Characterizing Soil Hydraulic Properties in an Agro-Forestry Ecosystem

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ABSTRACT

Land use impacts on soil quality may be characterized by changes in soil hydraulic properties. These properties directly influence infiltration as well as runoff and erosion. Soils in the major land resource area, the Southern Mississippi Valley Silty Uplands (MLRA 134), have high erosion potential and land use practices affect soil loss. We measured hydraulic properties of the dominant soil (Memphis silt loam) in MLRA 134 on adjacent mixed forest and pasture sites at six locations each in the Rodney Lake sub-basin of the Coles Creek watershed. The forest and pasture have been in existence for 100 and 30 years, respectively. Unconfined infiltration measurements were carried out in a rang of descending tensions, 15, 10, 6, 3 cm of water, using 20 cm disc tension infiltrometers. The Wooding's model for steady state flow was used to estimate soil hydraulic conductivity, K(h). Soil cores were also extracted from the 0-15 and 15-30 depths to determine bulk density (ρ_b). The WP4 PotentiaMeter® was used to measure soil water retention values, $\theta(h)$, at the two soil depths and the van Genuchten-Maulem model was fitted to the experimental data using the optimization computer code, RETC. Results from this study showed significantly higher K(h) in the forest than the pasture for both experimental and fitted data ($P<0.05$). Water content from 0 to -33 kPa was significantly higher in the forest than the pasture, however, water retention in the forest was significantly higher at all water potentials at the 30-cm depth ($P<0.05$). The van Genuchten-Maulem model showed a good fit to the experimental water retention data for both land use with root-mean-squares errors (rmse) of 0.0201 and 0.0249 in the forest at the 0-15 cm and 15-30 cm soil depths, respectively. Respective rmse for the pasture for the 0-15 cm and 15-30 cm soil depths were 0.0464 and 0.0357.