

Life cycle assessment of potted rosemary production in the Albenga Plain Savona Province, Italy

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Introduction

Albenga plain is one of the main agricultural district of Northern Italy accounting for a total area of 2727 ha (1170 ha as open field and 277 ha as protected crops). Agriculture is specialized in the cultivation of potted plants (Fig. 1) with specific regards to fresh herbs and ornamentals (130-150 millions pots annually sold) encountering for some 20% of the total domestic production of aromatic plants. Rosemary represents the main species in terms of pots grown (around 35 millions per year mainly in open field conditions) being particularly appreciated by foreign markets. The main objective of the present LCA study was to evaluate the environmental burdens of potted rosemary cultivation in open field in terms of carbon footprint and ecotoxicity in different ecosystems.

Materials and methods

Software: Open LCA ver. 1.11

Database: Agribalysse ver. 1.3

Methodology used: Recipe Midpoint E

System boundaries: "cradle to gate" (from transplant to sale to retailers) (Fig. 2).

Functional unit: 1 pot (14 cm Ø polypropylene pot + growing media + plant) (Table 1)

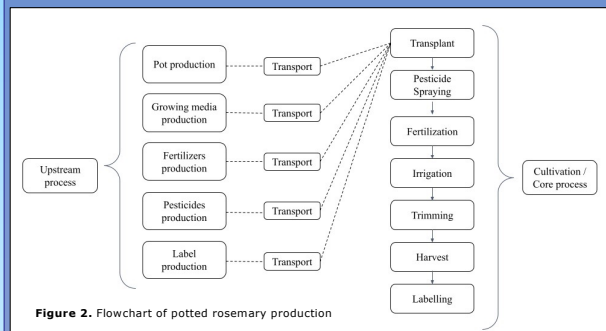


Figure 2. Flowchart of potted rosemary production

Main outcomes

Major environmental burdens are related to the following impact categories (Table 2): 1. Global Warming Potential (Table 3) and 2. Ecotoxicity (marine, freshwater, terrestrial) (Table 4). Totally the impact expressed in terms of kg of CO₂ equivalent for the production of a pot is equal to 0.30849 kg CO₂eq which, multiplied by the total production of Albenga area (35 million pots) corresponds to about 11000 t CO₂eq per crop cycle (corresponding to around 10 laps around the earth by a plane full of passengers). Specifically, the highest contribution to CO₂ emissions is represented by electricity consumption for pot production and for machine functioning during the cultivation phases. The second biggest impact is represented by polypropylene production. The highest impact for «ecotoxicity» category is represented by electricity, across all subcategories. The overall impact of potted rosemary production according to this category is around 1,5 million tons 1,4-DCB.

Figure 0. Model graph for rosemary in pot production

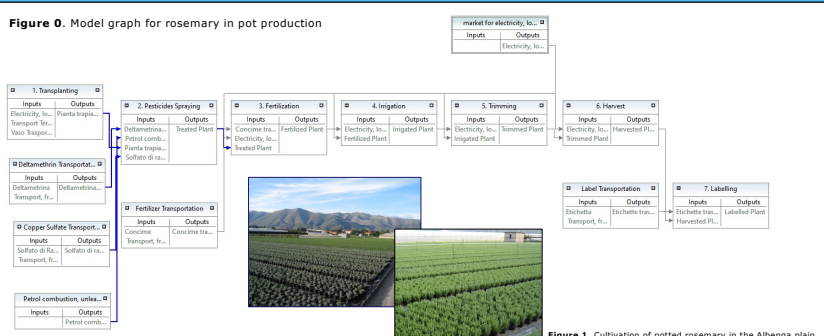


Figure 1. Cultivation of potted rosemary in the Albenga plain

Name	Impact result	Unit
Freshwater ecotoxicity	0,00588	kg 1,4-DCB
Ionizing radiation	0,05502	kBq Co-60 eq
Human carcinogenic toxicity	0,58704	kg 1,4-DCB
Freshwater eutrophication	7,69E-05	kg P eq
Ozone formation, Human health	0,00076	kg NOx eq
Global warming	0,30849	kg CO2 eq
Fossil resource scarcity	0,17929	kg oil eq
Terrestrial acidification	0,00191	kg SO2 eq
Fine particulate matter formation	0,00051	kg PM2.5 eq
Stratospheric ozone depletion	2,24E-06	kg CFC11 eq
Marine ecotoxicity	42,70071	kg 1,4-DCB
Mineral resource scarcity	0,00314	kg Cu eq
Ozone formation, Terrestrial ecosystems	0,00078	kg NOx eq
Marine eutrophication	7,18E-06	kg N eq
Human non-carcinogenic toxicity	37,49398	kg 1,4-DCB
Land use	0,02152	m2a crop eq
Water consumption	0,03255	m3
Terrestrial ecotoxicity	0,52313	kg 1,4-DCB

Table 2. Impact categories

Functional Unit: 1 Rosemary pot (650g)	
HDPP pot	40g
Growing media	420g
Plant	150g
Label	5g

Table 1. Properties of the functional unit

Global warming contribution tree	
Phase	Aggregate value (Kg 1,4-DCB)
Transplantation	0,2927
Pesticide spraying	0,29277
Fertilization	0,30071
Irrigation	0,30118
Trimming	0,30231
Harvest	0,30269
Labelling	0,30849

Table 3. Contribution tree for global warming

Marine ecotoxicity contribution tree	
Phase	Aggregate value (Kg 1,4-DCB)
Transplantation	35,77435
Pesticide spraying	36,15998
Fertilization	39,43435
Irrigation	39,56231
Trimming	39,86943
Harvest	39,9718
Labelling	42,70071

Table 4. Contribution tree for marine ecotoxicity

Conclusions

Cultivation of minor crops is an agricultural process that basically relies on different inputs necessary to create a suitable environment for plants to grow. Major impacts assessed refer to phases related to the upstream process, i.e. the ones where energy is consumed to produce such inputs (growing media, pot, fertilizers, pesticides). In order to reduce the calculated impacts by intervening on one or more productive factors through their substitution/elimination or on their production process will be the task of future investigations. The inputs that can be studied about their decrease or substitution and subsequent effect on the environmental impact are:

- reduction of peat rate in the growing media
- substitution of plastic (HDPE) used for pot production with e.g. starch based bioplastics
- reduction of nitrogen fertilization (nitric form, eutrophication)

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Acknowledgments

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