

TEXT-EAU-TERREAU

Project title: Substrate Texture: A unifying approach to explain and control Physical Properties and Water Efficiency in Horticultural Substrates

Acronym: **TEXT-EAU-TERREAU**

Project duration: 35 months - Start date: 01/11/2019 End date: 30/09/2022

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Summary:

Context

In soilless culture, improving water efficiency is of vital importance to avoid risks of root asphyxia, nutrient leaching, infestation by pathogens in case of excessive irrigation, and conversely, risks of substrates hydrophobicity and plant physiological stress in driest conditions. Water efficiency closely depends on the physical and hydraulic properties (water retention and flow, ability to drain) of the substrates, themselves resulting of their particles size and shape (texture) and organization (structure).

Texture is considered as the main reference describing a soil and many of its properties, *i.e.* its « Identity Card », and then is routinely characterized. In contrast, texture has never been studied for horticultural substrates, in part because its analysis is much more complex due to the large diversity of particles sizes and shapes (fibers, chips, etc.) used in horticultural substrates, in comparison with mineral soils which are mostly granular particles. These irregular shapes fall together to create a pore size distribution much larger than in mineral soils (over 75% by volume), so that particles size and shape greatly influence the resulting matric structure of the materials, and therefore their physical and hydraulic properties.

Goals

The general scientific aims of this project are (1) to finely analyze the texture (particles size and shape) of a large diversity of substrates components (peats, barks, wood products, coir, etc.), (2) to understand its influence on their structure, and then (3) to identify some relevant parameters from texture and structure used to develop a model for explaining, predicting and precisely controlling physical and hydraulic properties of substrates. By using this approach, this project would contribute to considerable scientific and industrial breakthroughs, improve water use and efficiency in soilless culture, and likely redefine the composition selection (raw materials, fractions, mixes) of substrates. This would also favor sustainable peat alternatives, as both describing physical properties required and irrigation techniques needed by the end-users. So that this project will result in more sustainable horticultural soilless systems.

Methodology

This project is based on the use of a very innovative and original technique for characterizing particles size and shape of substrates' components using dynamic image analysis. Other intrinsic properties such as the specific surface area and surface properties (hydrophobicity) will complete this detailed analysis of texture. These data will be coupled with a mechanistic description of the porosity (pore size, shape and connectivity) using X-ray microtomography, then with the measurements of rewetting capacity and other physical and hydraulic properties of substrates (water and air retention and flows). A unifying model will be then developed in order to explain, predict and control substrates' properties from both texture and structure analysis.