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# A life cycle assessment case study for walnut tree (*Juglans regia* L.) seedlings production

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## Abstract

**Purpose** High-quality wood production is based on both natural forestry populations and dedicated tree plantations, also mentioned as industrial plantations. The establishment of dedicated plantations needs high-quality seedlings, often grown in a nursery, having specific genetic and morphological features. From seed gathering to final selling, the growth of the seedlings needs human interventions and specific inputs such as fertilizers, pesticides, substrates, and capital goods (e.g., pots and greenhouses). All these inputs of course can cause not negligible environmental impacts, due to their production, maintenance, and final disposal. For these reasons, the environmental impact due to seedlings production in a nursery deserves deep analysis to assess the overall impact linked to wood supply chain: it is important that wood products are able to meet high environmental standards. This study is focused on 1- and 2-year-old walnut tree (*Juglans regia* L.) seedlings, aimed to high-quality timber production.

**Materials and methods** Life cycle assessment (LCA) methodology was adopted according to ISO 14040 standards. As case study, a nursery located in the South of Italy was studied. Both 1- and 2-year-old seedlings were analyzed from the LCA point of view and then compared, adopting 100 seedlings as functional unit.

**Results and discussion** Three inputs, plastic production, forming, and disposal to landfill, can be identified as the greatest polluters for both 1- and 2-year-old seedlings; for all the impact categories taken into account, their emissions joined always exceeded the 50% of the total amount, reaching values up to 90% (e.g., abiotic depletion, fresh water aquatic ecotoxicity, and photochemical oxidation). Two-year-old production system needs more inputs than 1-year-old; therefore, its greatest environmental impact was expected, but it is interesting to stress the increasing registered over the second year of growing, which reaches values up to 747% (fresh water aquatic ecotoxicity), most of which is due to polypropylene (mulching cloth, trays, and first of all, the pots).

**Conclusions** For four out of ten impact categories, polypropylene caused the greatest impact; therefore, interventions in this phase of the production system could be useful to reduce the overall environmental impact. Further investigations regarding the mortality rate for 1- and 2-year-old seedlings (after the plantation) are needed to better compare practical, economic, and environmental aspects.

**Keywords** Industrial plantations · *Juglans regia* · LCA · Life cycle assessment · Timber · Wood

## 1 Introduction

Wood is considered as the world's most important renewable material and regenerative fuel. Its main applications are construction material for housing and civil engineering, furniture, poles, and reinforcement for mining. Over the past 30 years, international trade in forest products has increased roughly threefold in terms of value, and now accounts for about 3% of total world trade (Matthew 2000).

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