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Using GEMLS to Describe the Contribution of Organic Carbon to Soil Water Holding Capacity

Alan E. Olness and David Archer

USDA-ARS-MWA, NCSCRL, 803 Iowa Ave., Morris, MN 56276

A detailed descriptive model of the water holding characteristics of soil is needed to enhance the USDA-ARS N fertilizer decision aid and develop a systematic method for valuing organic C in soil. The General Energy Model for Limited Systems (GEMLS) was evaluated for this purpose by applying it to the US national soil inventory database (more than 100,000 entries). The database was segmented into narrow ranges of organic C content and silt content. The data from each subset were plotted as a function of soil clay content. Because of a matrix transition effect, two complementary GEMLS functions were used to describe the 33 kPa and 1500 kPa water content as a function of soil clay, silt, and organic C contents. This entailed 6 parameters (two function coefficients, two energy coefficients, and two critical clay contents) and required an initial manual fit of the models to the data subsets (about 100 ± 20 observations). Criteria for acceptance were uniform and homogenous distribution of the model residuals, absence of a detectable trend line in the residual distribution, zero error sum, and maximal R2. The energy coefficient was a near linear function of silt content. After the initial manual fit, the data were subjected to analysis using SAS PROC MODEL and a variable energy coefficient. This work showed that the energy coefficient was also a complex function of organic C content. The two function coefficients appear to be constants and the two critical clay content values were linearly related to silt content. The R2 values for C contents < 2 % often exceeded 0.9. The final product is a continuous function capable of predicting the water holding content of soil as a function of its physical separates.

Alen E. Olness, (320) 589-3411 ext. 131, Fax: (320) 589-3787
E-mail: aolness@morris.ars.usda.gov

The Relevance of Extracting Organic Matter Based on Binding to Polyvalent Cations

Dan C. Olk

National Soil Tilth Laboratory, USDA-ARS, 2150 Pammel Drive, Ames, IA 50011

Soil polyvalent cations bind the calcium humate (CaHA) fraction of organic matter but not the mobile humic acid (MHA) fraction. These fractions are extracted with sodium hydroxide and have proven to be chemically distinct and relevant to nutrient cycling. In tropical lowland rice soils, the MHA was less humified than the CaHA in analyses by nuclear magnetic resonance spectroscopy for carbon, phosphorus and nitrogen (N), visible light absorption, elemental analyses, and other spectroscopic analyses. While