Developing Moisture Characteristic Curves and Their Descriptive Functions at Low Tensions for Soilless Substrates

Moisture characteristic curves (MCC) relate the water content in a substrate to the matric potential at a given tension or height. These curves are useful for comparing the water-holding characteristics of two or more soils or soilless substrates. Most techniques for developing MCC are not well suited for measuring low tensions (0 to 100 cm H2O) in coarse substrates used in container nursery production such as those composed of bark. The objectives of this research were to compare an inexpensive modified long column (MLC) method (Figure 1) with an established method for creating low tension MCCs and then to determine the best model for describing MCCs of bark-based soilless substrates.

The established method was conducted at the North Carolina Substrate Lab (NCSL). Three substrates composed of Douglas fir (*Pseudotsuga menziesii*) bark alone or mixed with either peatmoss or pumice were used to compare models. The models used were the Genuchten model and log-logistic model (Figure 2). Both methods described differences among the three substrates, although MCC for each method differed within a substrate type. Plots of the MLC and NCSL appear sigmoid in shape similar to those previously reported for soilless media (Figure 3). The four-parameter log-logistic function was determined to be the simplest and most explanatory model for describing MCC of bark-based substrates. The MLC method is inexpensive, rapid, and reliable for determining low-tension MCC for bark-based soilless substrates.
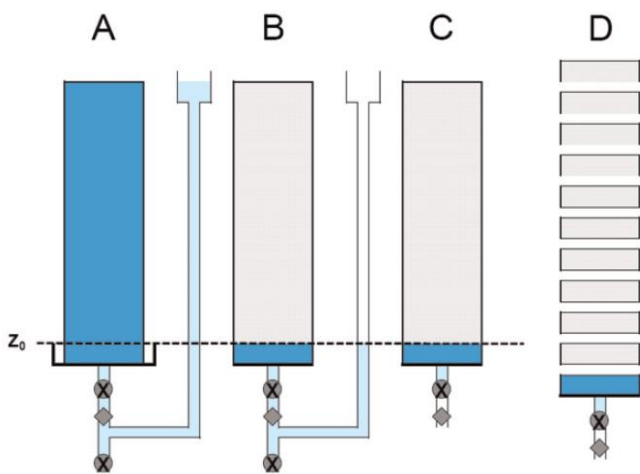

Figure 1. Diagram of the modified long column method: (A) substrate packed into a polyvinyl column, attached to a piezometer, and saturated; (B) column drained, the water level marked as the same level in the piezometer and defined as Z_0; (C) valve closed at the base of the column to maintain Z_0, the piezometer removed, and the column frozen; (D) frozen column cut into sections, and measured for water content (q) and tension as height (cm) above Z_0.

$$\theta = \theta_r + (\theta_s - \theta_r)/[1 + (h/x_0)^n]^m \qquad (1)$$

$$\theta = \theta_r + (\theta_s - \theta_r)/[1 + (h/x_0)^n] \qquad (2)$$

Figure 2. Equations for models used; (1) Genuchten model and (2) log-logistic function.

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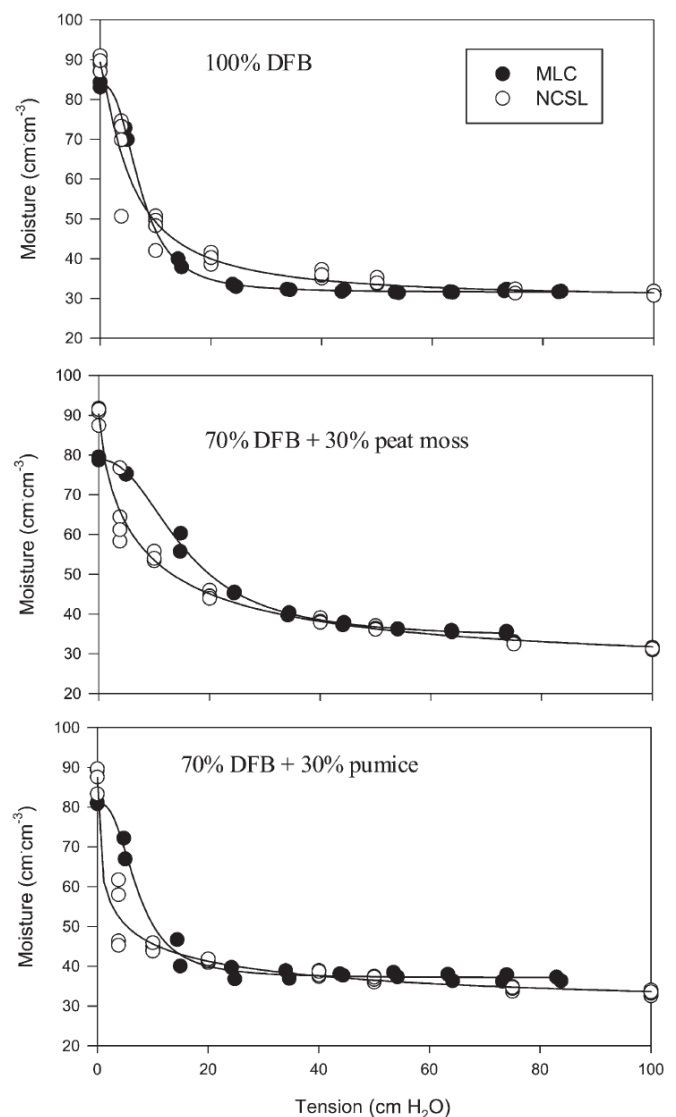
Figure 3. Moisture characteristic curves of three Douglas fir bark (DFB) substrates generated by either a modified long column (MLC) or modified hanging column (NCSL) method.

Altland, J.E., Owen Jr., J.S., Fonteno, W. 2010. Developing moisture characteristic curves and their descriptive functions at low tensions for soilless substrates. Journal of the American Society for Horticultural Science. 136(6):563-567.