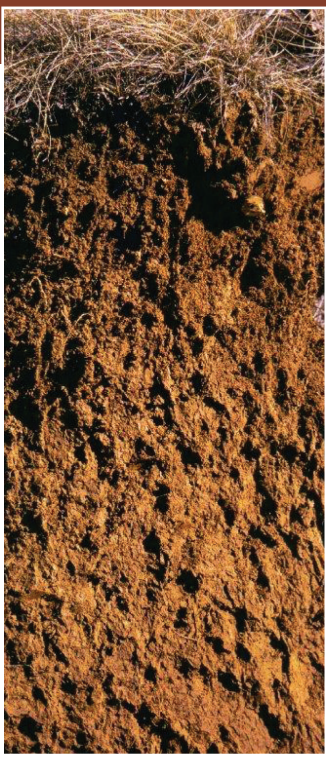
Menfro

Missouri State Soil



Soil Science Society of America

Introduction

Many states have a designated state bird, flower, fish, tree, rock, etc. Also, many states have a state soil – a soil that has significance or is important to the state. The "Menfro" is the Missouri State Soil. Let's explore how im-portant the Menfro is to Missouri.

History

The Menfro soil has a rich history in Missouri and for our nation. When Daniel Boone first settled west of the Mississippi River, it was on a Menfro soil. The first Missouri state capitol building in St. Charles, the present state capitol building in Jefferson City, and the governor's mansion are all built on Menfro soils. Also, Hannibal, the home of Mark Twain and Hermann, a historic German community are on Menfro soils. Menfro soils were first described in Macoupin County, Illinois in 1939. Since then the soil has been mapped (that is, located and described) along the Mississippi and Missouri Rivers in Illinois and Missouri. The state legislature designated the Menfro as the Misssouri State Soil in 2004.

What is Menfro Soil?

The Menfro series are deep, well drained, moderately permeable soils that were formed in thick loess (wind-blown) deposits on upland ridgetops, backslopes and benches adjacent to the Missouri and Mississippi Rivers and their major tributaries. Every soil can be separated into three size fractions called *sand, silt* and *clay*. They are present in all soils in different proportions and say a lot about the character of the soil. The combination of sand, silt and clay particles affect how the soil feels and determines many soil properties. In the Menfro soils, the top layer of soil that we plow and plant seeds in (*topsoil*) is fairly thin, typically around 7.5 cm (3 inches), with 2-4% *organic matter*. The color is dark brown when moist and the *soil texture* is usually a *silt loam* or *silty clay loam*. The subsoil, below where a farmer plows, is mostly silty clay loam in texture and about 100 cm deep (almost 4 feet). The subsoil has a yellowish-brown color, less *organic matter* than the topsoil (**Figure 1**).

Fig 1. Soil profile of a Menfro soil. Credit: Smithsonian Institution's Forces of Change.

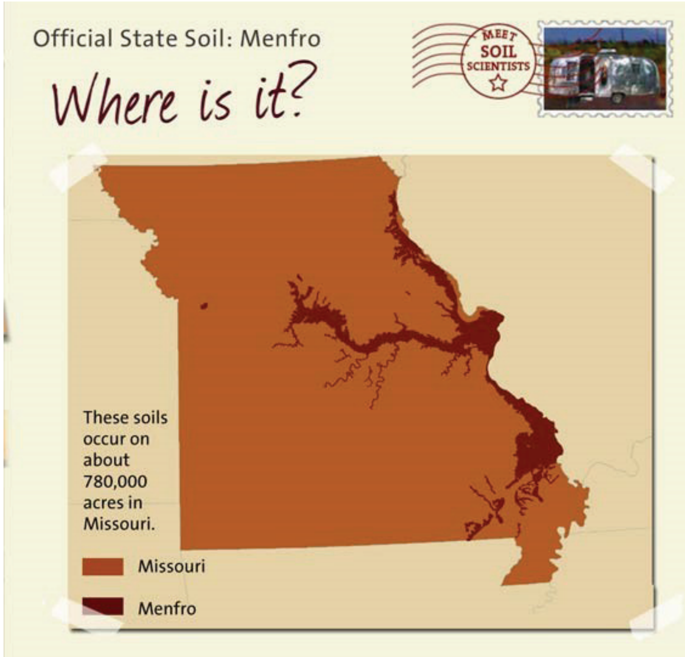


Fig. 2. The Menfro soils are spread along the Missouri and Mississippi Rivers in the State of Missouri and parts of Illinois. Source: Smithsonian Institution http://forces.si.edu/soils/interactive/statesoils/index.html

Where to dig Menfro

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*. They have different characteristics and properties for describing and identifying a soil. Menfro soil covers more than 315,000 hectares (780,000 acres) in Missouri and occurs in counties along the Missouri and Mississippi Rivers **(Figure 2)**. The soils are primarily found on upland ridgetops, backslopes and benches adjacent to the Missouri and Mississippi Rivers and their major tributaries. The hillslopes where they are located could be as gentle as 2% or steep up to 60%. In all, there are about 500 soil series or named soils in Missouri. Some common ones include Kickapoo, Dockery, Mexico, Leonard, Sampsel, Gerald, and Putnam.

Importance and Uses

What makes the Menfro soils so important is how widespread it is in the State and that they are considered *prime farmland* where the slopes are less than 6 percent. In general, soils can be used for agriculture (growing foods, raising animals, stables); engineering (roads, buildings, tunnels); ecology (wildlife habitat, wetlands), rec-reation (ball fields, playground, camping areas) and more. On modest slopes, Menfro soils are highly productive agricultural soils used for corn, soybeans, small grain, and specialty crops of tobacco, grapes, vegetables and fruits, but on steep slopes where the topsoil layer is thin, they are more commonly used as pastures for grazing and for deciduous hardwood timber production (**Figure 3**).

Limitations

When a soil cannot be used for one or more of the described functions, it is referred to as a limitation. *Soil Scientists,* who study the properties of soil and predict soil behavior based on

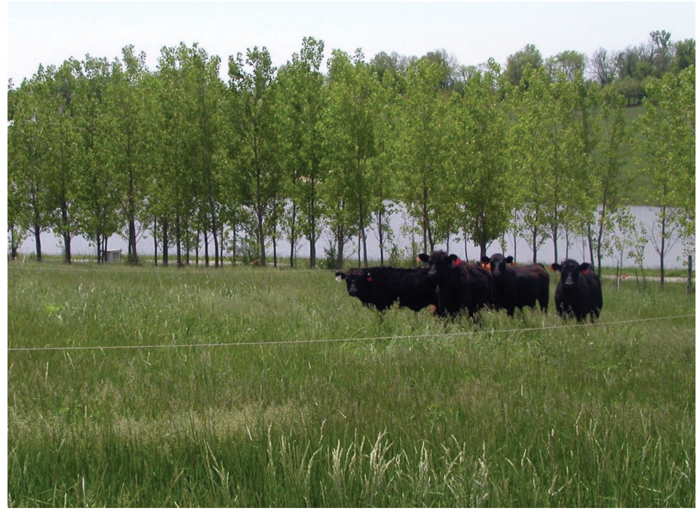


Fig 3. Cattle grazing on a Menfro soil (photo courtesy of Stephen Anderson, University of Missouri-Columbia)

available physical, chemical, biological and climatic data, studied Menfro soil and determined that it is somewhat limited for many different kinds of uses. Erosion is the main limitation of this soil because it is primarily *silty* and can be easily eroded. This means that over time and due to excessive tillage, the soil can be blown away by wind or carried downslope by heavy rains into nearby streams and rivers. The result is that a soil rich in nutrients can be degraded over time, making it less able to hold water and nutrients.

Management

Since Menfro soils tend to occur on steep slopes, preventing erosion is important! Menfro is a rich soil resource that should be well managed and protected. Without good management practices, soils such as Menfro are highly vulnerable. Many farmers are now converting to *"no-till"* farming (**Figure 4**). No till farming does not use a plow to turn over the 15-20 cm (6-8 inches) surface of soil (*topsoil*). The result of no-till farming includes better soil structure, increased organic matter, and better water holding capacity. The result of these improvements in soil properties is a reduced chance of erosion.

Fig 4. Example of a no-till field. Credit: USDA-NRCS

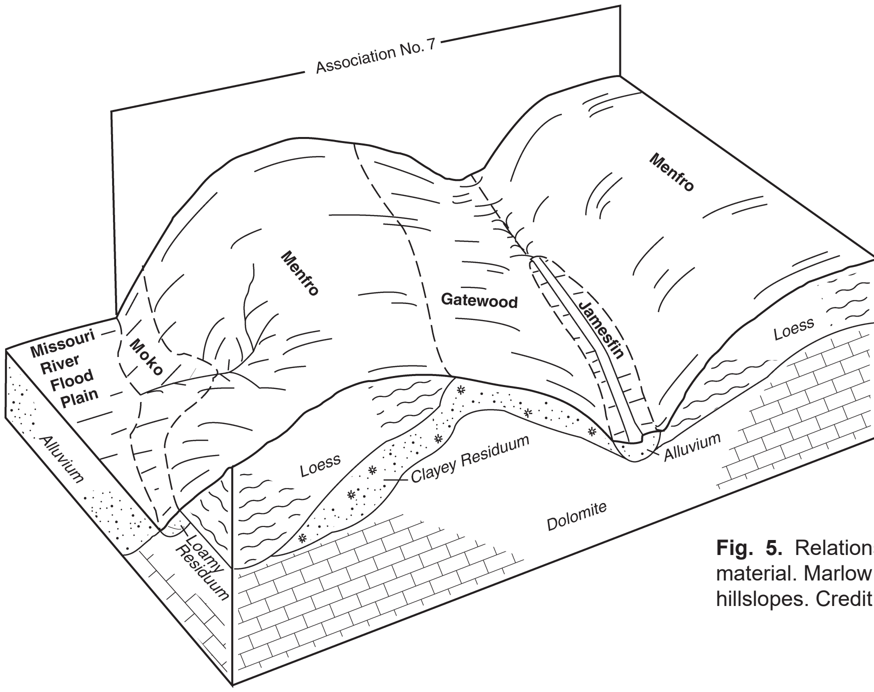


Fig. 5. Relationship of Marlow soils to landform position and parent material. Marlow soils are well drained and are found on smooth rounded hillslopes. Credit: NH Soils Staff

Menfro 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 Menfro series. It stands for **Cl**imate, **O**rganisms, **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 Menfro (and all other soils) are determined by the influence of CLORPT. When weathering takes place, environmental processes such as rainfall, freezing and thawing act on rocks causing them to dissolve, fracture or 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 Menro soil developed under humid temperate climate with hot summers and cold winters. The mean annual precipi-tation is 810 to 1067 mm (32-42 inches) and the mean annual temperature is 12 to 15 degrees C (54 - 59 ˚F).

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 hori-zons. 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. The Menfro soils developed under deciduous vegetation. This type of vegetation add leaf litter to the soil surface which results in thin dark surface layer.

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. Normally, deeper soils form at the bottom of the hill rather than at the top because gravity and water move soil particles downhill. However, Menfro soils are deep soils on steep slopes because they are formed in deposits that is deep and already in place, not on a rock surface. (**Figure 5**)

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. The parent material of the Menfro soil is *loess* (wind-deposited material). It is thickest on the river bluffs and thins out as one goes farther from the bluffs. The material is considered to be Peorian loess deposited after the Wisconsin glacial age. The parent material gives the soil the characteristic fine soil texture.

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 dif-ferent 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.

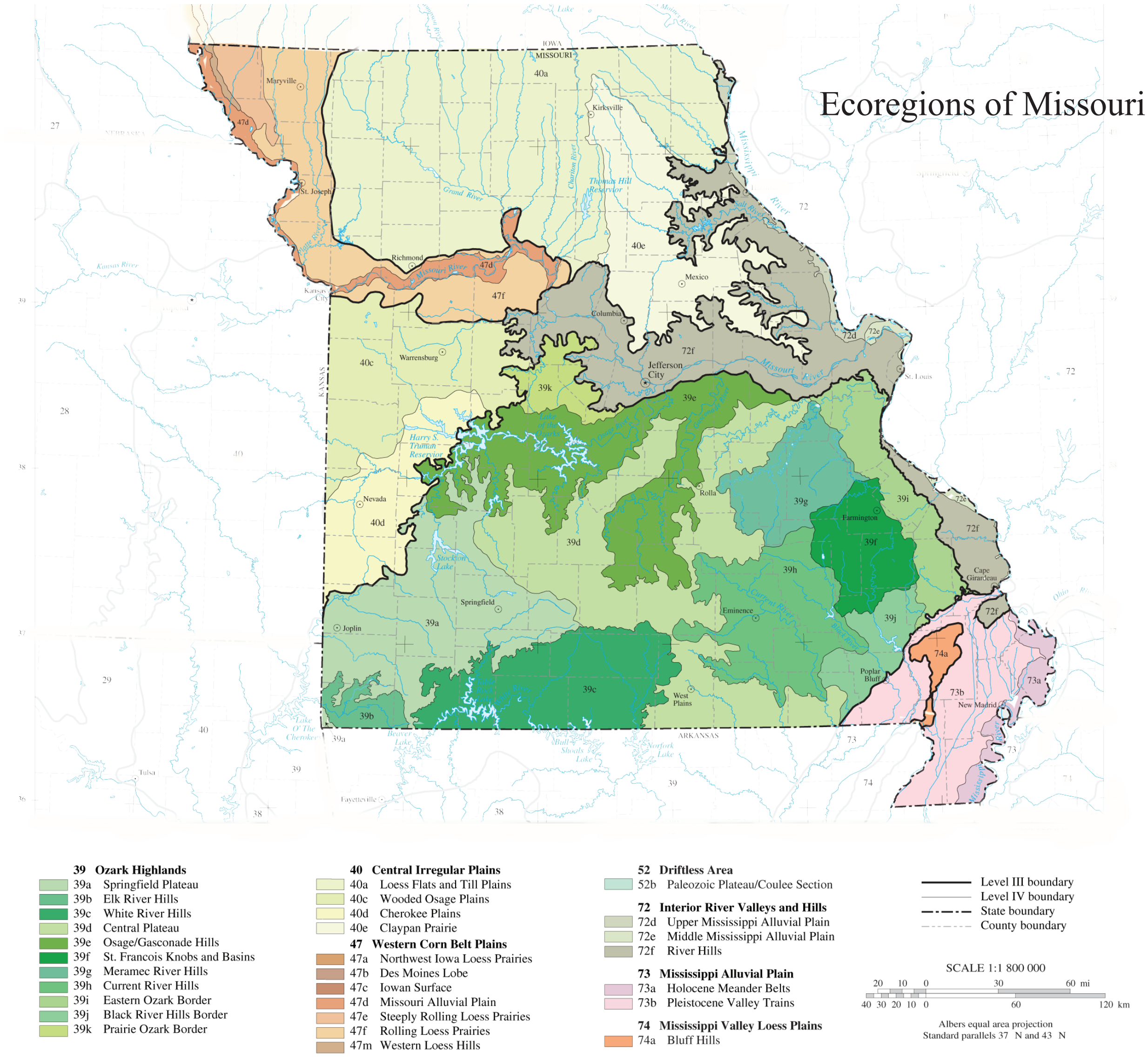


Fig 6. Missouri has six broad Ecoregions. Source: USEPA, Western Ecology Division.

Ecoregions, Soils and Land Use

There are six broad (Level III) and 28 more detailed (Level IV) ecoregions in Missouri (**Figure 6**). The broad ecoregions are (1) Ozark Highlands, (2) Central Irregular Plains, (3) Western Corn Belt Plains, (4) Interior River Valleys and Hills, (5) Mississippi Alluvial Plain, and (6) Mississippi Valley Loess Plains. Ecoregions are areas where ecosystems are generally similar. Ecosystems are identified through analysis of patterns and composition of geology, landforms, soils, land use, vegetation, climate, wildlife and hydrology, and how they affect or influence ecosystem quality and integrity so as to differentiate one ecosystem from another. The distribution of the Menfro soils overlaps the Interior River Valleys and Hills ecoregion. This is a transitional ecoregion between the forested Ozark Highlands and the flatter, loess- and till-covered, cultivated northern ecoregions. It is made up of many wide flat bottomed, terraced valley, forest valley slopes and dissected glacial till plains. Less than 50% of the ecoregion is cultivated, about 30% is pasture and the remainder is in forested with oak-hickory trees and tall grasses. The soils are developed from alluvium and so are deep, silty, clayey and are poorly drained. The Central Irregular Plains ecoregion covers the northern and parts of central Missouri. The topography of the ecoregion is generally level to rolling landscape. The soils in the northern part which are developed from glacial drift and is clayey while soils in the southern part are developed from shale, sandstone and limestone residuum or from shallow loess deposits. A soil feature called claypan is common in this area. This ecoregion is less irregular and less tree-covered than the Ozark Highlands with the vegetation tending to be more grass and the wooded areas occurring along streams. Land use activities include a mixture of coal min-ing, cropland and grassland for livestock production.

The Ozark Highlands ecoregion has more irregular physiography and is generally more forested than the adjacent regions. More than 60% of the area is open forest or woodland with cultivated lands for row crops limited to small tracts in the numerous valleys and small creek bottoms, and any clearings in the uplands being used for pasture or livestock grazing. From the 1980s onward, landcover change has been towards cutting the forest for agricultural expansion, primarily for cattle, poultry and swine production. The soils of this ecoregion are developed from cherty carbonate rocks and the soils in the area consists of 20-60% chert stones. The ecoregion also has some of the largest freshwater springs in North America.

Glossary

Alluvium: A soil parent material, such as sand silt or clay, deposited on land by streams.

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.

Claypan: A dense, compact, slowly permeable layer in the subsoil having a much higher clay content than the overlying material, from which it is separated by a sharply defined boundary. Claypans are usually hard when dry, and plastic and sticky when wet.

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.

Horizon: see Soil horizons

Landform: Any recognizable form or feature on the earth's surface, having a characteristic shape and produced by natural causes.

Landscapes: A wide view of the land from above that shows many different combinations of land shapes and features. Landscape is a collection of these natural landforms.

Loess: A loosely compacted deposit of windblown silt-sized sediment. Also a soil parent material transported to and deposited in current location by wind.

No Till: Farming that does not use a plow to turn over the top 15-20 cm (6-8 inches) surface of soil (topsoil) before planting seeds.

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

Physiographic province: Are broad-scale subdivisions based on terrain texture, rock type, and geologic structure and history.

Prime Farmland: Land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fi-ber, and oilseed crops and is also available for these uses. It has the soil quality, growing season, and moisture supply needed to pro-duce economically sustained high yields of crops when treated and managed according to acceptable farming methods, including water management. It could be cultivated land, pasture, forest land, or other land but it is not urban or built-up areas or water areas.

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.

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 parti-cles the smallest. Learn more about soil texture at www.soils4teachers.org/physical-properties.

Soluble Bases: Elements (calcium, magnesium, sodium and potassium) that are present in soil as ions and form what is called Cation Exchange Capacity. The amount in the soil can be reduced through leaching.

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

Topsoil: (A horizon) The horizon that formed at the land surface. Mostly weathered minerals from parent material with a little organ-ic matter added.

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

Soils for Teachers—www.soils4teachers.org

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

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

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

Smithsonian Institution — http://forces.si.edu/soils

Missouri Web Resources/Links

Missouri Association of Professional Soil Scientists—https://www.momapss.org

Missouri Association of Soil & Water Districts—http://www.maswcd.net/

Missouri Department of Natural Resources—https://dnr.mo.gov/

University of Missouri, College of Agriculture Food & Natural Resources, Agricultural Experiment Station —http://aes.missouri.edu/

NRCS Web Resources

Natural Resources Conservation Service, Missouri State Website—https://www.nrcs.usda.gov/wps/portal/nrcs/mo/home/

Natural Resources Conservation Service, Missouri Soils Homepage—https://www.nrcs.usda.gov/wps/portal/nrcs/mo/soils/surveys/

Web Soil Survey. https://websoilsurvey.nrcs.usda.gov/app/

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