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Pore structure of different biochars and their impacts on physical properties of Sphagnum moss growing media

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Suitability of organic materials as growing media in plant production is dependent on physical properties of the media. Undecomposed Sphagnum moss growing media is an innovative and potentially more sustainable alternative to the commonly used peat-based media. However, the physical properties of the moss media are not comprehensively understood. Furthermore, amending the growing media with biochar has the potential to sequester carbon and enhance the properties of the receiving substance, but biochar impacts on organic growing media properties remain unknown.

This study aimed to (1) quantify differences in water retention, aeration and pore structure properties of three different low- or non-humified Sphagnum-based growing media with 3D X-ray imaging and conventional physical measurements, (2) determine impacts of intense drying-wetting cycles on their pore structure. Furthermore, we aimed to (3) quantify the 3D pore structure of three different plant-based biochars and (4) demonstrate their impact on moss growing media physical properties.

The drying of the media occurred in three distinct phases with (1) large changes in the air-filled porosity in the suction range 0.2-3.2 kPa, (2) clearly smaller changes in 3.2-312 kPa and (3) again large changes in 312-1585 kPa. In the phases 2 and 3, the aeration of the media was satisfactory for plant growth, but the amount of easily available water was low. This sets challenges for the suitability of the materials in conditions without regular irrigation. These properties of the moss media were comparable to the peat media. The pore structure of the media was not sensitive to drying-wetting cycles, but the pore size distributions was observed to shift slightly towards smaller pore size classes with increasing decomposition degree and stress impact of the drying-wetting cycles.

Regarding biochar physical properties, the 3D imaging results demonstrated that irrespective of the feedstock, the major share (0.80-0.94 $m^3\,m^{-3}$) of the biochar pore volume resided in pores with diameters 2-11 μm. Biochar pore properties reflected plant tissue structure of the raw materials. The application of biochar increased the water retention of the growing media in the pore diameter range 1-8 μm. The maximum increase was 0.06 $m^3\,m^{-3}$. This is relevant for plant-available water, which indicates the usability of the biochar amendments.

From methodological point of view, the value of combining 3D imaging with conventional

measurements was shown. The approach revealed how water table continuum between biochar and surrounding growing media affect availability of water stored inside the biochar particles. The results are based on a recently published article (Turunen et al. 2019) and an accepted manuscript (Turunen et al. 2020).

References:

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