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Effects of Water Content of the Hydration Efficiency of some Organic Substrates



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Introduction

In soilless culture, the measurement of substrate's wettability is very important due to the large use and the high content of organic materials, and their more or less ability to become hydrophobic during drying. That can lead to retardation or resistance of water infiltration and creation of preferential flow paths for water and solutes and then deteriorate physical properties of substrates and plant water uptake as well.

In order to avoid these negative impacts for plant growth, and then to improve irrigation management, this work aimed to estimate the hydration efficiency of some main traditional and alternative organic products used as substrates under different initial moisture contents.

Materials & Methods

- 8 substrate components tested: peat, coir, wood fiber, fresh pine bark, aged pine bark, pine wood chips and 2 shredded wood (Fig. 1).
- Samples equilibrated at 4 initial moisture contents (MC): 25%, 37.5%, 50%, and 62.5%
- Hydration Efficiency measured by a method described by Fields et al. (2014) (more details below, Fig. 2)
 - 4 replicates of 200 mL of each substrate at each MC was packed in a cylinder (with the objective of having the same bulk density for a same material whatever the MC) and placed in the hydration efficiency unit.
 - A hydration event consisted of passing 200 mL water through the sample and collecting effluent as it came out the bottom.
 - 10 total hydration events were performed for each treatment.
 - Samples were then saturated from the bottom and allowed to drain in order to determine container capacity of the material.

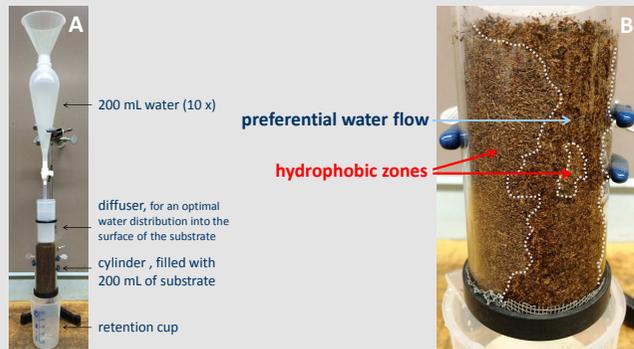


Figure 2. A) Set up of hydration device. B) Cylinder filled with peat substrate (37.5% MC), showing hydrophobic zones and water preferential flows

Results

Figure 1. Hydration efficiency curves, representing the cumulated volumetric water content after each hydration event. All substrate components were tested at initial moisture contents of 25% (red), 37.5% (purple), 50% (blue), and 62.5% (green). Dotted lines represent container capacity (same set of colors). Initial bulk density, *d*, for each substrate is given in brackets.

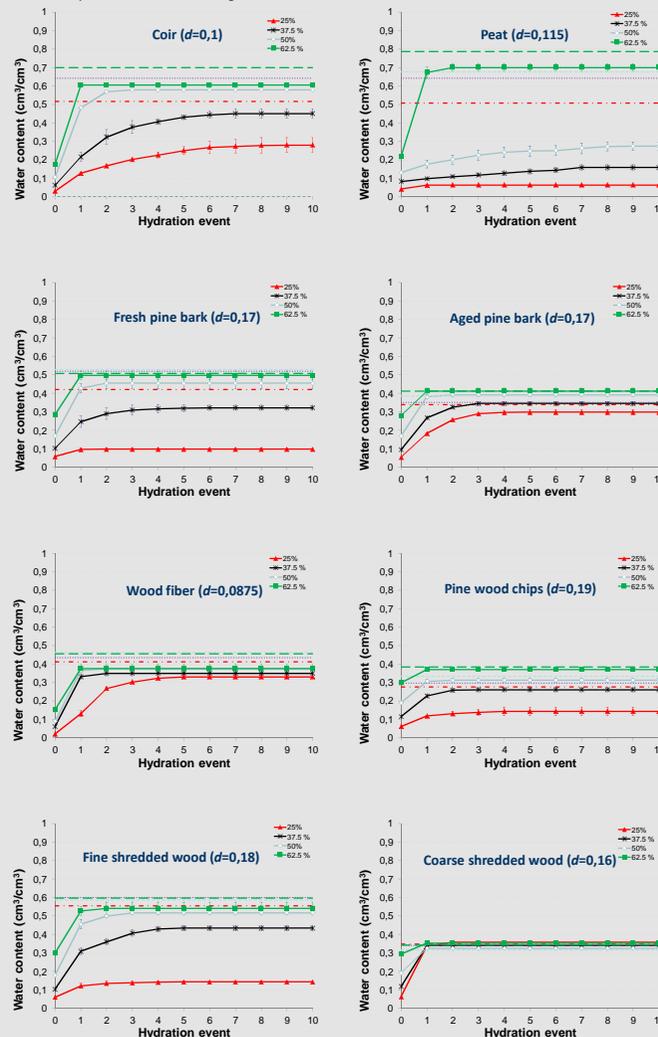


Figure 1. Substrate components tested.

Conclusions

Classification of the tested substrates can be defined according to their ability to rewet and to overcome risks of hydrophobicity as a function of initial moisture content (MC):

- Coarse shredded wood, Wood fiber and Aged pine bark** quickly recovered water contents close to their container capacity (CC) after few hydration events, whatever their initial MC.
- Pine wood chips, Fine shredded wood and Fresh pine bark** recovered water contents close to their CC for initial MCs $\geq 37.5\%$ or 50%, but exhibited risks of hydrophobicity for lower MCs.
- Coir** recovered water contents close to its CC for initial MCs $\geq 37.5\%$, but its ability to rewet at 25% is quite low and partially reversible (CC for 25% initial MC did not reach CC values obtained for the higher initial MCs).
- Peat** did not recover water contents close to its CC during hydration events, except for an initial MC = 62.5%. Moreover, its final CC is affected by its initial MC. So, the degradation in wettability and physical properties of peat is irreversible for initial MCs $\leq 50\%$, and its degree depends on its initial MC. The more the peat dried, the more its wettability and its physical properties degraded.

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