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Hydro-physical characteristics of selected media used for containerized agriculture systems

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ABSTRACT

Containerized plant production represents an extremely intensive agricultural practice with large amounts of moisture and fertilizer application. Hydro-physical characteristics such as water infiltration, texture and structure, particle size distribution affect the quality of the media used in containerized agricultural systems and the water availability to plants. Water retention characteristics depend on particle size distribution as well as the composition of the media used. Materials with coarser particles allow faster percolation of water and also retain relatively higher amounts moisture per unit weight due to higher porosity, while draining faster due to smaller surface area per unit weight. Faster drainage can result into airflow through coarser materials causing the media to dry. The objectives of this study were to characterize the selected hydro-physical properties of plant growth media that are commonly used by nurseries in South Florida. Characterization of the plant growing media can allow modeling of soil–water interactions and development of best management practices for more efficient use of water and agrochemicals by nurseries. Experimental analyses were performed to characterize the plant growth mixtures in terms of particle size distribution and hydraulic conductivity using three different methods (i.e., constant head permeability, falling head permeability test, and tension infiltrometer test). The saturated hydraulic conductivity of the mixtures measured by constant head method ranged from 0.029 to 0.042 cm/s (104–151 cm/h) and by falling head method ranged from 0.078 to 0.112 cm/s (281–403 cm/h). The saturated hydraulic conductivity of the mixtures measured by tension infiltrometer ranged from 0.02 to 0.34 cm/h. Understanding water retention and permeation characteristics of the plant growing media could assist development of best management practices (BMP) for containerized agricultural systems for efficient management of irrigation water and agrochemical use.

1. Introduction

Florida is the second leading horticulture state in the United States with greenhouse/nursery sales of more than $1.6 billion annually. Containerized plant production represents an extremely intensive agricultural practice with large amounts of water and chemical fertilizer use. Considering that three national parks (Everglades, Biscayne and Big Cypress) in South Florida surround the agricultural areas where containerized agricultural systems are used, there exists a major challenge for development of effective practices that combine maximizing crop production while reducing the quantities of agrochemicals released to the environments by runoff. Non-point source pollutants (i.e., nutrients, pesticides, and other chemicals) originating from agricultural areas have been implicated as a source of water quality degradation in southern Biscayne Bay (FFR, 1999). Nutrient loadings to Everglades, Biscayne Bay and Big Cypress National are an environmental concern due to high sensitivity of the ecosystem to eutrophication. The nutrient loads from agricultural and urban areas have significantly increased nutrient concentrations, particularly phosphorus in surface waters. In addition, discharging phosphorus at the current control target of 50 μg/L would continue to allow eutrophication of over 95% of the Everglades marshes (USEPA, 1998).

Farming methods can alter soil properties such as soil structure, porosity, as well as the hydraulic conductivity and water retention. In South Florida, transition to containerized agricultural practices is driven by market demands and production advantages including higher production per acre, faster plant growth, higher plant quality, and lack of dependence on arable land (Colangelo and Brand, 2001). In agriculture systems, environmental conditions affect the

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