SOIL SPATIAL VARIABILITY IN THE EVERGLADES AGRICULTURAL AREA IN SOUTH FLORIDA

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The Everglades Agricultural Area (EAA) is a 280,000 ha basin of Histosols lying on limestone bedrock in south Florida. Identifying sources of soil variability to improve the management of nutrients and agricultural practices is an ongoing task in this area. The Everglades ecosystem evolved under low nutrient inputs, and the formation of Histosols was from partially decomposed aquatic and wetland vegetation. The EAA was drained in the early 20th century, and roads and ditches were built up for cropping. The main crop grown in this area is sugarcane, with the rest being planted with sweet corn, rice, sod grass, and vegetables. The drainage of the EAA accelerated SOM oxidation and it is estimated that by 2050, nearly 50% of the EAA will have soils less than 20-cm in depth (Snyder, 2004), which makes more difficult the management of crops, irrigation systems, and soil.

Despite the assumption of homogeneity of these soils, agricultural practices could result in the increase of soil variability. Vertical, horizontal, and time are three directions of soil variability. Indentifying the sources of such variability could help improve the use of Histosols. Since the initial drainage of the EAA, these soils have been subsiding due to SOM oxidation. Roads, ditches, tillage, and fertilizers application have contributed to soil variability (Diaz *et al.*, 1992). This is also influenced by landscape, subsurface restricting layers, type of vegetation, and interactions among climate factors.

Since crop yields highly depend on soil quality, soil variability is a driving factor in crop productivity. Tillage practices aerate the soil and incorporate plant residues, both of which stimulate microbial activity and its interactions with SOM. Degradation of organic residues is also affected by environmental factors interacting with tillage such as rainfall and temperature (Morris *et al.*, 2003). Therefore, non-tillage and minimum tillage could preserve SOM content.

Changes in soil depth, pH, moisture, bulk density, and nutrients concentration are the result of interactions among parent material, topography, climate, vegetation, time, cropping practices, soil management, runoff, and fertilizer applications. For that reason, information regardless spatial variability of soil properties is still needed in the EAA when determining optimum fertilization rates to maintain sustainable agriculture production.

Soil spatial variability was studied on three fields at the Everglades Research and Education Center (EREC) to compare changes in selected chemical and physical soil properties due to cropping. All fields (5.5 ha each) were Pahokee muck (Euic, hyperthermic Lithic Haplosaprist), and they were sampled following a triangular grid plan (54 points per field) to 15-cm depth.

The underlying bedrock in this area is uneven. Despite uniform topography, there was a substantial variability within and across fields, with a significant effect of cropping on soil variability. Tillage, flooding, and application of fertilizers resulted in an increase of variability and nutrients concentration. Tillage, traffic of farm equipment, and cleaning of ditches accelerated the mixing of soil with limestone, which increased soil bulk density, pH, Ca, Mg, and Si concentration, especially in shallow soils. Tillage aerates the soil and accelerates SOM oxidation; whereas, flooding reduces the subsidence of these soils.

Tillage is usually a homogenizing factor, but in this study, the uncultivated field showed the lowest soil variability compared to tilled fields. The low soil depth in the uncultivated field may have resulted from low water table, which facilitates SOM oxidation. The highest SOM content was observed in the deeper soils and far from roads and ditches. The higher SOM content in the uncultivated field may be explained by the well decomposed SOM layer plus the addition of plant residue from natural vegetation, whereas cultivated fields some times are left bare, increasing the likelihood of SOM losses by wind and runoff. The increase in pH in cultivated fields is due to the addition of fertilizers and the interaction of soil with underlying bedrock. Similarly, pH increases near roads and ditches are due to a liming effect of dust from road material and rocks deposited along ditches when removing sediment.

Water extractable P (P_w) was low for cropping in all fields. Acid extractable P (P_a) showed more variability than P_w, and total P (TP) was more variable than both P_w and P_a. Phosphorous concentrations were influenced by fertilizer applications. The strong relationship between P_a and TP with SOM may indicate that SOM oxidation results in net mineralization of P. Potassium was in the normal range for vegetable production in all fields and showed the same pattern as P, confirming the effect of fertilization. The increase in Ca, Mg, and Si concentrations in cultivated fields corresponds to increases in mineral material along roads and ditches.

Soil depth plays an important role in soil variability. In shallow soils, the underlying bedrock influences soil properties such as pH, bulk density, SOM, and nutrients concentration. In these fields, SOM was, as expected, the most uniform soil property. Results confirm that cropping has a great impact on soil variability in this area and that precision agriculture practices could potentially result in an improvement of soil management practices without reducing crop productivity.

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