Vegetable Section

Proc. Fla. State Hort. Soc. 134:139. 2021.

—Scientific Note—

Soil Pedotransfer Function to Estimate Available Water of Northeast Florida Sandy Soils

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Additional index words. seepage; soil physics; subirrigation

Northeast Florida (NE) is an important vegetable production area with approximately 15,000 ha irrigated by the subirrigation method (e.g., seepage, drainage-tile). Development of irrigation tools to assist growers increase water conservation are needed. Most subirrigated areas in NE are sandy soils characterized by a high proportion of larger pores which drain easily and have low organic matter content (SOM), leading to low water holding capacity. To improve water use efficiency, the recommended irrigation models need to take into account soil physical and hydrological variation to reduce water application and nutrient loss and enhance crop production. The soil water available (AW) to plants can be estimated using a soil water retention curve (SWR). However, the determination of SWR involves intensive soil sampling and mastery of advanced laboratory analysis techniques, which is time consuming. Alternatively, soil pedotransfer functions (PTF) can indirectly estimate AW faster and at lower cost than direct determination of the SWR. This study aimed to develop a PTF to estimate AW considering soil bulk density (Bd), SOM, and particle-size distribution < 250 μm (PSD_{fine}) variation across the vegetable production areas in NE. The areas of interest included agricultural areas under vegetable production in St. Johns, Flagler, and Putnam counties in Florida. Five out of a possible 20 representative areas were selected, with a PSD_{fine} ranging from 526 (lower) to 937 (upper) $g.kg^{-1}$. Sixty-six undisturbed soil samples were taken at 0–0.40 m soil depth in each area in which SWR parameters had been determined. The influence of Bd, SOM, and PSD_{fine} on the SWR model was evaluated using a multilinear regression approach. AW was calculated by the difference between soil water content (θ) at field capacity (soil water potential, ψ = –60 hPa) and permanent wilting point (ψ = –15.000 hPa) obtained using SWR model. The SWR model [Eq.1] explained 74% of the θ variation and was negatively influenced by Ψ, and positively by Bd, SOM and PSD_{fine}.

$$\theta = e^{(-3.1663+1.2235 * Bd+0.0642*SOM+0.0006 * PSD_{fine})} * \Psi^{-0.3550};$$

$$(P < 0.0001, F = 224.3, r^2 = 0.74, n = 330) \qquad \text{[Eq.1]}$$

The AW was estimated for lower and upper PSD_{fine}, considering Bd range from 1.18 to 1.70 $g{\cdot}cm^{-3}$ and SOM average of 6.00 $g{\cdot}kg^{-1}$, for the 0–0.40 m soil depth layer. The average AW ± standard deviations were similar at 0.11 ± 0.02 and 0.14 ± 0.02 $cm^3.cm^{-3}$ between lower (Fig. 1A) and upper (Fig. 1B) PSD_{fine}, respectively. There was a significant increase in AW with the increase of SOM (e.g., increasing SOM by 50% resulted in additional 0.03 $cm^3{\cdot}cm^3$ of AW, corresponding to 27% of the AW relatively to the lower PSD_{fine} soils). Increasing AW range can reduce irrigation needs, which means saving groundwater and energy costs associated with pump irrigation. The PTF allowed for estimating AW using soil physical properties and SOM routinely measured in NE. Additional physical hydrological indicators, such as soil least limit water range, will be determined for these sandy soils. These indicators should be used for the development of recommended irrigation models for specific soils, irrigation methods and vegetable crops.

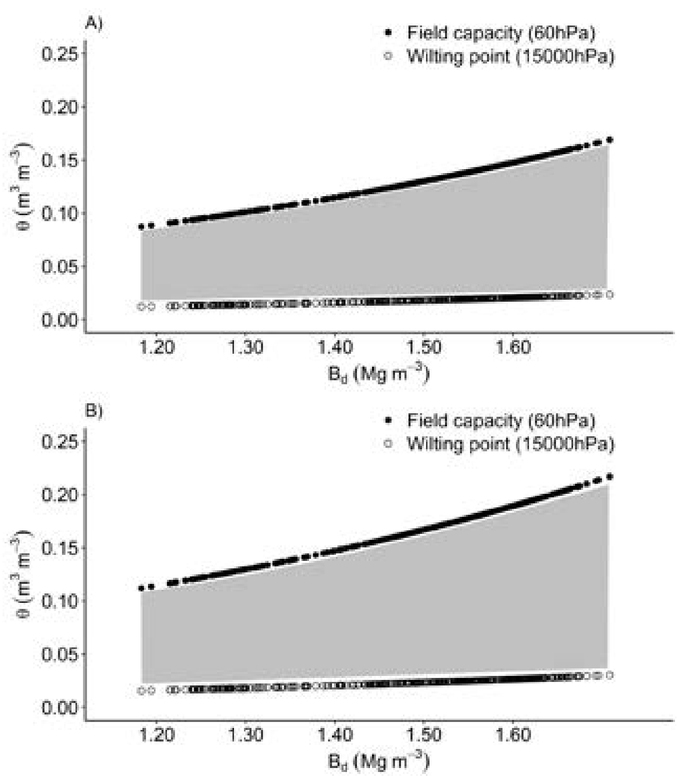

Fig. 1. Soil available water (AW) estimated to soils with particle-size distribution (PSD_{fine}<250 μm); **A**) 526 $g{\cdot}kg^{-1}$ (lower) and **B**) 937 $g{\cdot}kg^{-1}$ (upper) with soil organic matter content of 6.00 $g{\cdot}kg^{-1}$ at the 0–0.40 m soil depth layer. The gray areas correspond to the AW.

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