

Ornamental Nursery at the time of *Xylella fastidiosa*. Assessing the economic and environmental sustainability of innovations.

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Introduction

In recent years, the spread of *Xylella fastidiosa* in Apulia Region has led the scientific community to focus attention on the effects that the epidemic is having on olive cultivation and on the landscape and the economy of the areas devastated by the bacterium as inextricably linked to olive growing. However, the list of host species affected by the bacterium that may contribute to the spread of the epidemic is very long. Among them, there are many ornamental species, whose production is an important economic sector particularly export-oriented [1]. The political-institutional interventions adopted to contain the problem consisted in the adoption of limitations for nurseries producing in the containment areas and in the introduction of strict protocols for the diagnosis and health certification of marketed species. The reputation of the product in the international context has exacerbated the impact of this "dark" period for the Apulian nursery sector. It is clear that even the slightest improvement of the production process and of the diagnosis protocols can represent a hope for the economic sector. However, it is necessary to address carefully the issue in question, combining agronomic and phytosanitary studies with an assessment of the impacts that innovations may have in the environmental and economic sphere.

As part of the PRODIQUAVI project, funded by the Apulia Region under Measure 16.2 of the 2014-2020 RDP, consistently with the commitments made within the European Innovation Partnership, important innovations have been proposed to be transferred to the Apulian nursery sector. Research bodies and major companies in the sector have advanced the use of sanitized mother plants, more accurate diagnostic protocols and biostimulants associated with sustainable protocols as an alternative to the methods conventionally used by nurserymen. These innovations, in addition to improving the production process, are able to change some essential parameters in the rooting phase of cuttings: anticipation of the rooting phase and reduction of cuttings mortality. Given the importance of these aspects in the production process, it has been necessary to deepen the evaluation of the sustainability of the adoption of these protocols from the economic and environmental point of view.

In order to help producers consciously adopt the systems that will allow them to best fulfil the above implications, the study aims to evaluate the effects on the company's balance sheet and on the economic convenience of innovations as well as on environmental performance [2,3].

Methodology

The study aims to investigate two closely interlinked issues: (1) balance sheet effects and cost-effectiveness analysis; (2) environmental impacts of production processes. In the comparative analysis, the impacts of the two extreme scenarios were compared: "conventional scenario" - cultivation with the protocol commonly used by nurserymen - and "improved scenario" - application of innovations able to affect the anticipation of rooting (-20 days) and the reduction of the mortality rate of cuttings (-20%). The species on which the elaborations in question have been carried out are those that are most relevant for the sector of the Apulian ornamental plants: *Abelia grandiflora*, *Bougainvillea cv Don Mario*, *Lantana camara cv Bandana rosa*,

Jasminum officinalis, *Photinia fraseri* cv *Red Robin*, *Loropetalum chinense* cv *Black Pearl*, *Viburnum lucidum*, *Trachelospermum jasminoides*.

The first point consists in the collection of economic data useful for the formation of the budget and for the calculation of the following economic indices: PLV, Value Added (Va), Gross Operating Margin (Mol), Gross Operating profit (Rol), Pre-tax Result (Ron), Net Income (Rn), Net Corporate Product (Pna), Net Present Value (Van), Labor Profitability (ReL), Land Profitability (ReT), Labor Productivity (ProL), Land Productivity (ProT). The analysis carried out makes it possible to identify the budget items most involved and to quantify the economic performance of the compared scenarios [4].

The second point of the study consists in the collection of technical data for the preparation of a Life Cycle Assessment aimed at estimating the environmental impacts of products obtained with conventional protocols and compared with innovative protocols. The limits of the system identified for the preparation of production processes are as follows. First of all, the reference unit is equal to the production of 1,000 potted plants d16. Furthermore, the production process takes into account all the phases from cutting to the achievement of commercial maturity of the plant, defined as the time when the aesthetic and dimensional characteristics of the plants are such as to be able to be marketed. The production processes prepared take into account all agricultural inputs used, in particular: water, substrates, pots, treatments, energy, fuel, land occupation, occupation of farm facilities. Impacts are estimated with the ReCiPe Midpoint (H) method that allows, in addition to the Life Cycle Assessment (LCA) calculation, also the calculation of the simplified profit and loss account through the Life Cycle Cost (LCC). [5 - 11]

Results

The study is nearing completion and the final results will be achieved in the coming months, as part of the continuation of activities related to the project for the transfer of innovation to nursery companies.

However, the research work has already led to some important preliminary results. First of all, it has been possible to establish which are the main items of the budget involved in the production of ornamental species. The items with the highest absolute and percentage values are miscellaneous expenses and labor (salaries and wages). The comparison between conventional and innovative protocols led to the identification of the items with the most significant improvements in relative terms: Miscellaneous Expenses (-0.32%); Salaries (-0.80%) and Interest (-7.53%).

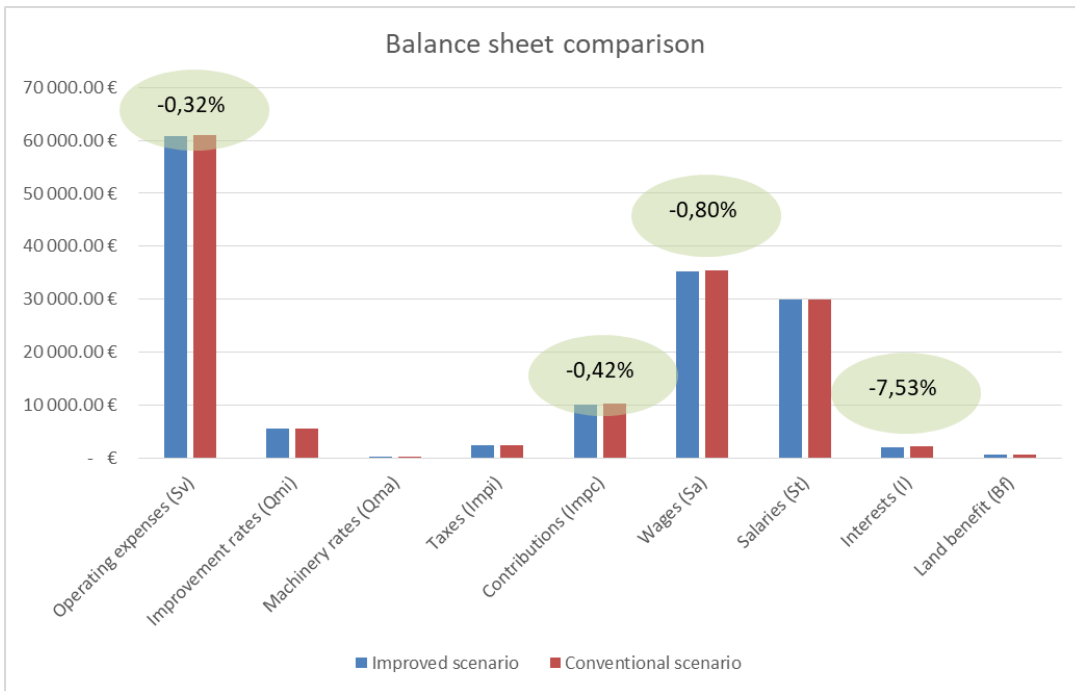


Figura 1 Balance sheet items affected by the introduction of innovative protocols (our elaborations)

From the point of view of company economic performance, the economic indicators which, in percentage terms, can boast the most marked improvement are Land profitability (+18%) and Labor profitability (+19%). Net Income (up to 3.78%) and Gross Operating Profit (up 2.50%) also registered decent results. The improvement in Gross Operating Margin (Mol) stood at around 1.92%.

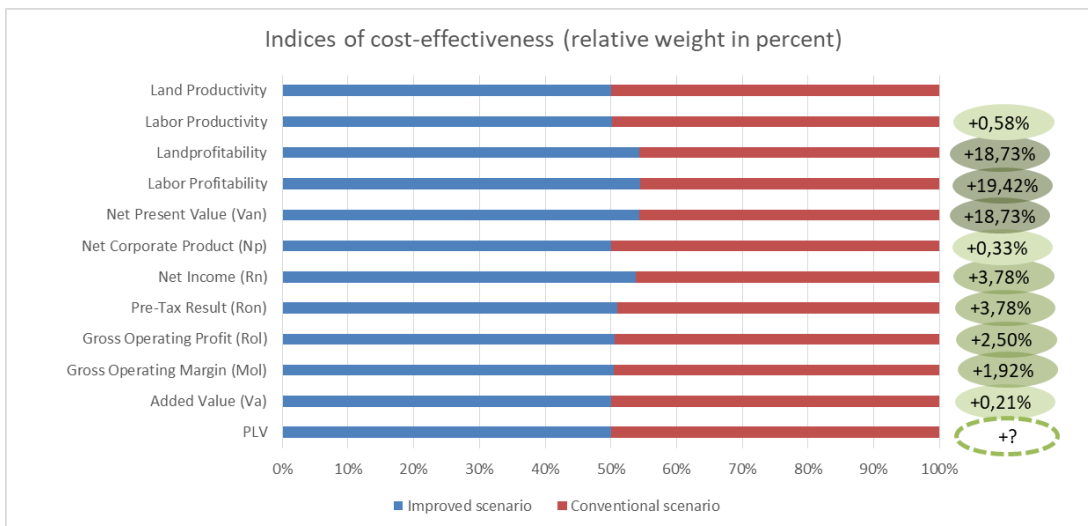


Figura 2 Comparison of economic indicators on a normalized scale

A preliminary implementation of the LCA led to an estimate of the environmental impacts deriving from the cultivation of some of the species considered. The most relevant effects concern the reduction of climate change (GWP100) expressed in Kg of CO₂-Eq with a decrease of 0.64%. The consumption of fossil resources (FDP) expressed in Kg of Oil-Eq. stands at a reduction of 0.95%, while the water saving in m³ is equal to 4.36%. The impact on water also concerns ecotoxicity with a reduction of 2.63%.

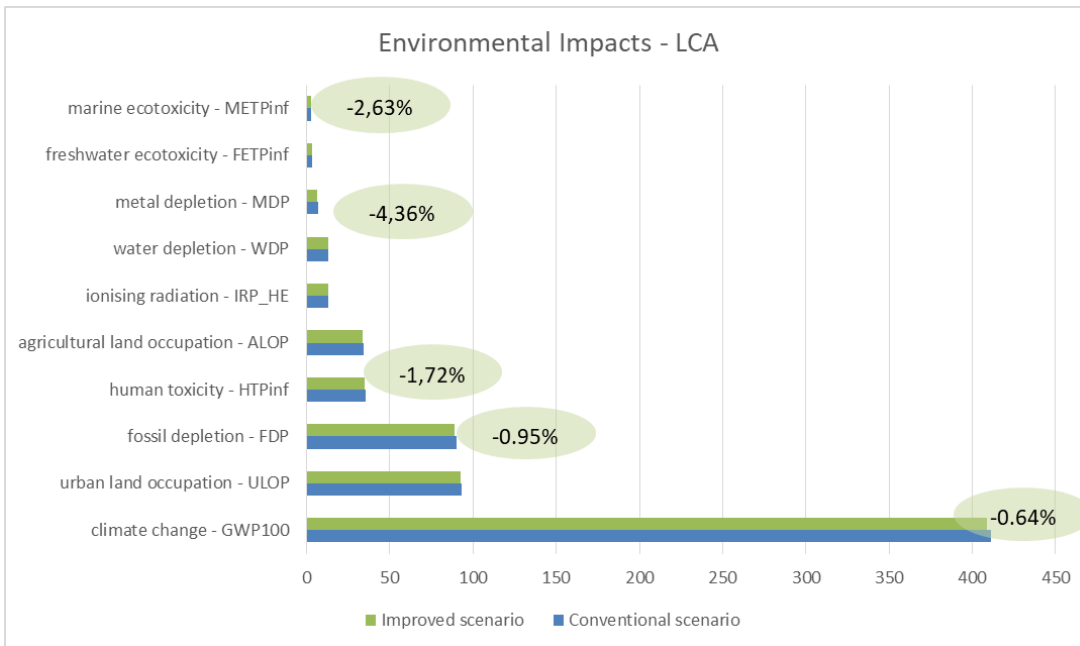


Figura 3 Environmental impacts of applying LCA for the conventional and improved scenario.

Conclusions (preliminary)

The study has led to preliminary important provisional results that suggest how much the introduction of small innovations in management and production can bring to the achievement of multiple objectives: economic objectives relevant to the nurseries and environmental objectives relevant to the community. Results shown are the average results for some species analyzed. Detailed results, not showed in the abstract, vary across species leading to more accurate considerations. The scale of the study is certainly limited as such as in the assumptions of the analysis but also in the weight of the results. This suggests how the potential impact of the changes in the production process can have for the entire industry if adopted at a larger scale.

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