Short Communication   **Open Access**

Mentha piperita: Energy and Economic Aspects

Barbieri C[*] and Manzone M

Department of Agricultural, Forest and Food Sciences, University of Torino, Torino, Italy

[*]**Corresponding author:** Barbieri C, Department of Agricultural, Forest and Food Sciences, University of Torino, Torino, Italy, Tel: +390116703826; E-mail: cinzia.barbieri@unito.it

Abstract

This study analyzes the energy and economic sustainability of the production of *Mentha × piperita L. var. officinalis* Sole f. *rubescens* Camus, also known as Mentha Italo-Mitcham (Black Mint or English peppermint) to equip farmers and processors with better information for market pricing. As background, we describe its principal production processes from transplantation to essential oil. Afterward, the focus is on the economic sustainability based on detailed costs and analysis of the energy consumed during crop production. Economic data from 2015 were collected directly from two farms in one of Italy's areas of traditional cultivation (Pancalieri and its surroundings, Piedmont Region), while the energy data were sourced from a combination of farm data and 'standardized' measures. These early results show that the production of essential oil of mint from Pancalieri is not profitable, which likely results from its few and relatively low energy input activities required during its cultivation cycle.

Keywords: *Mentha × piperita*; Cultivation; Energy; Profitability; Production cost

Introduction

This study aims to evaluate the energy consumption and economic results for sustainable production of *Mentha × piperita L. var. officinalis* Sole f. *rubescens* Camus, also known as Mentha Italo Mitcham (Black Mint or English peppermint) [1]. The area of study is the municipality of Pancalieri and its surroundings, in the Northwest of the Piedmont Region, Italy. Mint has been cultivated in the study area since the 18th century, while the Mentha Italo Mitcham (Menta of Pancalieri) species began its cultivation in the early 19th century. In Italy, Piedmont Region is one of the most important for MAP cultivation with 248 farms covering 870 ha (2010) amongst the 2,938 farms and 7,191 ha Italy-wide (2010). Of the Piedmont Region MAP crops, mint is the preeminent species [2,3]. Regional data indicates that mint is of interest to about 40 farms and 100 ha between the provinces of Torino and Cuneo [2]. Mint from Pancalieri-known for its superior quality-is used almost entirely (99%) for essential oil production. Pancalieri mint is unusual in that about 80% of it is purchased by a single food producer in the region (2015), making its 'market' essentially non-existent. After a brief description of the production process, this work evaluates and discusses energy consumption during the production process, followed by evaluation and discussion of some economic aspects.

The production processes

The mint production process begins in November with soil preparation (ploughing, harrowing) of a field, after which stolons are taken from the field on which they had been cultivated in the previous year and transplanted. Planned weeding occurs during pre-emergence in March, followed by alleyway clean-up in May. Fertilization is in March (2) and September (1), and the first irrigation takes place in May with an additional one in June. Harvest occurs with a single cut in August followed by distillation (whole plant, 'green herb'). The two to three-year cultural cycle follows a consistent production process throughout the area of study, with slight alterations in fertilization (a single one in spring) or irrigation. Additionally, some farmers recently have substituted the top of the plant to stolon's in the transplantation.

Energy and economic aspects

Energy consumption: The energy consumed to produce mint was derived from the fuel and lubricant amounts consumed as well as from farm machine manufacturing energy consumption [4]. To calculate actual energy input, we employed several coefficients: machine with engine 92.0 MJ kg^{-1}, equipment without engine 69.0 MJ kg^{-1}, fuel 37.0 MJ L^{-1}, and lubricant 83.7 MJ kg^{-1} [5,6]. For the fuel and lubricants, 1.2 MJ kg^{-1} was added to account for their distribution [7,8], while 55% of the total energy content in each machine was added for maintenance and repair [9]. The fuel consumption calculation used a 'topping-off system', in which the machine tank is re-filled after each work cycle [6]. Finally, lubricant consumption was estimated with a value of 2% of fuel consumption [10].

Results for mint cultivation and management, we derived a total consumption use of 16.7 GJ ha^{-1} per year. Across all work phases, the harvest operation required the highest input (23.8%), while rolling and harrowing operations (carried out at the start of the vegetative cycle in the second and third years) resulted in the lowest value (0.8%). Soil preparation (fertilization, ploughing, and harrowing) represented 54.8% of the total energy input (Graph 1). The energy required for cultural operations (weed control) represented 8.3%. The energy analysis highlighted the high amount of direct energy consumed by fuel and lubricants (84% of total energy input).
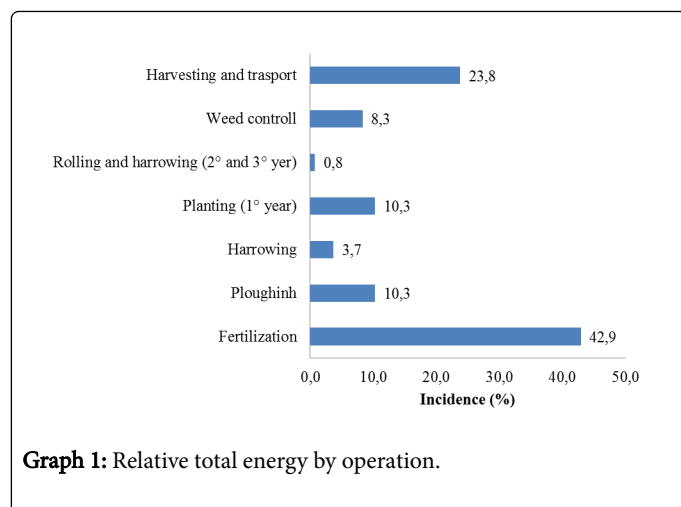
Graph 1: Relative total energy by operation.

Economic aspects: Economic data were collected at the beginning of 2016 through personal interviews. All economic data (prices of outputs and inputs) refer to 2015 and to 1 ha, and output values refer to the essential oil produced from 1 ton of mint. The typical yield from 1 ha of mint ranges between 60 and 70 kg of raw essential oil. Output value is derived from the annual farmer-food producer contracted price, which is based on production cost [11]. We collected the following data for each cultivation operation: inputs (fertilizer tonnes ha^{-1}); family labour or other labour (hours ha^{-1}); water (liters h^{-1}; tractor and equipment utilization (hours ha^{-1}). To calculate the total cost of production, we divided the various components of cost into specific and corporate overhead. Cost types. Specific costs were composed of several annual operating costs: i) inputs; ii) operating machinery (tractors and equipment); iii) labour; iv) interest on operating capital; v) land. Corporate overheads comprised several groupings: i) farm insurance; ii) expenses for accounting; iii) share membership to Consortium of irrigation; iv) others [2,12,13].

Specific cost calculations are described below. Area farmers provided us fertilizers, herbicides, and irrigation water pricing information. Machinery costs were calculated on the basis of 'hourly cost' by machine type, and was then adjusted for depreciation, interest on machinery capital ("the present value of machinery by the rate of the capital borrowed to purchase it, or 4%" [12]), insurance (provided by farmers), maintenance (present value of machinery multiplied by 2%) to determine total cost [2,11]. Operating capital included the sum of annual input, labour, land rental (farmer provided), and machinery expenses specific to the mint crop, to which an operating capital cost was associated, represented by an interest expense of 6% per annum. Two sources of labour were considered that represented the only used on the farms considered in the study-family and temporary employees. Farmers provided temporary employee costs, while the cost of family labour was calculated according to the concept of opportunity cost with reference to the basic hourly wage of a 'qualified horticultural worker' [14]. Overhead cost estimates and calculations were based on information provided and reviewed by the farmers, and included distillation cost. Taxes were not included in the calculated production cost. Finally, total output minus total costs determined profit.

Table 1 shows the production cost of mint from Pancalieri (essential oil) for 2015. Specific costs account for approximately 60% of the total cost, while the next highest cost portion is attributable to overhead costs of more than 22%, and distillation (19%). The production is not profitable.

Costs	€/ha	%
Labour (family and other)	856.00	14,21
Machinery	797.02	13,23
Cost of inputs	618.00	10,26
Land (rent)	1,150.45	19,10
Cost of capital	105.01	1,74
Total specific costs	3,526.48	58,55
Total overhead cost	1,342.40	22,28
Total production cost ('green herb')	4.868,88	80,85
Distillation	1.154,00	19,20
Total cost (essential oil)	6,022.00	100,00
Total output (essential oil, raw)	5,949.00	
Profit	-73.00	

Table 1: The calculated production cost of Pancalieri mint essential oil for 1 ha (2015).

Conclusion

These early results show that the production of mint from Pancalieri is not profitable. From an energy perspective, this crop seems to require little energy to produce, given the few and low energy input activities needed during its cultivation cycle. Note this study will be expanded to more farms to enhance its results. It has already benefited from the cooperation of Pancalieri operators and from previous research.

Acknowledgements

References

1. Municipality of Torino (2017) History of Mint of Pancalieri, Basket Products. Agriculture and Mountain.
2. Borra D, Mazzarino S (2009) Problems related to the production and marketing of mint in Piedmont Publications of the Department of Economics and Agricultural, Forestry and Environmental Engineering. Grugliasco, (Torino), Italy. p: 7-58.

3. Colombo ML, Manzo A, Dalfrà S (2014) The supply chain of officinal plants. Study Editions. Milan, Italy. p: 245-275.

4. Manzone M, Spinelli R (2014) Efficiency of small-scale firewood processing operations in Southern Europe. Fuel Proc Technology 122: 58-63.

5. Bailey AP, Basford WD, Penlington N, Park JR, Keatinge JD, et al. (2003) A comparison of energy use in conventional and integrated arable farming in the UK. Agric Ecosys Environ 97: 241-253.

6. Jarach M (1985) On equivalence values for analysis and balance energy in agriculture. Riv Ing Agr 2: 102-114.

7. Mikkola HJ, Ahokas J (2010) Indirect energy input of agricultural machinery in bioenergy production. Renewable Energy 35: 23-28.

8. Pellizzi G (1992) Use of energy and labour in Italian agriculture. J Agric Eng Res 92: 111-119.

9. Lubbe A, Verpoorte R (2011) Cultivation of medicinal and aromatic plants for specialty industrial materials. Industrial Crops and Products 34: 785-801.

10. Fluck R (1985) Energy sequestered in repairs and maintenance of agricultural machinery. Trans ASAE May-June. p: 28.

11. American Society of Agricultural Engineers (1999) ASAE Standards: Agricultural Machinery Management. EP466.2.

12. Barbieri C, Ferrazzi P (2011) Perilla frutescens: Interesting New Medicinal and Aromatic Plant in Italy. Nat Prod Comm 6: 1461-1463.

13. De Benedictis M, Cosentino V (1979) Economy of the farm. Theory and methods [Farm management. Theory and Methods]. The Mill. Bologna, p: 427-473.

14. Ministry of Labor and Social Policy (2014) National Collective Employment Contract for Employees engaged in activities in the fields of Agriculture and Floriculture, Floriculture, Forestry and Garden Maintenance. Rome, Italy.