



Obtained Yield and Financial Parameters of Organically Grown Mint in the Republic of Macedonia

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aims: The objective of this paper is to present the soil and weather conditions, applied production technology and to demonstrate the economic viability of irrigated and organically grown Mint (*Mentha piperita*).

Methodology: The obtained yield results are in reference to the open field growing conditions. In order to present the results in clear and understandable manner, standard methods for cost calculation were applied, usual for organic plant production. In order to obtain comparable results, the processed data in this paper are from the two-year production trials (2009 and 2010), of a new-established mint plantation planted in October 2008, in the region of Ovche Pole - central part of the Republic of Macedonia.

Results: In the first year of utilization (2009), two cuttings were performed yielding 3500 kg/ha of

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above-ground dry mass. In the second year of utilization (2010), there were three cuttings yielding 5155 kg/ha of above-ground plant dry mass. Economic analysis proves that profitability in organically produced Mint (*Mentha piperita*) is obtained in the second growing season year, recording profit of € 8125 per hectare.

Conclusion: Based from the obtained results the benefits of growing Mint are: opportunities to optimize yield and achieve uniform high quality product. Organic way of growing Mint, can be a great business idea for the farm and family business.

Keywords: Mint; organic farming; yield; profitability.

1. INTRODUCTION

The origin of peppermint species cannot be determined. Dried leaves were found in ancient times, in the Egyptian pyramids. Two species of mint were used by the ancient Greek physicians. However, some writers debate whether one is the modern peppermint, though there is evidence that *M. x piperita* was cultivated by the Egyptians [1]. It is thought to be a natural hybrid between spearmint (*M. spicata* Linn. emend. Nathh.) and water mint (*M. aquatic* Linn), the latter itself being a hybrid of *M. longifolia* (Linn.) Huds, and *M. rotundifolia* (Linn.) Huds so *M. piperita* is a triple hybrid [2]. Mint is popular medicinal plant in several traditional systems of medicine. Medicinal, aromatic and the spice plants are widely used in pharmaceutical, food, cosmetics, alcoholic beverage industries and as well as in chemical (pesticide) industry. Up to the mid '50's of the last century, these plants were used as raw material from wild flora of these species, and some plants still are used how growing wild plants [3]. The WHO has estimated that more than 80% of the world's population in developing countries when satisfying basic health care needs depend primarily on herbal medicine. Approximately two thirds of the 50000 different medicinal plant species which are in use are collected out in the wilderness [4]. As far as production levels are concerned, the volume is estimated on more than 4000 t/year. Almost 80% of it is produced in USA. Mint production is also organized in Canada, UK, Australia and New Zealand, while in Asia this crop is mostly grown in India and China [5]. In South Africa under irrigation and good management, peppermint will yield 20 to 25 tons of plant material per hectare per year, at an oil recovery rate of 0,3% or 60 to 75 kg essential oil per ha. [5]. In Europe only 10% of medicinal species which are in commercial use are cultivated. Cultivation of some herbs has proved difficult because of low germination rate or specific ecological requirements [3]. Mints are widely cultivated on

almost all types of soils and climates. The major commercially produced species are: Japanese or menthol mint (*Mentha arvensis* L. var. *piperascens*), peppermint (*M. piperita* L.), common or native spearmint (*M. spicata* L.), Scotch spearmint (*M. cardiaca* Baker), garden mint (*M. viridis* L.) and bergamot mint (*M. citrata* Ehrh). China, India, U.S.A, Japan, France, Italy, Russia and Bulgaria are some of the major producers of mint oils [6]. Peppermint *Mentha piperita* L., which is used in production of flavors, fragrances and pharmaceuticals, were investigated for their antimicrobial properties against 21 human and plant pathogenic microorganisms.

Three of the largest producers of mint and mint related products, (such as essential oils) are the United States, India and China [7]. The U.S.A and India produce the largest supplies of mint oil used in chewing gum, toothpaste, mouthwash and several other products. Irrigation and nitrogen should be in adequate quantities for maximum growth; plant stress causes early bloom and production of menthofuran which reduces oil quality for some markets [8]. Republic of Macedonia has very favorable geographic position, diversity of soil types and low contamination of natural resources which provides conditions for cultivation of aromatic, spice and medical plants. The advantages of the Macedonian territory for organic cultivation of the medicinal aromatic and spice plants are: Areas with low degree of pollution or unpolluted resources (soil, water, air); Favorable geographical position, diverse landscape; fertile river valleys, flat lowlands and mountain slopes; diverse types of the soils. Naturally, there are weaknesses and these are: Unused agro-environment potentials; Lack of Macedonian literature for growing technology of aromatic & medicinal herbs and spices; Lack of exploration experience in this area; Lack of skills on farmer level on growing methodology for certain aromatic spices and medicinal plants; Lack of

devised strategy for cultivation medicinal plants that can penetrate on the market; Lack of information on potential yields, prices and markets for this group of the plants. Unfortunately, this is the first research attempts for growing Mint under the soil & weather conditions in the central part of Macedonia, hence we're unable to compare our results with any previously obtained, as they do not exist. Generally, the purpose of publishing this paper is to inform on the possibilities and the benefit of growing Mint under the organic principles in Macedonia.

2. MATERIALS AND METHODS

Major components of *Mentha piperita* essential oils identified by Gas Chromatography (GC) and Gas Chromatography-Mass Spectrometry (GC/MS) are: limonene 1-2.1%, 1,8-cineole 3.4-5.3%, menthone 18.4-27.9%, menthofuran 1.3-5.5%, isomenthon 2.9-3.8%, linalool 2.5-4.8%, β -caryophyllene, 1.5-4.2%, terpinen-4-ol 1.2-3.8%, menthol 27.5-42.3%, pulegone 1.0-14.4%, α -terpineol/borneol 0.7-2.4% [9].

Difference in the values of the percentages of individual components in peppermint oil due to the different places of production of mint i.e. the different agro-ecological conditions [2]. Ovche Pole valley (GPS coordinates: N 41°49', E 21°59'), suffers negative effect by being overlapping area of two climate types. The Mediterranean and Continental climate, which are the main reason for inconsistent and uneven precipitation, especially in the summer when there are significant low precipitation values [4]. The soil on which Mint was cultivated according to the principles of organic farming belongs to vertisol type. Its characteristic and nutrient availability are presented in Table 1 (total area of 2 ha).

Table 1. Agrochemical analysis of soil from experimental field in Ovche Pole

Analyzed parameters	Location
	Ovche Pole
Available P ₂ O ₅ (mg/100 g soil)	24.19
Available K ₂ O (mg/100 g soil)	74.1
Humus (%)	1.94
Conductivity (mS/cm)	0.25
Total N (mg/g)	0.98
pH	7.65

The results from the agrochemical soil analysis presented in Table 1, performed on the soil from the trial fields on which the Mint was planted in

Ovche Pole, indicates that the soil is with the following characteristics: good phosphorus availability (24.19 mg/100 g), rich in availability of potassium (74.1 mg/100 g), poor in humus content (1.94%) and slightly increased salinity [10]. The total nitrogen level is on satisfactory level (0.98 mg/g) while the pH value is on the alkaline side (7.65). Applied production technology of organically grown Mint, can be seen from data stated below, as well as from Table 4, named as: Revenues and incomes in the year of establishment (2008) and in the first year of utilization (2009). Planting was mechanized, with certificated quality propagation material with a length of 10-15 cm. Spacing between the rows was 70 cm. Width of rows was planned in a way to avoid plant damage during mechanized inter row cultivation for wee control. In our case, the Peppermint was planted by the end of October 2008. The new plants were watered immediately after transplanting. During the vegetation, in the stage of most intensive growth (up to the first cut) the prevention of the weeds was performed by 2 treatments between rows with cultivator. In-row weeds were reduced manually. Between each mowing, irrigation was applied using sprinklers providing 50 l/m² of water. Peppermint has a shallow root system and requires frequent irrigation with short sets, thus additional labor is required for moving irrigation equipment in peppermint compared to most field crops [7]. In the first year of exploitation (2009), due to youth fullness of the growing crop only two mowing were performed. The next year (2010), the number of mows increased by one. Practices described are based on production practices considered typical for the crop and area, but will not apply to every situation.

3. RESULTS AND DISCUSSION

3.1 Biomass Productivity

Timing and types of establishment and cultural practices will vary among growers within the region and from season to season due to variables such as weather, soil, and insect and disease pressure [8]. Besides favorable agro climatic conditions for the production of high quality dried herb material, plants responds quite well to good irrigation and fertilizer management. As [11] indicates, the area of Ovche Pole is characterized by moderate low average amount of rainfall (640–750 l/m²). Fig. 1 illustrates that ten years rainfall average (2001-2011), as well as average monthly precipitation in the years of study (2009-2010), can be seen that in July,

August and September, the average monthly precipitation values are lowest. From the above-mentioned, it can be noted that for the cultivation of mint in this region, and to get more than two mowing, it is necessary to irrigate, especially in the months with low precipitation.

Production of dried mint herb in these analyses ranged from 3500 kg/ha in first year of exploitations (2009), up to 5155 kg/ha in the following year (2010), as presented in Table 2 below, where it is presented and the ratio between dry leaves and stems.

The analysis of organic mint production (baled dry mass), subject of this paper are grouped in accordance and mutual dependence of applied specific agricultural techniques and administrative expenses

3.2 Financial Results

In order to check the financial effect of the suggested crop, for which any crop would be interesting to the producers (in this case—the Mint), it was necessary to determine the production costs [12]. The determination of the economic effect of the production of organic Mint, gives opportunity to the producers for greater visibility, monitoring and planning of all activities in accordance with cost operations. Calculation of costs and the incomes in the production of organic mint in the year of establishment (2008) and in first year of utilizing (2009), includes many

elements. These can be grouped depending on the price of certain agro-technical measures and certain administrative costs (Table 3).

Table 4 presents that the overall cost structure, costs for propagating material, (underground stolons) are with biggest share (51.7 %). Due to the large volume of investments in the first year of establishment, the cost per unit is high (1.9 €/kg). For all the reasons mentioned previously, in the first year of utilizing the profit is significantly lower (1569 €/ha) compared to the second year (2010). Lower yield/profit in the first year of utilization is due to incompletely developed crop growing, and the lower number of mowing.

3.3 Calculation of the Expenses in the Second Year of Utilizing the Crop (2010)

In the second year of crop's utilization, the total costs (€/ha), and the costs per unit (0,15 €/kg), are significantly smaller. The total income is € 19050 (Table 4). The income per unit area is 8125 €/ha. Calculation of costs and incomes in the second year of production of organic Mint is presented in Table 4. Data in this Table do not refer to costs for: soil cultivation, organic manure, its application, costs of propagating material and transplanting costs. In the second year of the utilizing the crop, the costs for harvesting and collecting, account for biggest share (50%), in the overall cost structure.

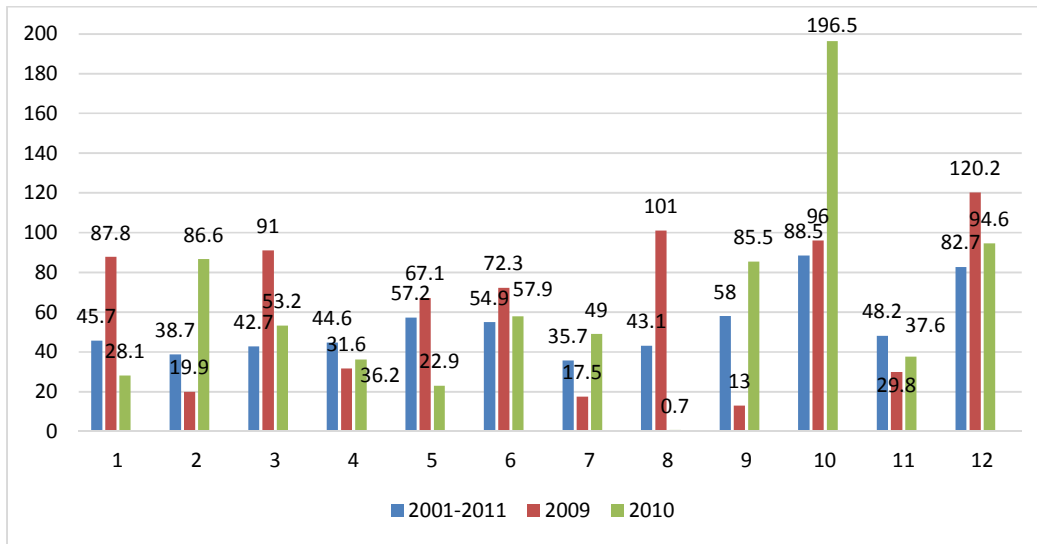


Fig. 1. Monthly amount of precipitation (mm)

Table 2. Yield of dried mint herb (kg/ha)

Year	Leaves	Stems	Leaves + Stems	Ratio
				Leaves : Stems
2009	1900	1600	3500	1,2 : 1
2010	3682	1473	5155	1,4 : 1

Table 3. Revenues and incomes in the year of establishment (2008), and in the first year of utilization (2009)

2008-2009	Unit	Qty	Price per unit (€)	Total (€)	Part of total income/cost (%)
Income obtained from production	kg	7000	1.77	12390	93.9
Income from subsidies	ha	2	400	800	6.1
Total revenues				13190	100.0
Soil cultivation costs	ha	2	310	620	6.1
Costs for Organic manure and application	t	60	30	1800	17.9
Costs for propagating material		4	1300	5200	51.7
Transplanting costs	ha	2	150	300	3.0
Irrigation costs	ha	2	250	500	5.0
Harvesting and collection costs (two mowing: 2 x 233 €)	ha	2	466	932	9.3
Crop insurance costs	ha	2	250	500	5.0
Certification costs	ha	2	100	200	2.0
First year total costs				10052	100.0
Cost of production unit (€/kg)		1.9			
Profit per unit area (€/ha)		1569			

Table 4. Costs and incomes in the second year of utilizing the crop (2010)

	Unit	Qty	Price per unit (€)	Total (€)	Part of total income/cost (%)
Income obtained from production	kg	10310	1.77	18250	95.8
Income from subsidies	ha	2	400	800	4.2
Total income				19050	100.0
Irrigation cost	ha	2	250	500	17.9
Harvesting and collection cost (three mowing: 3 x 233 €)	ha	2	700	1400	50.0
Crop insurance cost	ha	2	250	500	17.9
Certification cost	ha	4	100	400	14.2
Total costs				2800	100.0
Cost of production unit (€/kg)				0.15	
Profit per unit area (€/ha)				8125	

If of the total income (€ 19050), total costs are deducted (€ 2800), obtained value refer for second year profit (2010), which amounts to total of € 16250 or profit per unit area of 8125 €/ha.

4. CONCLUSION

Mint organic production has a lot of advantages because:

- The characteristics of the obtained product is suitable for extended storage in controlled conditions;
- Provides opportunities for monitoring and market analysis and possibly getting a higher price;
- Excludes the application of synthesized chemicals for nutrition and protection of the growing crop;

- Provides agro ecosystem sustainability through maintenance of biodiversity and antipollution impact on natural ecosystems for future generations.
- It can to optimize yield and achieve uniform high quality product.
- Relatively higher profit margin, through organic way of growing, can be a great business idea for the farm and family business.
- At last, but no least important, following the profitability results of growing organic Mint, appears that this production orientation could be of great business opportunity for Macedonian farmers.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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