Thermal Conductivity and Diffusivity of Four Trinidadian Soils as Affected by Peat Content

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Abstract. *Thermal conductivity and diffusivity were measured in the field and the laboratory with a portable thermal properties sensor and probe (KD2, Decagon Devices, Inc.) for twelve major agricultural soils in Trinidad. These parameters were measured because they are required for the design of underground cables and for agronomic practice. The effect of incorporating peat into four of the agricultural soils on thermal conductivity and diffusivity was further investigated over a range of stresses from 0 to 1000 kPa using a compression machine. Air-dry peat was applied at four levels (0%, 4%, 8%, and 12% by mass) to the four soils (two sandy loams, a clay loam, and clay) and tested at three moisture contents by mass, namely, 5% below Proctor optimum for maximum compaction, optimum, and 5% above optimum. Bulk densities achieved during soil compression were computed to assist in the interpretation of the results. The thermal conductivity measured in the field ranged from 0.90 to 1.55 W* m^{-1} $^{\circ}C^{-1}$ *and were within 0.1 W* m^{-1} $^{\circ}C^{-1}$ *of the values measured in the laboratory for the individual soils. Mean thermal conductivity during laboratory measurements declined significantly from 1.21 to 0.97 W* m^{-1} $^{\circ}C^{-1}$, *and mean thermal diffusivity dfeclined from 0.25 to 0.19* mm^2 s^{-1} *as the peat content increased from 0% to 12% by mass. Mean thermal conductivity and thermal diffusivity increased significantly with increasing applied stress and moisture level at the 0.001 level and declined, in most cases, with increasing clay content. The effect of peat incorporation in decreasing soil thermal conductivity and thermal diffusivity is diminished at low soil moisture and bulk density. Thermal conductivity and diffusivity were significantly (p = 0.001) and linearly related to each other. Two significant (p = 0.001) linear equations developed to relate each thermal property to bulk density suggest that unique relationships may exist between the two thermal properties and bulk density. A multiple linear regression equation was further developed from the experimental data to be utilized as a first estimation of bulk density. The results from this study contribute to the greater understanding of how peat affects thermal conductivity and diffusivity.*

Keywords. *Peat, Soil physics, Thermal conductivity, Thermal diffusivity.*