Miami

Indiana State Soil

Soil Science Society of America

Chip Clark/Smithsonian Institution

Introduction

Many states have a designated state bird, flower, fish, tree, rock, etc. And, many states also have a state soil – one that has significance or is important to the state. The Miami is the official state soil of Indiana. Let's explore how the Miami soil is important to Indiana.

History

In 1900, when the Miami series was established, soil units were differentiated by surface texture alone. In 1904, the Miami Series was called one of the "four or five great series of uniform characteristics" in the Ohio and Mississippi River basins. The Miami soils have been studied in detail. In 1986, the Indiana Association of Professional Soil Scientists (IAPSC) voted to designate Miami as their state soil.

What is Miami Soil?

Miami soils are moderately well drained and are moderately deep to dense till. Miami soils formed in as much as 18 inches of loess or silty material and in the underlying calcareous, loamy till **(Figure 1)**. They are on rolling and dissected Wisconsin till plains. The native vegetative is hardwood forest. Miami soils are fertile and have a moderate available water capacity.

Every soil can be separated into three separate size fractions called *sand, silt,* and *clay,* which makes up the *soil texture*. They are present in all soils in different proportions and say a lot about the character of the soil. In a typical profile of Miami, the topsoil is brown, friable (easily crumbles) silt loam. The subsoil is dark yellowish brown, firm clay loam in the upper part and brown, firm loam in the lower part. The substratum (lower horizons) is brown, very firm calcareous loam.

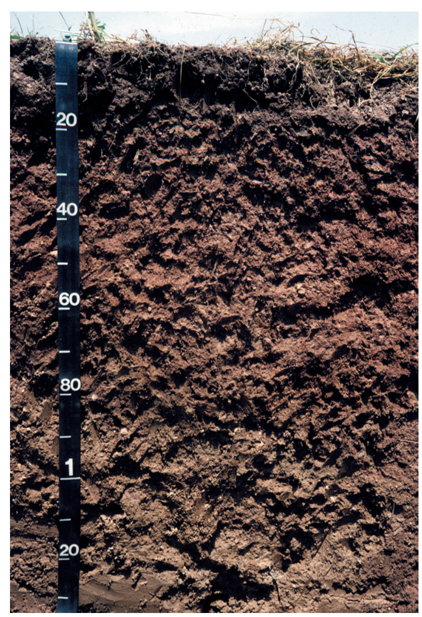

Fig. 1. Miami soil profile. Credit: NCRS

Where to dig Miami

Yes, you can dig a soil. It is called a soil pit and it shows you the *soil profile*. The different horizontal layers of the soil are called *soil horizons*. This does not mean that other types of soil cannot be found there but that the Miami is the most common. Miami is in the northern 2/3rds of Indiana and occurs in more counties than any other soil in the state. **(Figure 2)** Miami covers about 795,000 acres of land in 42 counties of the state's 92 counties. In all, there are a total of 555 named soils (series) in Indiana.

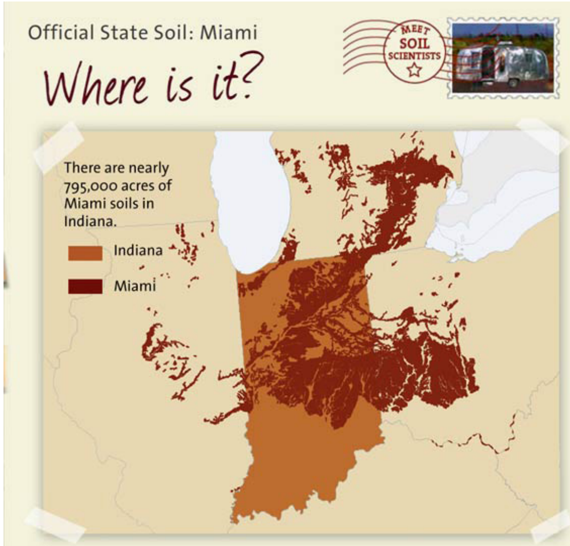

Fig. 2. Location of the Miami soil in Indiana (and parts of Illinois, Michigan and Ohio). Credit: Smithsonian Institution's Forces of change. http://forces.si.edu/soils/interactive/state-soils/index.html

Fig. 3. No-till corn planted into a cover crop mix on Miami soils on a rolling till plain. Steeper side slopes remain forested. (Credit: USDA-NRCS)

Importance

What makes the Miami soil so important is its use and prevalence in the State. Indiana is nationally ranked for agricultural production because of the highly productive Miami soils along with other prime farmland soils in the State. Prime farmland is land that is best suited for crop production. No other state has a higher percentage of prime farmland than Indiana. Sixty-six percent of the state's 13 million acres of cropland are considered prime farmland. Miami soils are in a toposequence on the landscape with the associated Williamstown, Crosby, Brookston and Treaty soils, all of which are prime farmland and very productive. Indiana is also a national leader in the volume per acre of high quality hardwood timber produced, with Miami and associated soils contributing to this hardwood lumber production.

Uses

In general, soils can be used for agriculture (growing foods, raising animals, stables); engineering (roads, buildings, tunnels); ecology (wildlife habitat, wetlands), recreation (ball fields, playground, camp areas) and more. The less sloping Miami soils are used mainly for growing corn, soybeans, or winter wheat **(Figure 3)**. The steeper areas are used as pasture, hay land, or forest land. This productive cropland, hay land and pasture also supports extensive livestock production. A significant acreage has been converted to residential and commercial uses.

Limitations

When a soil cannot be used for one or more of the described functions, it is referred to as a limitation. Soil experts, called *Soil Scientists*, studied Miami soil and identified that it has a limiting layer of dense till at a depth of 24 to 40 inches. The permeability of this dense till is slow or very slow, so the design and construction of any engineering structure or sanitary facility on this soil must take this feature into account. Miami soils also have a perched seasonal high water table at a depth of 2 to 3 feet between December and April in normal years, which may require drainage practices for some uses. The sloping areas of the Miami soils are subject to erosion and should be kept under vegetative cover to prevent degradation. **(Figure 4)**

Fig. 4. No-till wheat with daikon radish companion crop on rolling landscape of Miami soils. (Credit: USDA-NRCS)

Management

The Miami soil is typical of the state's overall soil resource in its need for good management practices to be matched with the various land uses. Gently sloping sites are productive for row crops and small grains while steep slopes are more suited to pasture and hay land uses or forest production. Miami soil responds well to agricultural production and will remain productive over time when erosion control practices are incorporated in a good crop management system. A conservation cropping system that minimizes disturbance, maximizes soil cover, maximizes biodiversity, provides continuous living roots and uses adapted nutrient and pest management will maintain the function of the soil and improve soil health. **(Figure 5)** Cover crops provide soil cover, increase biodiversity, recycle nutrients and ensure living roots in the soil for extended periods of time. **(Figure 6)** Properly managed pastures with a dense cover will keep the soil healthy and provide feed to livestock for a large portion of the year. Timber stand improvement practices and the use of best management practices during timber harvests maintains the benefits and services provided by forest lands.

Fig. 5. Emerging soybeans No-tilled into cover crop and corn residues. Rolling Miami soil protected from the spring weather with a soil health management cropping system. (Credit: USDA-NRCS)

Miami is suited to both residential and commercial urban development when the soil limitations and characteristics are considered and overcome in design and construction. Miami is similar to other soils in its need for erosion and sediment control planning to prevent soil erosion and resulting sedimentation under the intensive use of urban development. Wise development of residential and commercial sites on the more sloping areas allows the nearly level and gently sloping areas to remain in agricultural production and preserves prime farmland.

Miami Soil Formation

Before there was soil there were rocks and in between, ClORPT. Without ClORPT, there will be no soil. So, what is ClORPT? It is the five major factors that are responsible for forming a soil like the Miami series. It stands for **Cl**imate, **Or**ganisms, **R**elief, **P**arent material and **T**ime. ClORPT is responsible for the development of soil profiles and chemical properties that differentiate soils. So, the characteristics of Miami (and all other soils) are determined by the influence of ClORPT. Weathering takes place when environmental processes such as rainfall, freezing and thawing act on rocks causing them to dissolve or fracture and break into pieces. ClORPT then acts on rock pieces, marine sediments and vegetative materials to form soils.

Climate – Temperature and precipitation influence the rate at which parent materials weather and dead plants and animals decompose. They affect the chemical, physical and biological relationships in the soil. The Miami soils formed in a temperate and humid climate. Mean annual precipitation ranges from 30 to 42 inches. Mean annual temperature ranges from 46 to 54 degrees F (7.8 to 12.2 degrees C). Frost-free period is 140 to 180 days.

Organisms – This refers to plants and animal life. In the soil, plant roots spread, animals burrow in, and bacteria break down plant and animal tissue. These and other soil organisms speed up the breakdown of large soil particles into smaller ones. Plants and animals also influence the formation and differentiation of soil horizons. Plants determine the kinds and amounts of organic matter that are added to a soil under normal conditions. Animals breakdown complex compounds into small ones and in so doing add organic matter to soil. Native vegetation of the Miami soil is deciduous forest. The natural community consisted mostly of sugar maple, black maple, beech, shagbark hickory, red oak, white oak, tulip poplar, red elm, basswood, and white ash. Miami soils have a light colored surface layer since they formed under forest vegetation, whereas the associated Brookston soils have a dark colored surface layer as they formed in a mixture of marsh grasses, sedges and water-loving tree species.

Fig. 6. Emerging cereal rye cover crop from freshly harvested corn on Miami soils. (Credit: USDA-NRCS)

Relief – Landform position or relief describes the shape of the land (hills and valleys), and the direction it faces which makes a difference in how much sunlight the soil gets and how much water it keeps. Deeper soils form at the bottom of the hill rather than at the top because gravity and water move soil particles downhill. Miami soils typically formed on the higher positions of the landscapes. **(Figure 7)** The Miami soils are deeper to the seasonal high water table than the lower lying, flatter Crosby and Brookston soils. The greatest extent of the Miami Series is

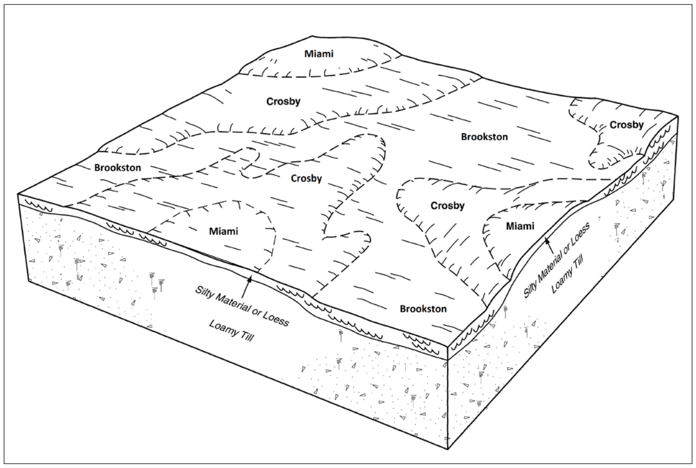

Fig. 7. Relationship of soils, landform position (relief) and parent material. Miami soil is located on the convex slopes, slightly higher than the associated soils that are shallower to a seasonal high water table. Credit: USDA-NRCS.

on gently and moderately sloping, convex hillslope positions. Slope gradients are dominantly 0 to 25 percent, but range to 60 percent. Elevation is 600 to 1200 feet above mean sea level.

Parent material (C horizon) – Just like people inherit characteristics from their parents, every soil inherits some traits from the material from which it forms. Some parent materials are transported and deposited by glaciers, wind, water, or gravity. Miami soils formed in as much as 18 inches of loess or silty material and in the underlying calcareous, loamy till. They formed in thick deposits of Wisconsin-aged glacial till, some as thick as about 350 feet (2). The depth of soil formation can be determined by the depth to carbonates since the topsoil and most of the subsoil have been leached of carbonates and only the substratum remains as strongly effervescent.

Time – All the factors act together over a very long period of time to produce soils. As a result, soils vary in age. The length of time that soil material has been exposed to the soil-forming processes makes older soils different from younger soils. Generally, older soils have better defined horizons than younger soils. Less time is needed for a soil profile to develop in a humid and warm area with dense vegetative cover than in a cold dry area with sparse plant cover. More time is required for the formation of a well-defined soil profile in soils with fine textured material than in soils with coarse-textured soil material. The Miami soils formed in Wisconsin-aged glacial till deposited 15,000 to 22,000 years ago. Miami soils have well defined soil profiles.

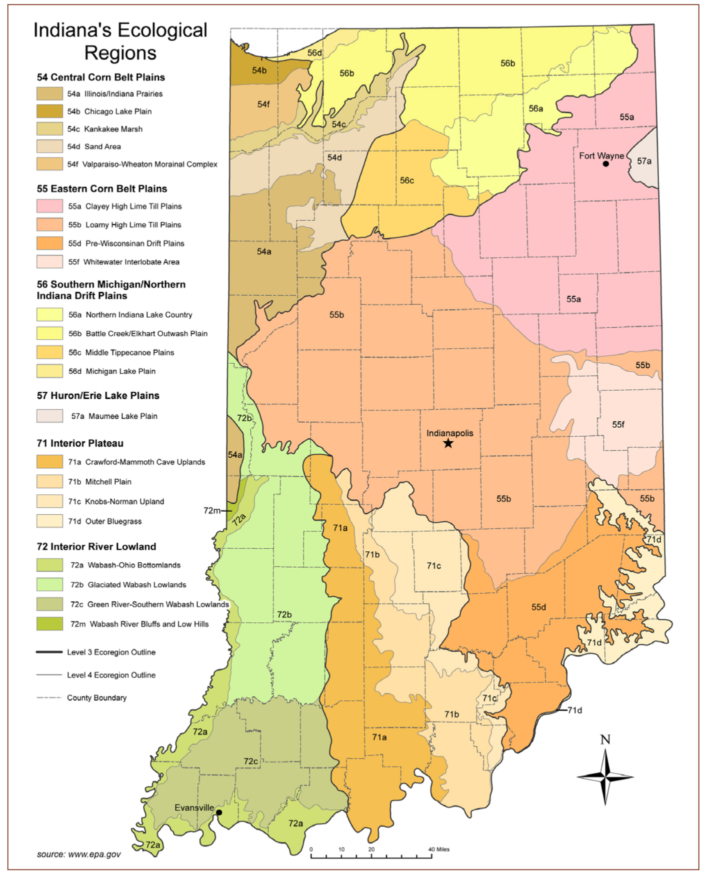

Fig. 8. Ecological Regions of Indiana. Source-EPA.

Ecoregions, Soils and Land Use in Indiana

Miami soils are dominantly in the Loamy, High Lime Till Plains (55b) of the Eastern Corn Belt Plains Ecological Region. **(Figure 8)** This ecoregion is primarily a rolling till plain with local recessional moraines. These areas were once forested, but today are extensively used for corn, soybean and livestock production. There are some Miami soils in the adjacent Ecoregions of the Middle Tippecanoe Plains (56c) and the Northern Indiana Lake Country (56a).

Glossary

Benchmark soil: A benchmark soil is one of large extent within one or more major land resource areas (MLRA), one that holds a key position in the soil classification system, one for which there is a large amount of data, one that has special importance to one or more significant land uses, or one that is of significant ecological importance.

Clay: A soil particle that is less than 0.002 mm in diameter. Clay particles are so fine they have more surface area for reaction. They hold a lot of nutrients and water in the soil. A clay soil is a soil that has more than 40% clay, less than 45% sand and less than 40% silt.

Clay Loam: Soil material that contains 27-40% clay and 20-45% sand.

Ecoregion: Represents areas with similar biotic and abiotic characteristics which determine the resource potential and likely responses to natural and man-made disturbances. Characteristics such as climate, topography, geology, soils, and natural vegetation define an ecoregion. They determine the type of land cover that can exist and influence the range of land use practices that are possible.

Effervescent: The gaseous response (seen as bubbles) of soil to applied dilute hydrochloric acid (HCL) indicating the presence of carbonates in the soil.

Friable: A consistency term pertaining to the ease of crumbling of soils.

Glacial Till or Till: Unsorted and unstratified earth material, deposited by glacial ice.

Horizon: see Soil horizons

Leaching: The removal of soluble material from soil or other material by percolating water.

Loam: Soil material that contains 7-27% clay, 28-50% silt and less than 52% sand.

No-till: A tillage system whereby a crop is planted directly into the soil with no primary or secondary tillage since harvest of the previous crop.

Organic matter: Material derived from the decay of plants and animals. Always contains compounds of carbon and hydrogen.

Permeability: The ease with which gases, liquids or plant roots penetrate or pass through a bulk mass of soil or a layer of soil.

Recessional Moraine: An end or lateral moraine, built during a temporary but significant halt in the final retreat of a glacier.

Sand: A soil particle between 0.05 and 2.0 mm in diameter. Sand is also used to describe soil texture according to the soil textural triangle, for example, loamy sand.

Silt: A soil particle between 0.002 and 0.05 mm diameter. It is also used to describe a soil textural class.

Silt Loam: Soil material that contains between 50% or more silt, 0-50% silt and 12-27% clay (or) 50-80% silt and less than 12% clay.

Soil Horizon: A layer of soil with properties that differ from the layers above or below it.

Soil Profile: The sequence of natural layers, or horizons, in a soil. It extends from the surface downward to unconsolidated material. Most soils have three major horizons, called the surface horizon, the subsoil, and the substratum.

Soil Scientist: A soil scientist studies the upper few meters of the Earth's crust in terms of its physical and chemical properties; distribution, genesis and morphology; and biological components. A soil scientist needs a strong background in the physical and biological sciences and mathematics.

Soil Texture: The relative proportion of sand, slit, and clay particles that make up a soil. Sand particles are the largest and clay particles the smallest. Learn more about soil texture at www.soils4teachers.org/physical-properties

Subsoil: (B horizon) The soil horizon rich in minerals that eluviated, or leached down, from the horizons above it. Not present

Additional Resources

Soil! Get the Inside Scoop. David Lindbo and others. Soil Science Society of America, Madison, WI.
Know Soil, Know Life. David L. Lindbo, Deb A. Kozlowski, and Clay Robinson, editors. Soil Science Society of America, Madison, WI.

Web Resources

SOIL SCIENCE LINKS:

Soils for Teachers—www.soils4teachers.org

Soils for Kids—http://www.soils4kids.org/

Have Questions? Ask a Soil Scientist—https://www.soils4teachers.org/ask

Soil Science Society of America—https://www.soils.org/ /

NRCS Links

Natural Resources Conservation Service, IN Homepage–www.nrcs.usda.gov/wps/portal/nrcs/site/in/home/

Natural Resources Conservation Service–www.nrcs.usda.gov/wps/portal/nrcs/main/national/soils/

Natural Resources Conservation Service, Educational Resources–www.nrcs.usda.gov/wps/portal/nrcs/main/soils/edu/

Indiana Links

Indiana Association of Professional Soil Classifiers–http://www.iapsc-in.com

Indiana Registry of Soil Scientists–http://www.oisc.purdue.edu/irss

Isee – Integrated Spatial Educational Experiences–http://isee.purdue.edu

References

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Bonsteel, J. A. 1914. The Miami Series of Soils. U.S. Department of Agriculture Bulletin 142. Washington, D.C./

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