito za investitora.

Ključne riječi: ekonomska učinkovitost, investicija, ljekovito bilje, smilje

Introduction

In the last decade, the interest of scientific community researches and interest of pharmaceutical industry for immortelle [*Helichrysum italicum*/Roth/ G. Don] increased. This interest is driven by usage of plants from the family of Asteraceae in folk medicine and knowledge since ancient times for its antibacterial (Chinou et al., 1996; Nostro et al., 2001; Mastelić et al., 2005; Rossi et al., 2007), antifungal (Özgen et al.,2004; Boussaada et al., 2008; Jayaraman et al., 2008; Muley et al., 2009; Kasim et al., 2011) and antioxidant (Maffei et al.,1990; Schinella et al., 2007) properties. Medicinal plants from the family of Asteraceae have been used in the treatment of many diseases of the digestive, respiratory, and cardiovascular systems and skin diseases, as well as for the preparation of beverages, and as culinary spices (Stanković et al., 2011). The genus *Helichrysum*, belonging to the family of *Asteraceae*, consists of a few hundred species (Mastelić et al., 2008). The most used parts of immortelle are flowers and leaves for extracting essential oils. *Helichrysum italicum* essential oil exhibits of complex chemical composition and has a strong biological property (Denys and James, 1991; Smirnova and Pervykh, 1998; Mastelić et al., 2008). In their study (Mastelić et al., 2008) found that main components of *Helichrysum italic* essential oils from the Mediterranean part of Croatia are α- pinene, neryl acetate, α-cedrene, nerol, α-curcumene, γ-curcumene and geranyl acetate.

The immortelle native to the Mediterranean region (Denys and James, 1991; Mastelić et al., 2008) grew up and is prevalent on the rockery and rocky grasslands of Mediterranean region in Bosnia and Herzegovina (BiH). From the geographical point of view Herzegovina (region of the Federation of Bosnia and Herzegovina) is characterized by the Mediterranean climate, with an abundance of sun and warmth, heterogeneous relief and has a long and rich tradition in collecting and growing different types of medicinal and aromatic plants (Kosović and Dunjić, 2000). The long tradition of growing and collecting the medicinal plants in Herzegovina is the reason for its usage in folk medicine according to its antibacterial, antifungal and antioxidant properties. In former Republic of Yugoslavia, Herzegovina was defined as a rich area of medicinal and aromatic plants, with estimation of more than 1,300 different species, such as sage (*Salvia officinalis*), immortelle (*Helichrysum italicum*), heath (*Saturea montana*), juniper tree (*Juniperus communis*), autumn crocus (*Colchicum*

autumnale), St. John's wort (*Hypericum perforatum*), hemp stalk (*Vitex agnus castus*), according to the Kosović and Dunjić (2000).

Since 1990's organic farming is growing out of the niche, taking more and more important place in the market (Čagalj, 2016). In 2016 Bosnia and Herzegovina set the rules (Official Gazette of Federation Bosnia and Herzegovina, 72/16) for organic farming which has to be followed for labeling food products as organic. Worldwide numerous researches have been made according to the consumer acceptance, preferences and willingness to pay (WTP) for organically produced food. There is one recent study (Čagalj et al., 2016) from the region, where it is found that consumers are willing to pay in average 30-40% more for organically produced food.

Concerning that aerial parts of plants from *Asteraceae* family are natural source of biologically active substances with strong antioxidant and antimicrobial effects (Stanković et al., 2011), in recent years, cosmetic and pharmaceutical industry have in special focus to investigate the valuable plants for the application in the formulation of cosmetic and pharmaceutical products, and found it in *Helichrisium italicum*. Increase in demand for Immortelle (mostly for essential oil of it) and its high market price, at the international and domestic market, led to the increase in collection and producers (farmers) began to raise the plantations of immortelle. Increase in the collection (unorganized, irresponsible and unskilled) according to the increase rate of demand of medicinal plants, led only by profit, resulted in the almost extermination and degradation of medicinal plants in some parts of Herzegovina. Farmers who decided to raise plantations of immortelle were usually raised without any plans, were not educated in growing immortelle (agro-techniques in cultivation, plantation care, protection from pests and diseases) and without knowing any economic indicators of immortelle production. Areas under the immortelle rapidly raised concerning that supply cannot meet demand, retailing prices were relatively high, retailers payed directly on the field for the immortelles, but still, there are no official data on collection or production of Immortelle in Bosnia and Herzegovina. Conversely to the last few years and rapid growth of immortelle out of the niche, last year (2017), market stabilized and prices rapidly fall. The results of this research revealed that in Herzegovina immortelle is grown intensively on 1,500 ha. According to this rapid increase production of immortelle in Herzegovina, there is considerably less literature that revealed economic efficiency of immortelle from the Mediterranean, especially in the terms of ecological growing worldwide, and this study is the first to reveal economic efficiency of ecologically grown immortelle.

The main objective of this study is to reveal the economic efficiency of organically growing immortelle. Another objective of this study is to reveal the optimum growing space (0.9 x 0.4 m and 0.8 x 0.4 m) for immortelle growers in relation to the economic efficiency achieved by descriptive economic analysis. The relationship between growing space of immortelle and economic analysis were considered for the first time in Bosnia and Herzegovina and at Mediterranean region at all. This study is important for immortelle producers, agricultural leaders, marketers and agricultural policy decision makers in future planning for this strategic agricultural crop that is growing out of niche last few years. The present study of revealed economic indices and analysis of immortelle production can be used to improve the economic and environmental management for Immortelle producers in the whole Mediterranean region.

At the Mediterranean, immortelle is planted in distance between and within rows of 0.9 x 0.4 m (density of 27,778 plants*ha^{-1}), and 0.8 x 0.4 m (density of 35,000 plants*ha^{-1}) and 0.6 x 0.3 m (density of 55,000 plants*ha^{-1}). This study revealed the planting distance between and within rows of 0.9 x 0.4 m and 0.8 x 0.4 m, according to that was the most usage spacing of interviewed farmers and according to the literature review.

Materials and methods

Study area

The study area was in Herzegovina-Neretva Canton is one of ten Cantons of Federation of Bosnia and Herzegovina. It consists of nine municipalities, from Prozor in the north to Neum in the south. They surround the river Neretva from its spring (Konjic municipality) to the river basin (Metković, a municipality in Republic of Croatia bordering the Canton). This region was chosen to be a study area, as it represents most of the immortelle plantations in this part of Mediterranean.

Data collection

Data collection took place in two growing seasons, 2014/2015 and 2015/2016 in Bosnia and Herzegovina in the region of Herzegovina. The sample population consists of immortelle producers (N=53) in the study area that were willing to participate in the research. Primary data was obtained through direct interviews with immortelle producers. A number of 53 questionnaires were addressed to each producer. The questionnaire consisted of questions about the area of immortelle plantation, variable and fixed costs of production, the total amount of immortelle produced per growing season, the essential oil total production and agrotechnical needs. The selling prices of 1 kg of immortelle are determined on the basis of monetary valid market prices. The data from questionnaires were transformed in Excel format and subjected to analysis using SPSS 18 software to calculate the economic indices. Secondary data were collected from research at the laboratory of the Federal Agromediteranean Institute in Mostar (number of seeds per plant) and literature review.

Econometric model

For the economic analysis of growing immortelle in this research, the data were collected from producers, according to their answers to the questionnaire. Concerning that no one of the producers has the immortelle plantation later than 5 years old, the simulation model was developed (Figure 1) to estimate the economic values for the 8-year period of the plantation (lifetime of immortelle plantation). Simulation modeling has been commonly used a method to estimate economic indicators in agricultural production (Rozman et al., 2002). The simulation model for this research was based on the input data from the questionnaire. The input data was gathered by enlisting each individual phases of the technological process of planting Immortelle, growing in two different spacing, the agro-technological needs, cultivation, and distilling immortelle. All the data, inputs and costs that arise in the first

year of the plantation were used. The input data of spent quantities (variable costs) and their prices (number of plants, human labor, machine labor, plugging, harrowing, liming, etc.) and other variable costs that arise were collected. Total production value, gross profit, benefit to cost ratio, and productivity was also calculated for immortelle production in the research area. The following economic parameters were calculated:

Total costs (TC) = Fixed costs (FC) + variable costs (VC)

Average variable costs (AVC) = VC / quantity (Q)

Average fixed costs (AFC) = FC / Q

Average total costs = AFC + AVC

Gross margins (GM) = Gross revenues – total variable costs (TVC)

Net return (profit) = Total revenue – total cost

Brake-even yield = Total costs/production unit price

Average cost of 1 kg of (essential oil) = Total costs (cultivation + harvesting + distillation) €/kg/quantity of essential oil per kg

Total production value = Immortelle yield (kg*ha^{-1}) x Essential oil price (€*kg^{-1})

Gross return = Total production value (€*ha^{-1}) – Variable production cost (€*ha^{-1})

Benefit cost ratio= Total production value / Total production cost (€*ha^{-1})

Labor productivity = Immortelle yield (kg*ha^{-1}) / Total working hours (h*ha^{-1})

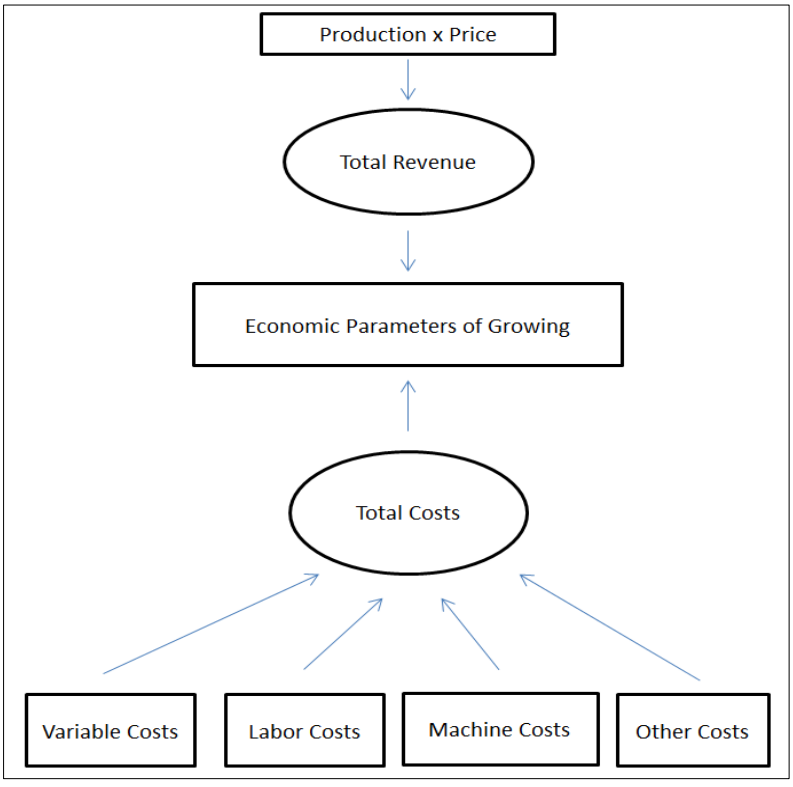

Figure 1. The structure of the developed model

Results

Investment costs in plantation and total production costs of growing immortelle

Results revealed that the investment costs of the plantation of 1 ha of immortelle for the rows spacing 0.9 x 0.4 m are 4,408.66 € (Table 1), and 4,789.66 € for rows spacing 0.8 x 0.4 m (Table 2). The highest share of costs in plantation consists of the cost of seedling of immortelle with 56.7% for plantation space between rows of 0.9 x 0.4 m and 58.7% of total plantation costs for plantation space between rows of 0.8 x 0.4 m.

Table 1. Investment costs of plantation (hand planting) for spacing 0.9 x 0.4 m, 1 ha

No	Items	Units	Volume	Price	Value (€)
1.	Autumn deep plowing	ha	1	202.25	202.25
2.	Milling-rotary tiller	ha	1	101.12	101.12
3.	Transport of seedlings	w.d.	1	25.28	25.28
4.	Scaling and marking of plantation space	hours	8	2.53	20.24
5.	Connective tissue	kg	15	2.02	30.3
6.	Seedlings of immortelle	pieces	27,778	0.09	2,500.02
7.	Hand planting	w.d.	12	25.28	303.36
8.	Watering plants during planting	m^3	6	0.8	4.8
9.	Water supply	m^3	6	4.55	27.3
10.	Cost of labor for watering	hours	30	1.01	30.3
11.	Farmers fence	m	400	2.53	1.012
12.	Other costs		1	151.69	151.69
	Total				4,408.66

Table 2. Investment costs of plantation (hand planting) for spacing 0.8 x 0.4 m, 1 ha

No	Items	Units	Volume	Price	Value (€)
1.	Autumn deep plowing	ha	1	202.25	202.25
2.	Milling-rotary tiller	ha	1	101.12	101.12
3.	Transport of seedlings	w.d.	1	25.28	25.28
4.	Scaling and marking of plantation space	hours	9	2.53	22.77
5.	Connective tissue	kg	18	2.02	36.36
6.	Seedlings of immortelle	pieces	31,250	0.09	2,812.5
7.	Hand planting	w.d.	14	25.28	353.92
8.	Watering plants during planting	m^3	7	0.8	5.6
9.	Water supply	m^3	7	4.55	31.85
10.	Cost of labor for watering	hours	34	1.01	34.34
11.	Farmers fence	m	400	2.53	1,012
12.	Other costs		1	151.69	151.69
	Total				4,789.68

In Tables 3, 4 and 5 are presented the costs of cultivation, harvesting and distillation in the full yield (5th year of planting) by individual costs included. For the planting spacing 0.9 x 0.4 m the total production costs (the sum of mentioned costs) are 5,603.51 €*ha^{-1}. The biggest share in the production cost has the cost of cultivation (47%).

Table 3. Variable costs of cultivation for spacing 0.9 x 0.4 m in full yield, 1 ha

No	Costs of cultivation	Units	Volume	Price	Value (€)
1.	Interrow cultivation - thrower (6 x 1.5 w.d.*ha^{-1})	w.d.	9	25.28	227.52
2.	Costs of labor worker on thrower	w.d.	9	25.28	227.52
3.	Fuel	L	25	2.02	50.56
4.	Row hilling - hand 6 x 10 w.d.	w.d.	60	25.25	1,515
5.	Organic fertilizers - average 1,250 kg*ha^{-1}	bags	50	9.35	467.5
6.	Water for watering after yield (0.5 L*plant^{-1})	m^3	14	0.8	11.2
7.	Water transportation costs	m^3	14	4.55	63.7
8.	Costs of labor for watering	hours	30	1.01	30.3
9.	Other costs		1	50.01	50.01
	Total cultivation cost				2,643.31

Table 4. Total costs of harvesting for spacing 0.9 x 0.4 m in full yield, 1 ha

No	Costs of harvesting	Units	Volume	Price	Value (€)
1.	Hand harvesting (150 kg*day^{-1}*1 picker^{-1})	w.d.	81	25.28	2,047.68
2.	Shrinking	w.d.	1	25.28	25.28
3.	Transportation		1	25.28	25.28
	Total harvesting cost				2,098.24

In cultivation cost the highest individual cost is row hilling – hand and it present 57.3% of total cultivation cost.

The highest individual cost in harvesting is labor cost (hand harvesting) and it present 97.8% of total harvesting cost.

Table 5. Variable costs of distillation for spacing 0.9 x 0.4 m in full yield, 1 ha

No	Costs of distillation	Units	Volume	Price	Value (€)
1.	Costs of transportation (12.64 €*t^{-1})*(yield: 12.22 t*ha^{-1})	t	12.22	12.64	154.46
2.	Material costs	pieces	1	50.54	50.54
3.	Gas (15 kg*hour^{-1})	kg	360	0.35	126
4.	Electricity	kWh	50	0.1	5
5.	Water for cooling (24 hours*m^3*h^{-1})	m^3	240	0.8	192
6.	Manipulative costs (filling - emptying distiller)	hours	2.53	12.22	30.92
7.	Labor costs	hours	50	5.05	252.5
8.	Other costs		1	50.54	50.54
	Total distillation cost				861.96

The following tables 6, 7 and 8 presenting the same costs in the full yield (5th year of planting) for planting spacing 0.8 x 0.4 m. For 0.8 x 0.4 m planting system the production costs (6,284.12 €*ha^{-1}) are in general 8.9% higher than in 0.9 x 0.4 m planting system. The biggest share in the production cost have the cost of cultivation (47.3%).

Table 6. Variable costs of cultivation for spacing 0.8 x 0.4 m in full yield

No	Costs of cultivation	Units	Volume	Price	Value (€)
1.	Interrow cultivation - thrower (6 x 1.5 w.d.*ha^{-1})	w.d.	10	25.28	252.8
2.	Costs of labor worker on thrower	w.d.	10	25.28	252.8
3.	Fuel	L	25	2.02	50.56
4.	Row hilling - hand 6 x 10 w.d.	w.d.	67	25.25	1,691.75
5.	Organic fertilizers - average 1,250 kg*ha^{-1}	bags	60	9.35	561
6.	Water for watering after yield (0.5 L*plant^{-1})	m^3	16	0.8	12.56
7.	Water transportation costs	m^3	16	4.55	71.44
8.	Costs of labor for watering	hours	34	1.01	34.34
9.	Other costs		1	50.01	50.01
	Total cultivation cost				2,977.26

In cultivation cost for 0.8 x 0.4 m planting system, the highest individual cost is row hilling – hand and it present 56.8% of total cultivation cost.

The highest individual cost in harvesting is labor cost (hand harvesting) and it present 97.8% of total harvesting cost.

Table 7. Variable costs of harvesting for spacing 0.8 x 0.4 m in full yield

No	Costs of harvesting	Units	Volume	Price	Value (€)
1.	Hand harvesting (150 kg*day^{-1}*1 picker^{-1})	w.d.	91	25.28	2,300.48
2.	Shrinking	w.d.	1	25.28	25.28
3.	Transportation		1	25.28	25.28
	Total harvesting cost				2,351.04

Table 8. Variable costs of distillation for spacing 0.8 x 0.4 m in full yield

No	Costs of distillation	Units	Volume	Price	Value (€)
1.	Costs of transportation (12.64 €*t^{-1})*(yield: 13.75 t*ha^{-1})	t	13.75	12.64	173.8
2.	Material costs	pieces	1	50.54	50.54
3.	Gas (15 kg*hour^{-1})	kg	405	0.35	141.75
4.	Electricity	kWh	56	0.1	5.6
5.	Water for cooling (24 hours*m^3*h^{-1})	m^3	270	0.8	216
6.	Manipulative costs (filling - emptying distiller)	hours	2.53	13.75	34.79
7.	Labor costs	hours	56	5.05	282.8
8.	Other costs		1	50.54	50.54
	Total distillation cost				955.82

Results of data analysis (Table 9 - 12) revealed that the average yield of immortelle (in full yield - 5th year) for the spacing 0.4 x 0.9 m was 12,222 kg*ha^{-1}, while the yield of immortelle (in full yield - 5th year) for the spacing 0.4 x 0.8 m was 13,750 kg*ha^{-1}.

Retail value of the crop of Immortelle in 2014 was 1.52 €*kg^{-1}, while retail value of 1 liter (L) of essential oil was 1,500 €.

In a developed model, the yield of the immortelle was calculated as the product of each immortelle yield per ha and production of essential oil with the essential oil yield of 0.12%.

From the start of the yield in the second year, yields are gradually increasing till the fifth year.

The fifth year is the first year of the full yield of the immortelle. Retail price was 1.52 € for the 1 kg of the crop and 1,500 € for the 1 L of the essential oil, according to the collected data from the interviewed producers.

Economic indicators: profit (net return), labor productivity, break-even yield, profitability and cost effectiveness of growing immortelle crops and essential oils.

Calculated investment and production costs and total revenue represent the input parameters for the financial part of a cost-benefit analysis that includes methods of return on assets, net present value and internal rate of return on the basis of economic data.

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Table 9. Annual review of yields and net return values for the green mass for spacing 0.9 x 0.4 m

Year	1	2	3	4	5	6	7	8
Yield (kg)	3,125	5,555	8,333	10,277	12,222	10,277	8,333	5,555
Total revenue (€)	4,750.04	8,444.51	12,666.77	15,622.35	18,577.93	15,622.35	12,666.77	8,444.51
Total costs (€)	7,086.41	3,349.41	4,166.52	4,716.75	4,741.55	4,150.08	3,478.42	3,295.02
Net return (€)	-2,336.37	5,095.1	8,500.25	10,905.6	13,835.89	11,472.27	9,188.35	5,149.49

Table 10. Annual review of yields and net return values for the essential oil for spacing 0.9 x 0.4 m

Year	1	2	3	4	5	6	7	8
Oil (L)	3.91	6.94	10.42	12.85	15.28	12.85	10.42	6.94
Total revenue (€)	5,859.42	10,416.75	15,625,13	19,270.99	22,916.85	19,270,99	15,625,13	10,416.75
Total costs (€)	7,861.1	4,159.29	5,001,39	5,576.1	5,603.51	4,959.96	42,53,11	3,295.02
Net return (€)	-2,001.68	6,257.46	10,623.73	13,694.89	17,313.34	14,311.03	11,372.01	7,121.73

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Table 11. Annual review of yields and net return values for the green mass for spacing 0.8 x 0.4 m

Year	1	2	3	4	5	6	7	8
Yield (kg)	3,515	6,250	9,375	11,562	13,750	11,562	9,375	6,250
Total revenue (€)	5,343.75	9,500	14,250	17,575	20,900	17,575	14,250	9,500
Total costs (€)	7,857.39	3,234.99	4,167.2	4,713	5,328.29	4,713	4,167.2	3,234.99
Net return (€)	-2,513.64	6,265.01	10,082.8	12,862	15,571.71	12,862	10,082.8	6,265.01

Table 12. Annual review of yields and net return values for the essential oil for spacing 0.8 x 0.4 m

Year	1	2	3	4	5	6	7	8
Oil (L)	4.39	7.81	11.72	14.45	17.19	14.45	11.72	7.81
Total revenue (€)	6,591.8	11,718.75	17,578,13	21,679.69	25,781.25	21,679.69	17,578.13	11,718.75
Costs (€)	8,225.51	3,623.19	4,667.27	5,278.56	6,284.12	5,278.56	4,667.27	3,623.19
Net return (€)	-1,633.71	8,095.56	12,910.86	16,401.13	19,497.13	16,401.13	12,910.86	8,095.56

The return period of the investment for both types of planting distance is three years since planting when the net financial cash flows became positive and were higher than the investment costs.

In the eight years (lifetime of plantation) net present value (NPV) based on the inflows and outflows scenario of production and selling of immortelle plants (green mass) with the plant distance 0.9 x 0.4 m is positive 24,710.43 € (with the discount rate of 7%) and NPV for plant distance 0.8 x 0.4 m is positive 30,090.48 € (with the discount rate of 7%). Value of the internal rate of return (IRR) is 62% for plant distance 0.9 x 0.4 m, and 68% for plant distance 0.8 x 0.4 m.

Revenue of the retail of the essential oils is calculated as the multiplication of the produced amount of essential oils and retail price. According to this retail values, total revenues and income were calculated for the fifth year of the project and represent the basis for analysis and assessment of production efficiency in the year of full yield (Table 13 and 14).

Table 13. Economic indicators of ecological immortelle and essential oil production in full yield (0.9 x 0.4m)

	Items	Plant value (€)	Essential oil value (€)
1.	Total revenue (€*ha^{-1})	18,577.44	22,905
2.	Costs of cultivation (€*ha^{-1})	2,643.31	2,643.31
3.	Costs of harvesting (€*ha^{-1})	2,098.24	2,098.24
4.	Distillation and transportation (€*ha^{-1})		861.96
5.	Total production costs (€*ha^{-1})	4,741.55	5,603.51
6.	Net return (profit) (€*ha^{-1})	13,835.89	17,313.34
7.	Labor productivity (€*kg^{-1})	13.65	16.24
8.	Break-even yield (kg); (L)	3,119.44	5.91
9.	Profitability (%)	391.8	258.3
10.	Cost-effectiveness	2.57	2.58

Sensitivity analysis in eight-year period revealed that with 10% lower yields with the same retail price of immortelle plants (green mass) (1.52 €) NPV for the spacing 0.9 x 0.4 m is positive (16,441.43 €) and the value of IRR is 58%, while at the spacing of

0.8 x 0.4 m, sensitivity analysis with 10% lower yields showed that NPV is also positive (20,638.78 €) and the value of IRR is 66%.

Sensitivity analysis with normal yields and 30% lower retail price (1,064 €) NPV for the spacing 0.9 x 0.4 m is positive (10,535.02 €) and the IRR is 40%, while at the spacing of 0.8 x 0.4 m, sensitivity analysis with 30% lower retail price showed that NPV is also positive (6,078.57 €) and the value of the IRR is 30%.

Table 14. Economic indicators of ecological immortelle and essential oil production in full yield (0.8 x 0.4 m)

	Items	Plant value (€)	Essential oil value (€)
1.	Total revenue (€*ha^{-1})	20,900	25,770
2.	Costs of cultivation (€*ha^{-1})	2,977.25	2,977.25
3.	Costs of harvesting (€*ha^{-1})	2,351.04	2,351.04
4.	Distillation and transportation (€*ha^{-1})		955,82
5.	Total production costs (€*ha^{-1})	5,328.29	6,284.12
6.	Net return (profit) (€*ha^{-1})	15,571.71	19,497.13
7.	Labor productivity (€*kg^{-1})	13.73	16.33
8.	Break-even yield (kg); (L)	3,505.45	6.59
9.	Profitability (%)	292.2	260.6
10.	Cost-effectiveness	3.92	2.61

Discussion

Investment costs in the first year are 65.9% of the total cost of raising 1 ha of immortelle for the space between rows of 0.9 x 0.4 m, and 64,0% for the plantation space of 0.8 x 0.4 m. High share of investment costs in the first year is the result of the working operations that arises in the first year of plantation, such as soil preparation for the plantation (plowing, milling), plantation (transportation of seedlings, scaling and marking of plantation space, costs of seedlings, hand plantation), and costs of nursery after plantation.

The return period of the total investments for both types of planting distance is in the 4th year of the project and concerning that the return period of the total investments is in the period of the 8 years of the project, investments are acceptable for investment.

NPV are positive for both types of spacing with the discount rate of 7%, and according to this method of NPV, investment in both types of spacing are acceptable for the producers. Concerning that the IRR for both types of planting distances are higher than the discount rate of 7%, investments are also acceptable for the investor according to this method, Investment is economically efficient according to revealed results of 10% lower yields and 30% lower retail prices.

Conclusions

Results of the research considered for the both organic immortelle planting spaces that they are economically profitable for producers. An analysis shows that growing immortelle (green mass) with the space between rows 0.8 x 0.4 m generates higher average income for producers, 15,571.71 €*ha^{-1}, than the immortelle growing with the space between rows 0.9 x 0.4 m (13,835.59 €*ha^{-1}). Values of the methods of the return of the investment, net present values and internal rates of return showed the economic validity and feasibility of investment in the organic production of immortelle with the both growing distance between rows, Investment is liquid during the whole economic period of eight years, Sensitivity analysis of 10% lower yields and 30% lower retail prices revealed that the investment is slightly sensitive to changes in the reduction of yield and possess the satisfactorily capacity to ensure production capacity deterioration.

Values of the economic indices of break-even yield, labor productivity, cost-effectiveness, and profitability showed that the organic production of immortelle for both growing spaces between rows is economically efficient and profitable.

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