

A plant nursery protocol to produce *Phytophthora*-free cork oak seedlings

Ensuring the production of healthy woody plants for forest restoration projects in Sardinia, Italy.



Cork oak forests in Northern Sardinia. If affected by *Phytophthora* spp. they are more prone to the effects of climate change and cork oak decline.

Author: Sara Maltoni | © Agency FoReSTAS



Nurseries: growing plants on benches aboveground (right) reduces the chances of contamination by *Phytophthora* spp. compared to benches on the ground (left).

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/// Context ///

Species of the oomycete genus *Phytophthora* are well-known pathogens that cause damaging diseases of forest trees and agricultural crops worldwide and are strongly associated with the decline of oak trees in Mediterranean ecosystems. Affected plants often showed symptoms such as crown thinning, chlorosis, and decay caused by extensive fine root loss and/or collar rot.

In a study conducted in 23 European countries in 2015, *Phytophthora* taxa were recorded in 91.5% of nurseries and 66.0% of forest and landscape planting sites. *Phytophthora* species were also detected in Italian nurseries, including

those dedicated to the production of plant material used for forest restoration.

Since eradication of these pathogens is difficult, prevention of their introduction through the use of pathogen-free plant material is the most efficient and cost-effective approach to prevent forest decay. To address the need for pathogen-free for reforestation projects, a forest nursery management method has been developed to produce *Phytophthora*-free plants. The method was developed in a model nursery and consists of a mix of management techniques, best practices and training of employees, and resulted in the production of *phytophthora*-free propagation material.

/// Solution for a Resilient Future ///

A hazard analysis to determine all potential sources of contamination for *Phytophthora* species is crucial to define the best management solution. A protocol to produce plants free of *Phytophthora* was developed by a team of professionals and scientists belonging to the University of Sassari and the Sardinian Regional Agencies AGRIS and Fo.Re.S.T.A.S., within the Phytosanitary Forest Monitoring Center project. The protocol includes the following tips:

- Start with healthy propagative material, free of infection or external contamination by *Phytophthora* species as well as other possible pathogens. Seeds are collected if possible in certified seed forests, for plants reproduced by plant parts, these come from nursery-born plants grown following this protocol..
- Raise containers off the ground with benches up to one metre and add a gravel barrier between containers and the ground to reduce the risk of contamination from potentially infected soil. Gravel avoid water stagnation in the soil, as *Phytophthora* grows in puddles of water and high temperatures.
- Use new, clean or disinfected containers, as used pots may contain *Phytophthora* spores. Special attention is paid to storing the phytocontainers indoors, away from sources of contamination

- Perform heat treatment of the potting media (soil) using steam, as it is lethal to most plant pathogenic fungi and *Phytophthora* but does not kill all soil microorganisms and will not result in "sterile" soil. The procedure involves mixing plant soil, peat, perlite, and pumice est. Mixing is done with an automated machine that saves considerable time.
- Once mixed, the substrate undergoes steam sterilization that reaches temperatures of up to 120 degrees, substrate that is loaded into a box and covered with heat-resistant cloths, inside of which is a series of steel pipes with perforations that allow steam to diffuse evenly into the mixed substrate.
- Irrigate using deep well water, or implement a water filtering system to avoid contamination, Groundwater is used once analyzed, as public water was heavily contaminated. Filtration systems may be a solution, but they must be carefully maintained on time to ensure their proper functioning
- Adopt disinfection measures of footwear and tools at the entrance to the plant growing area, as cleaning procedures to prevent spreading *Phytophthora* propagules. The work tools are for the exclusive use of the model nursery productions
- Monitor disease symptoms typical of *Phytophthora*, such as wilting, leaf necrosis (browning), chlorosis (leaf yellowing),

dieback, root and collar rot, and sudden plant death are of particular concern, for immediate intervention. Treating *Phytophthora* contaminated plants is impossible, plants showing signs of disease must be destroyed

- Inform and train all nursery staff to learn about potential hazards and comply with the protocol and all best



Plants are grown in containers raised above the ground in order to avoid contact with moist soil. soil waterlogging is eliminated by physical barriers, gravel or synthetic sheeting.

Author: Maurizio Frongia | © Agency FoReSTAS

management practices. staff working in the nursery have been trained to ensure the utmost care in the application of *Phytophthora*-free plant production protocol

This protocol can be replicated in other nurseries to increase plant biosecurity with positive implications for forest and semi-natural ecosystems.



Sowing in heat-treated potting soil in the nursery of Campulongu (FoReSTAS).

Author: Gianni Pili | © Agency FoReSTAS

/// Always Moving Forward ///

As forest nurseries represent the major pathway of introduction of exotic and invasive *Phytophthora* species in Mediterranean countries, EU directives on urban forestation and forest restoration underline the importance of producing plants free of pathogens. Developing new technologies for preventing and controlling *Phytophthora* diseases is then a key to reduce cork and other oak decline or tree dieback.

Currently, the implementation of this innovative plant production strategy, based on the presented protocol, has been limited to a portion of a public forest nursery managed by the FoReSTAS Agency. In order to set up this pilot nursery, large investments have been made and the type of management also resulted in increased operating costs. More than ten different

Mediterranean species are highly susceptible to *Phytophthora* grown during the two years of nursery production, only one seedling of *M. communis* was found positive during monitoring in the first year, while in the second year no *Phytophthora* was isolated from the 10,000 plants grown in the second year, with more than 100 tests conducted.

To effectively prevent the introduction of pathogens into forest ecosystems, the approach presented should be adopted by nurseries linked to reforestation projects. The dissemination of this good practice has been carried out under the Livingagro ENI CBC MED project throughout the Mediterranean, including MENA countries. The practice is currently being further developed and disseminated under the LIFE FAGESOS project.

Further information

- Jung, T., et al. 2015. Widespread *Phytophthora* infestations in European nurseries put forest, semi-natural and horticultural ecosystems at high risk of *Phytophthora* diseases. For. Path. 46: 134-163. <https://doi.org/10.1111/efp.12239>
- Campulongu Productive Nursery. <https://www.sardegnaforeste.it/struttura-territoriale/vivaio-produttivo-di-campulongu> (Accessed 16 August 2024) (In Italian)
- Livingagro ENI CBC MED project website. <https://www.livingagrolab.eu/> (Accessed 16 August 2024)
- LIFE FAGESOS project information. <https://webgate.ec.europa.eu/life/publicWebsite/project/LIFE21-CCA-IT-LIFE-FAGESOS-101074466/phytophthora-induced-decline-of-fagaceae-ecosystems-in-southern-europe-exacerbated-by-climate-change-preserving-ecosystem-services-through-improved-integrated-pest-management> (Accessed 16 August 2024)

Acknowledgment / Contribution

University of Sassari, AGRIS Regional Agency for Scientific Research, Experimentation and Technological Innovation in the agricultural, agro-industrial and forestry sectors, and Fo.Re.S.T.A.S. Regional Forestry Agency for the Development of the Territory and the Environment of Sardinia, Department of Environmental Protection, Autonomous Region of Sardinia.

Authors: Dr. Bruno Scanu, Salvatore Seddaiu, Sara Maltoni and Mauro Forteschi, Maurizio Frongia

Partners: FoReSTAS – Agenzia forestale regionale per lo sviluppo del territorio e l'ambiente della Sardegna



Co-funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Project co-funded by



Schweizerische Eidgenossenschaft
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