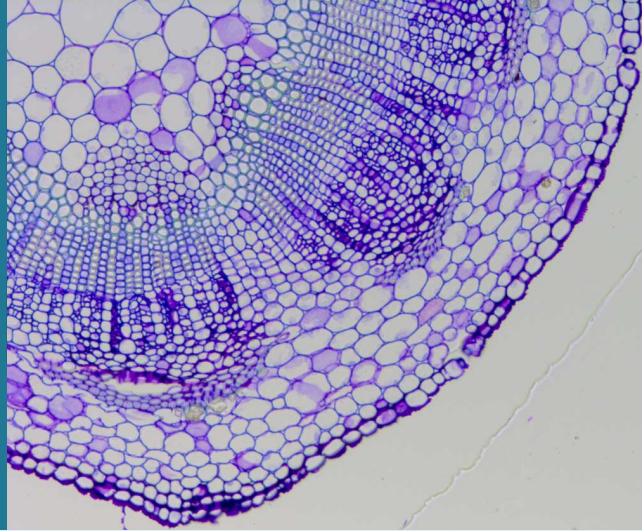


# Plant Biotechnologies



The Plant Biotechnologies research group develops new concepts, products and services based on plant bioprocess engineering approaches, as well as synthetic biology using chassis (micro)organisms and integrative biology. The goal is the valorisation of plant biomass as feedstock of molecules for sustainable industrial products and the green biotech sector. The research team applies functional genomics approaches to clarify their biosynthetic pathway in planta, as well as heterologous expression of microbial secondary metabolite biosynthetic gene clusters in host organisms combined with a high-throughput mass spectrometry-based biodescovery metabolomics platform.

## MAIN EXPERTISE FIELDS

- Plant and microbial bioprospecting
- Plants and microorganisms produce a wide array of secondary metabolites with biological activities of high interest for the cosmetic, nutraceutical, pharmaceutical and agro-chemical industries. The Plant Biotechnologies research group also promotes the valorisation of plant genetic diversity in compliance with access and benefit-sharing (ABS) principles and valorises agro-industrial by-products as a source of commercially relevant molecules. This includes the upcycling of brewery residual biomass, apple/pear pomace to a source of bio-active compounds.
- Plant cultures
- Plants are cultivated both in vitro, in soil and as cell suspension cultures to characterise them from the molecular point of view. Among the research activities of the group, there is the study and valorisation of multi-purpose and underutilised crops, such as Cannabis sativa and Urtica dioica, as sources of both fibres and phytochemicals, as well as the cultivation of plant cell cultures, for example apple varieties, for the production of high added-value molecules and the biodescovery of bioactive molecules of microbial origin for plant protection applications.
- Synthetic biology and bioprocess engineering

Metabolic engineering combined with comprehensive chemical characterisation techniques are used to develop chassis organisms, plants and plant cell cultures for the sustainable production of known and novel high-value molecules with new or superior biological activities. Once a cell line is established at the laboratory scale, the Plant Biotechnologies research group develops bioprocess engineering approaches for upscaling.

## RESEARCH CHALLENGES

- Plants as phytofactories
- Resilient and sustainable agriculture
- Upcycling

## APPLICATION AREAS

- Cosmetics
- Bio-stimulants
- Bio-control
- Biopesticides
- Sustainable agriculture
- Nutraceuticals
- Food industry

## MAIN ASSETS

- A multidisciplinary approach to understand the molecular basis of the heterogeneous cell wall composition in hemp stems - [CANCAN](#)
- Studying cell wall-associated processes in fibers of nettle - [CABERNET](#)
- Exploitation of plant seed mucilage in the development of protein based xero-scaffolds embedding human gut relevant probiotic cells - [PROCEED](#)
- Functionalized Silicon particles application to boost phyto-resilience - [SILPHYTO](#)
- Impact of cadmium and zinc on fiber production in hemp (Cannabis sativa): an integrated approach assessing the protective effect of silicon - [HEMPFI](#)
- Production of nutritional supplements using green extraction methods for the upcycling of brewery residues - [BEQ-FIT](#)

## EQUIPMENT

- Bioreactors (0.5 L-300 L, stirred- and wave-tank, with and without illumination)
- Bioreactor for solid state fermentation
- Plant tissue culture facility
- Plant growth chambers
- Plant transformation facility (gene gun, electroporator, qPCR and PCR machines, automated dispensing system for 384 well plates, gel electrophoresis chambers, Bioanalyzer, NanoPhotometer, vacuum infiltration system)
- Bead grinder
- Laboratory blender
- Fluorescence microscope and stereo-microscope
- Phenotyping station
- Microtome/vibratome/cryomicrotome
- Microplate reader
- Ultrasonic bath
- Freeze dryer
- CCD camera
- Turbovap® evaporator
- Ultracentrifugal Mill
- Pilot plant for extraction
- Rotary evaporator
- Vacuum oven
- Table-top Homogenizer
- Table-top vacuum packing machine
- High pressure homogeniser
- Oscillatory rheometer
- 3D printer
- Ultrasound processor

## SELECTED PUBLICATIONS

- [Phyto-courcier: a silicon particle-based nanobio-stimulant: evidence from Cannabis sativa exposed to salinity](#), Guerrero G., Maria Suter F., et al. 2021. ACS Nano 15, 3061-3069
- [Impact of cadmium and zinc on proteins and cell wall-related gene expression in young stems of hemp \(Cannabis sativa L.\) and influence of exogenous silicon](#), Luyckx M., Hausman J.-F., et al. 2021. Environmental and Experimental Botany, 183, 104363.
- [Molecular insights into plant desiccation tolerance: transcriptomics, proteomics and targeted metabolite profiling in Cratogeomys plantagineus](#), Xu X., Legay S., et al. 2021. The Plant Journal.
- [A bioactive diversity of lignin: Reappraisal](#), Behr M., Guerrero G., et al. 2019. Trends in Plant Science, 24, 1052-1064.
- [Cell wall composition and transcriptomics in stem tissues of stinging nettle \(Urtica dioica L.\) spotlight on a neglected fibre crop](#), Xu X., Backes A., et al. 2019. Plant Direct, 3, 1-17.
- [Cannabis sativa: the plant of the thousand and one molecules](#), Andre, C.M., Hausman, J.-F., et al. 2016. Frontiers in Plant Science 7, 19.
- [Transcriptomic profiling of hemp bast fibres at different developmental stages](#), Guerrero, G., Behr, M., et al. 2017. Scientific Reports 7, 4961.
- [Cytotoxic and fibrogenic capacity of alpha \(Medicago sativa L.\) and beta-sitosterol \(Tropaeolum arvense\) and galactomannan](#), Hellebois, T., Galani, C., Fortuin, J., Shaplov, A., & Soukoulis, C. 2021. Carbohydrate Polymers, 267, 118190.
- [Structure, conformational and rheological characterisation of alfalfa seeds \(Medicago sativa L.\) galactomannan](#), Hellebois, T., Soukoulis, C., Xu, X., Hausman, J.-F., Shaplov, A., Taoukis, P. S., & Galani, C. 2021. Carbohydrate Polymers, 256, 117394.
- [A comprehensive overview on the micro- and nano-technological encapsulation advances for enhancing the chemical stability and bioavailability of carotenoids](#), Soukoulis, C., & Bohn, T. 2018. Critical Reviews in Food Science and Nutrition, 58(1), 1-36.
- [Plant seed mucilage as emerging biopolymer in food industry applications](#), Soukoulis, C., Galani, C., & Hoffmann, L. 2018. Current Opinion in Food Science, 22, 28-42.

## Partners

PM International (LU)  
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