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SL274

Soils & Fertilizers for Master Gardeners: Soil Formation in Florida[1]

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This article is part of a series entitled *Soils and Fertilizers for Master Gardeners*. The rest of the series can be found at http://edis.ifas.ufl.edu/topic_series_soils_and_fertilizers_for_master_gardeners. A glossary can also be found at http://edis.ifas.ufl.edu/MG457.

Introduction and Purpose

The physical, chemical and biological properties of soils depend on how they were formed. The variability of soils in Florida is due to the differences in soil forming factors. The purpose of this publication is to provide information about types of soils found in Florida and the factors that influenced their formation.

The state of Florida is situated on the Floridian plateau (Figure 1), which is a broad and nearly level landform that separates the Atlantic Ocean from the Gulf of Mexico. Sea level fluctuations throughout geological history have deposited marine sediments on the plateau, which has created at least 11 marine terraces. Some of these sediments hardened to form the bedrock beneath the soils. This bedrock is composed predominantly of limestone that is easily dissolved by water, leading to the sinkholes, caves and springs (called karst features) that are common in Florida. The soils of Florida have also been greatly influenced by marine forces (e.g., ocean currents, sea level fluctuation).

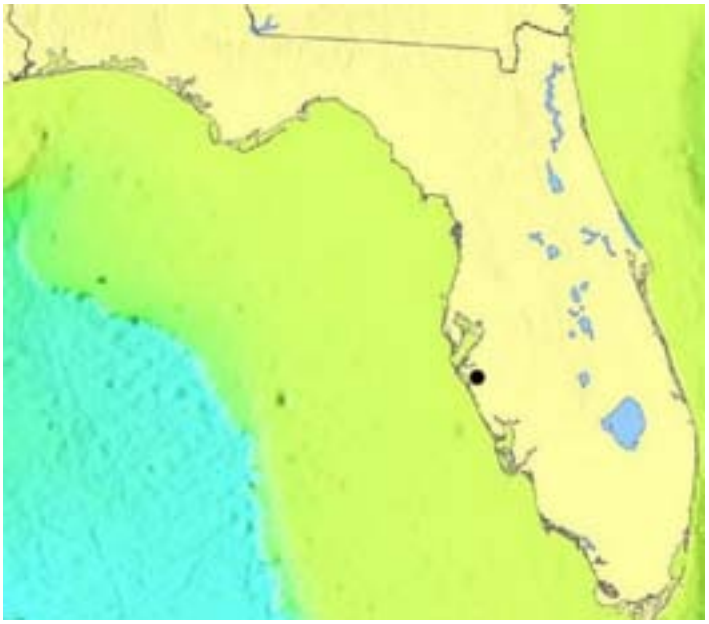

Figure 1. The Floridian plateau. (Credits: USGS)

Factors that Impact Formation of Soils

Soil scientists recognize five specific factors that interact to form our soils. They are: 1) parent material, 2) climate, 3) topography, 4) biological factors, and 5) time. These factors will be explained in more detail below.

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Parent Material

Parent material is the rock or other material from which the soil formed. Some soils form directly from the rocks beneath them as they break down over time. This scenario is not common in Florida, with the exception of some calcareous soils in Miami-Dade County. (For more information about these soils, see EDIS publication SL183 *Calcareous Soils in Miami-Dade County* http://edis.ifas.ufl.edu/TR004). Alternatively, soils can form from materials that were transported from another location by wind, water, or ice.

Many of Florida's sandy soils were formed directly from sandy marine sediments, which were transported and deposited by ocean currents as sea levels fluctuated. Florida's organic soils developed from decaying freshwater swamp and marsh plants, where flooded conditions prevented the complete decomposition of organic matter to carbon dioxide. Clayey soils of the panhandle and upland ridges were formed from materials that were eroded from the Appalachian Mountains and the southern coastal plain. These materials were transported southward by the action of rivers.

Climate

The climate impacts soil formation in many ways. Local temperature and moisture regimes influence the rate at which parent material will weather (break down) into soil. Weathering rates are typically enhanced under warm, wet conditions, which are common in Florida. Likewise, these conditions accelerate the breakdown of organic residues in the soil, which is why Florida's sandy soils are lower in organic matter compared with soils of the northeastern and midwestern states where the climate is humid, but cooler.

Topography

The elevation and slope of the land affects soil formation by influencing drainage, erosion, and dominant vegetation. Soils formed on ridges are often well-drained and more prone to erosion than soils formed where the land surface is relatively flat. In low-lying areas with poor drainage, there is often an accumulation of organic matter, allowing the formation of organic soils.

Plants and Animals

The activities of animals, plants, humans, and microorganisms play a role in the formation of soils. For example, the burrowing activity of some animals physically mixes the soil, while the decomposing action of microbes degrades organic residue and incorporates it into the soil. In addition, many of the properties of a soil are influenced by the indigenous vegetation. The natural plant cover of the soils is directly influenced by the soil characteristics, water and drainage conditions, soil pH, and mode of development (particularly for organic soils). Specific soil areas are covered by specific types of natural vegetation; however, most soils characteristically support more than one type of vegetation. The following general relationships exist between soils and vegetation types:

Figure 2. A Florida histosol formed from decaying organic matter. Note the thick organic horizon. Credits: Mary Collins, Soil and Water Science Department, UF/IFAS.

1. Pine forests grow on sandy soils with an organic hardpan layer, a subsurface clay layer, or calcareous subsoil.

2. Pine and oak forests and scrub developed on deep, dry, well-drained sands.

3. Hammock forests favor fine sands and sandy loams with calcareous subsoils.

4. Swamp forests contain sandy mucks and muck soils.

5. Marshes (sawgrass, sedges and rushes) exist on deep to medium deep Everglades peat, usually over marl or limestone.

6. Prairies (treeless grasslands) developed on sandy soils with an organic hardpan layer: marl soils.

Time

The formation of a soil profile is a complex process that takes a very long time. The rate at which parent material breaks down to soil will vary depending on the type and origin of the materials, the climate, and the topography of the area. It also takes time for water to influence the transport or accumulation of organic matter and clay materials, which is why soil formation is much faster in a humid climate compared with an arid climate.

Figure 3. The Candler soil is a weakly-developed entisol found in central Florida. Note the lack of distinct soil horizons.

Credits: Mary Collins, Soil and Water Science Department, UF/IFAS.

Compared to other areas of the United States, the soils of Florida have had little time to develop due to the fluctuation of sea level that repeatedly covered most of the peninsula. However, the degree of development of Florida's soils still varies considerably throughout the state. For example, the entisols that dominate the central Florida Ridge and some coastal areas (Figure 3) have had little time for development of the characteristic profiles of older, inland panhandle soils. These ultisols (Figure 4) in the north Florida panhandle exhibit significant horizon development and leaching of nutrients.

Figure 4. The Lucy soil is an ultisol found in the Florida Panhandle. This soil shows signs of significant weathering activity. Note the distinct horizons and red color from high iron levels indicating other nutrients have been leached from the profile. (Source: Wade Hurt, USDA-NRCS [retired])

Summary

The five soil forming factors (parent material, climate, topography, biological factors, and time) all have played a role in the formation of Florida soils. Most Florida soils have been impacted by marine forces as sea levels have fluctuated throughout geologic time. Marine sediments are the most abundant parent material in Florida; however, some soils have formed from decaying organic matter or eroded sediments from the north. The warm, wet climate acts to speed the breakdown of parent materials to form the soil. Biological factors such as animal and microbial activity and native vegetation also influence the physical and chemical properties of the soil. Florida's soils have had little geologic time to form, but there is still a great deal of variability throughout the state.

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