



**UNIVERSITÀ DEGLI STUDI
DELL'INSUBRIA**

“Growth and Characterization of Plant Organisms”

Coordinator: Prof. Bruno E.L. Cerabolini

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Keywords: biochar, biomass, nutrients, fibers, phytoremediation, plant functional traits

Purpose: Growth under controlled conditions, and anatomical, morphological, and functional characterization of plant organisms. This facility serves as a center of excellence for the conservation of natural resources. Examples of applications: 1) characterization of nutrients (CHNS-O) and functional traits of plants, 2) valorization of lignocellulosic biomass from invasive alien species, 3) phytoremediation applications, 4) production and characterization of biochar.

Location: c/o Department of Biotechnology and Life Sciences; Spallanzani Pavilion, Via Monte Generoso, 71, and Lanzavecchia Pavilion, Via Dunant, 3 - 21100 Varese

Organization: The facility is part of a network that brings together research groups with multidisciplinary expertise and advanced technological resources.

The facility is organized into two substructures:

- Growth chambers and root morphology;
- Characterization of plant biomass;

Linkage with CRIETT's Technology Platforms and the University's Scientific Platforms:

This facility operates in collaboration with:

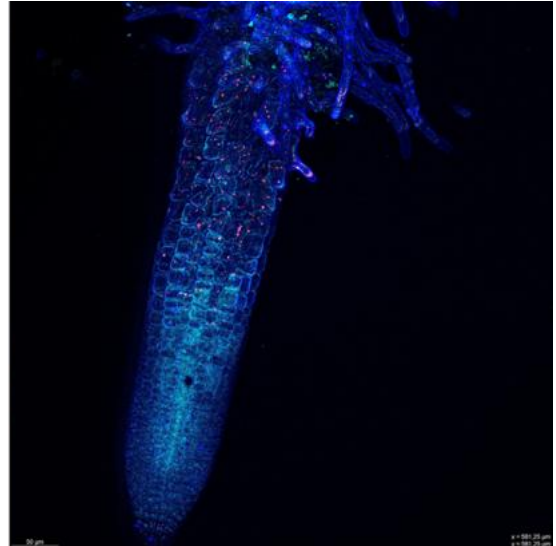
- CRIETT's Microscopy and Imaging Platform
- University Sustainability Platform within the scope of the following objectives: 1) Valorization of biomass and production of natural substances; 2) sustainability and protection of natural resources; 3) environmental contaminants.

Substructure “Growth Chambers and Root Morphology” Sub-facility

Coordinator: Prof. Antonio Montagnoli

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Keywords: organic soil conditioners, molecular factors, root morphology, fine roots, rhizosphere, stress



Facility for the cultivation of plant organisms under controlled conditions thanks to the presence of various types of growth chambers. In addition, the laboratory enables anatomical and morphological analyses, with particular focus on the dynamics and morphology of fine roots and the architecture of structural roots, as well as the photosynthetic activity of plant organisms. A section of the laboratory is also dedicated to molecular analysis. These studies examine the influence of abiotic and anthropogenic factors, environmental stress, and organic soil amendments (biochar). Finally, the laboratory includes several units located outside in the large garden, such as an outdoor area for growing plants, a weather station, an experimental vineyard with rhizotrons, highly automated growth chambers, and reinforced soil monoliths.

Substructure “Characterization of Plant Biomass”

Coordinator: Dott. Michele Dalle Fratte

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Keywords: Plant adaptations, environmental sustainability, invasive alien species, ecological strategies, functional traits of leaves.



Facility for the classification and characterization of plant organisms. It is possible to conduct comparative analyses of the morpho-functional characteristics of plants (traits) aimed at highlighting the range of functional types and ecological strategies within vascular plants, for the interpretation of ecosystem functions and vegetation processes such as coexistence and dominance within plant communities, the effects of disturbance, stress, and abandonment, dynamic successions, relationships between biomass, biodiversity, and the element cycle, and for understanding the relationships between plants and pollutants in the context of phytoremediation. The laboratory also includes instruments useful for characterizing the nutrient content, protein value, and fiber content (lignin, cellulose, hemicellulose) of plant biomass.

Publications:

Growth chambers and root morphology

1. Montagnoli A, Hudak AT, Raunonen P, Lasserre B, Terzaghi M, Silva CA, Bright BJ, Vierling LA, de Vasconcellos BN, Chiatante D, Dumroese RK. Terrestrial laser scanning and low magnetic field digitization yield similar architectural coarse root traits for 32-year-old *Pinus ponderosa* trees. *Plant Methods* 2024 20:102
2. Beatrice P, Dalle Fratte M, Baronti S, Miali A, Montagnoli A. The long-term effect of biochar application to *Vitis vinifera* L. reduces fibrous and pioneer root production and increases their turnover rate in the upper soil layers. *Front. Plant Sci.* 2024 15:1384065.
3. Montagnoli A, Terzaghi M, Miali A, Chiatante D, Dumroese RK. Unusual late-fall wildfire in a pre-Alpine *Fagus sylvatica* forest reduced fine roots in the shallower soil layer and shifted very fine-root growth to deeper soil depth. *Sci Rep* 2023 13, 6380
4. Beatrice P, Saviano G, Reguzzoni M, Divino F, Fantasma F, Chiatante D, Montagnoli A. Light spectra of biophilic LED-sourced system modify essential oils composition and plant morphology of *Mentha piperita* L. and *Ocimum basilicum* L. 2023 *Front. Plant Sci.* 14:1093883.
5. Montagnoli A, Lasserre B, Terzaghi M, Byambadorj S-O, Nyam-Osor B, Scippa GS and Chiatante D (2022) Fertilization reduces root architecture plasticity in *Ulmus pumila* used for afforesting Mongolian semi-arid steppe. *Front. Plant Sci.* 2022 13:878299.
6. Beatrice P, Chiatante D, Scippa GS, Montagnoli A. Photoreceptors' gene expression of *Arabidopsis thaliana* grown with biophilic LED-sourced lighting systems. *PLoS ONE* 2022 17(6): e0269868.
7. Montagnoli A, Baronti S, Alberto D, Chiatante D, Scippa GS, Terzaghi M. Pioneer and fibrous root seasonal dynamics of *Vitis vinifera* L. are affected by biochar application to a low fertility soil: A rhizobox approach. *Sci Total Environ.* 2021 10;751:141455.

Characterization of plant biomass

1. Rosa, F., van Bodegom, P. M., Hellweg, S., Pfister, S., Biurrun, I., Boch, S., ... & Scherer, L. (2025). Land-Use Impacts on Plant Functional Diversity Throughout Europe. *Global Ecology and Biogeography*, 34(1), e13947. Wiley-Blackwell Publishing Ltd. doi: 10.1111/geb.13947
2. Puglielli, G., Bricca, A., Chelli, S., Petruzzellis, F., Acosta, A. T., Bacaro, G., ... & Tordoni, E. (2024). Intraspecific variability of leaf form and function across habitat types. *Ecology letters*, 27(3), e14396. Wiley-Blackwell Publishing Ltd. doi: 10.1016/j.ecolind.2023.111113
3. Ceriani A, Dalle Fratte M, Agosto G, Beatrice P, Reguzzoni M, Bettucci L, Casini D, Cerabolini BEL, Montagnoli A. Woody and herbaceous invasive alien plant species-derived biochars are potentially optimal for soil amendment, soil remediation, and carbon storage. *Global Change Biology Bioenergy.* 2024; 16:e13117
4. Ceriani, A., Dalle Fratte, M.*, Agosto, G., Montagnoli, A., & Cerabolini, B.E.L. (2023). Using plant functional traits to define the biomass energy potential of invasive alien plant species. *Plants*, 12(18), 3198. Multidisciplinary Digital Publishing Institute (MDPI). doi: 10.3390/plants12183198
5. Dalle Fratte, M.*, & Cerabolini, B.E.L. (2023). Extending the interpretation of Natura 2000 habitat types beyond their definition can bias their conservation status assessment: An example with species-rich *Nardus* grasslands (6230*). *Ecological Indicators*, 156, 111113. Elsevier B.V. doi: 10.1016/j.ecolind.2023.111113
6. Dalle Fratte M, Montagnoli A, Anelli S, Armiraglio S, Beatrice P, Ceriani A, Miali A, Nastasio P, Cerabolini BEL. Mulching in lowland hay meadows drives an adaptive convergence of above and below-ground traits reducing plasticity and improving biomass: A possible tool for enhancing phytoremediation. *Front. Plant Sci.* 2022 13:1062911.

• **A) Facility for the Growth and Characterization of Plant Organisms**



Grow rooms for cultivating plants in a controlled environment, equipped with various light sources (e.g., COELUX, neon lights).



Sampling and analysis of root systems. The facility is equipped with various instruments for sampling the roots of both herbaceous and woody species (e.g., a motorized corer) and for subsequent anatomical and morphological analysis (e.g., a scanner with a transparent unit).

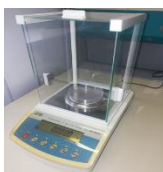
• **B) Plant Biomass Characterization Facility**



Ankom A200 Fiber Analyzer for characterizing the fibers (lignin, cellulose, hemicellulose) of lignocellulosic biomass.



Thermo Scientific FlashEA 1112 CHNS Analyzer and muffle furnace for characterizing the nutrient content (CHNS-O) and ash content of biomass.



Precision scales and scanners for measuring key leaf characteristics (leaf area, specific leaf area, dry matter content).