Monongahela Silt Loam

West Virginia State Soil

Soil Science Society of America

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 Monongahela Silt Loam is the official state soil of West Virginia. Let's explore how Monongahela Silt Loam is important to West Virginia.

History

Monongahela silt loam was first identified in Greene County, Pennsylvania, in 1921, and was named for the Monongahela River. It was designated as the official soil of West Virginia in 1997 by the state legislature. The Governor at the time, Cecil Underwood, honored this designation by issuing a colorful painting **(Figure 1)** and displaying it in his office during November of that year. Mr. Bill Dawson of Huntington, WV completed the painting which now hangs in the WV State Capitol with the other state symbols.

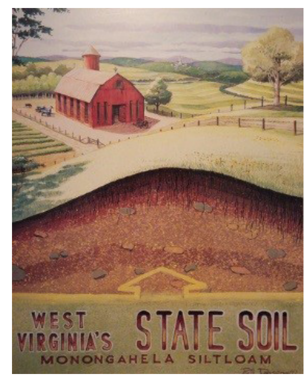


Fig. 1. Painting honoring the state soil designation. Credit: www.wvencyclopedia.org/articles/2020

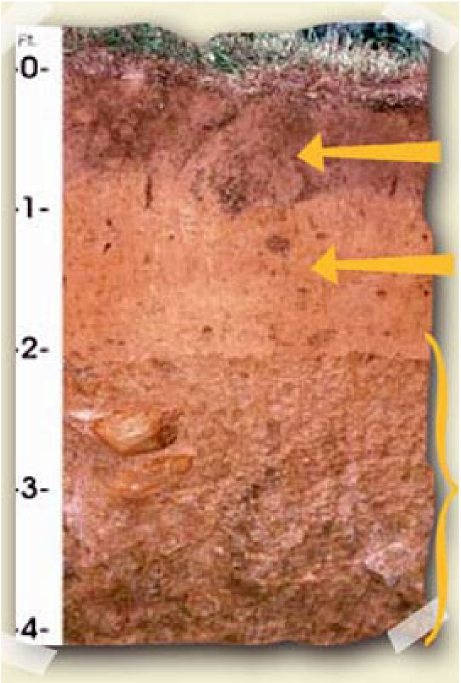
What is Monongahela Silt Loam Soil?

The Monongahela series was first established in Greene County, Pennsylvania in 1921 but occurs in West Virginia, Virginia, Tennessee, Pennsylvania, Ohio, Maryland, Kentucky, and Alabama. The series was names for the Monongahela River, which drains Green county and much of north-central West Virginia. The name "Monongahela" is derived from a Native American word meaning "high banks or bluffs, breaking off and falling down in places" in reference to the instability of the river's banks. These very deep, moderately well drained soils are found on *alluvial stream terraces* in river valleys that are not flooded. The soil derives largely from sandstone and shale, sedimentary rocks formed millennia ago by the siltation of streams. It occurs particularly on terraces but is also present on slopes of as much as 25 percent grade. The soil is slightly acidic.

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. The Monongahela Silt Loam is classified as silt loam in the upper portion of the soil then grades to a loam or clay loam lower in the soil. Clay films, or coatings of clay, can be found below 12 inches in the soil showing that increase of clay percentage.

Horizons, or soil layers, of importance in the Monongahela Silt Loam include a plow layer and a *fragipan* **(Figure 2)**. The plow layer is evidence of past and/or current use of the soil for agriculture. The plow layer includes the top 7 inches of the soil that show evidence of mixing by cultivation practices. The fragipan is a very dense subsoil layer that has coarse prismatic or columnar structure. The picture below shows the prismatic structure of a fragipan found in WV. The term comes from the Latin fragilis, meaning brittle,

Photo Soil Monolith: Chip Clark/Smithsonian Institution



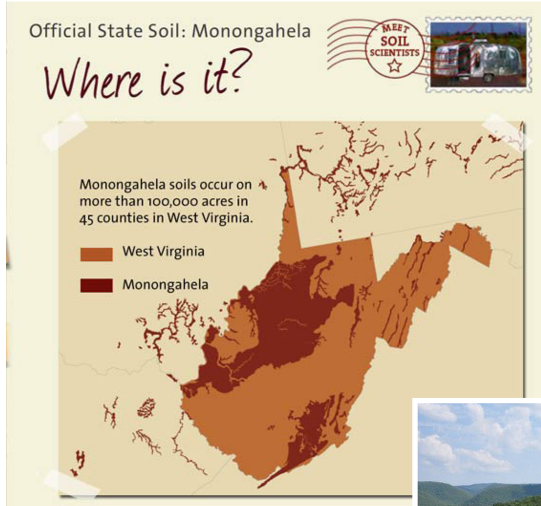


Fig. 2. (Far Left) Monongahela Soil Profile, Smithsonian Institution.

Fig. 3. (Left) Location of the Monongahela soil series. Smithsonian Institution.

Fig. 4. (Below) Rural West Virginia; Credit; Kara Newhouse on Flickr.

and pan, i.e., "brittle pan." These layers typically restrict water movement and root growth. The fragipan on the Monongahela Silt Loam is found at a depth around 20 inches.

Where to dig Monongahela Silt Loam

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 Monongahela Silt Loam is the most common. The Monongahela Silt Loam soil can be found on upper terraces that no longer flood along major rivers and streams in West Virginia. Major drainages with a high proportion of these soils mapped include the Kanawha, Little Kanawha, Elk and Monongahela Rivers. Monongahela Silt Loam covers 100,000 acres of land in 45 counties of West Virginia (**Figure 3**). In all, there are a total of 203 named soils (series) in West Virginia.

Fig. 5 Cornfield near upper tract West Virginia. Credit: West Virginia Explorer

Importance

What makes the Monongahela Silt Loam soil so important is its use and prevalence in the State? This soil is a highly productive crop and pasture soil in a State that has limited opportunities for crop production due to the rugged terrain (**Figure 4**). In areas where the soil is found with 3% or less slopes it is considered Prime Farmland. Prime farmland is a designation assigned by U.S. Department of Agriculture defining land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is also available for these land uses. As such Monongahela silt loam is used extensively for cultivated crops, hay, pasture, and home site development.

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. Monongahela soils are used primarily for pasture, cultivated crops, and industrial and residential sites. Common crops include corn, soy beans, and wheat (**Figure 5**). There are some localized areas that still grow tobacco. Pasture acres have a mixture of grasses and legumes (**Figure 6**). The soils are well suited to crop production. Forest acreage is limited, but where found common trees growing on wooded areas include red oak, white oak, yellow-poplar, sycamore, white pine, and Virginia pine.

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 Monongahela Silt Loam soil and identified that it has a limitation for dwellings with basements. The fragipan mentioned above perches water on top of it at a depth shallower than a basement (**Figure 7**). This higher clay content in these lower layers also have the ability to shrink and swell depending on moisture content of the soil. These limitations can be overcome with additional engineering practices.

Fig. 6. Pasture with Fencing, Credit: West Virginia Conservation Agency

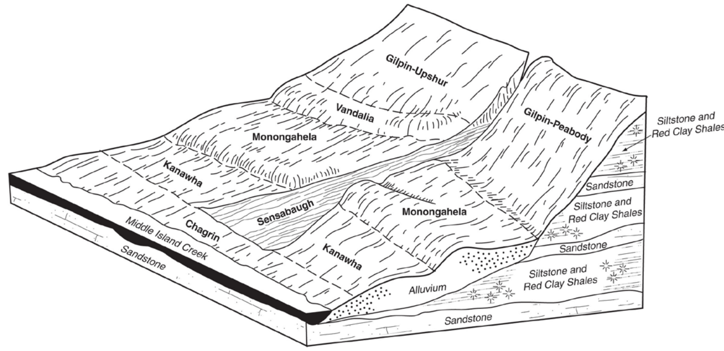


Fig. 7. Typical relief pattern of soils, including Monongahela and parent materials found along Middle Island Creek, Doddridge County, WV. Credit USDA-NRCS

Management

Since one of the top uses of Monongahela silt loam is agriculture and in particular crop production, a common best management practice, or BMP, is no till farming. No till farming is a way of growing crops from year to year without the added disturbance of tilling the soil. This practice increases the amount of organic matter retained on and in the soil, therefore also increasing the water holding capacity and nutrient retention of the soil. It also helps to limit soil erosion.

Monongahela Silt Loam 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 Monongahela 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 Monongahela Silt Loam (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. Temperatures in West Virginia average 52°F, increasing towards the southern parts of the state. The winter average daily temperature is about 32°F, while in the summer it is about 70°F. The average annual precipitation of West Virginia is about 44 inches. However, the pattern of the precipitation is strongly influenced by the physical geography, namely, the Allegheny Mountains ranging from 36 to almost 65 inches per year. The annual snowfall ranges from 12 to 24 inches in those southwestern lowlands to greater than 72 inches in the mountains. (Law and Mogil)

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. Most of the characteristics found in the soils from organisms have been hidden by the current plow layer found in the soil. However, earthworms are highly important to aerate and mix organic matter into the soil profile. The acidic nature of the soil is likely due to both the geology and the forest litter that used to accumulate in the wooded environment.

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. The Monongahela silt loam soil is found on old terraces in valleys across the state **(Figure 7)**. These soils are formed from material that has been moved downslope and deposited by streams. As a result these soils are deep, typically greater than 65 inches.

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 materials that form the soil are sediments from acid sandstone and shales that were formed during the Early Cambrian through Early Permian ages, 541 to 252 million years ago.

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 Appalachian Mountains have been through at least two different periods of uplift, or mountain building. The most recent occurred approximately 66 million years ago. This region of the mountain did not have continental glaciation though several of the river drainages were shaped by glacial processes. The Monongahela silt loam soils have been developing since the mountain were built and begum weathering.

Ecoregions, Soils and Land Use in West Virginia

There are three ecoregions within West Virginia. Monongahela silt loam is found in all three of them **(Figure 8).** The most dominant of the ecoregions is the Central Appalachians. This region is primarily a high, dissected, rugged plateau composed of sandstone, shale, conglomerate, and coal. The rugged terrain, cool climate, and infertile soils limit agriculture, resulting in a mostly forested land cover. The high hills and low mountains are covered by a mixed mesophytic forest with areas of Appalachian oak and northern hardwood forest. Bituminous coal mines are common, and have caused the siltation and acidification of streams.

The northwestern portion of the state lies within the Western Allegheny Plateau ecoregion. The hilly and wooded terrain of the Western Allegheny Plateau was not muted by glaciation and is more rugged than the agricultural till plains of ecoregions to the north and west, but is less rugged and not as forested as ecoregions to the east and south. Extensive mixed mesophytic forests and mixed oak forests originally grew in the Western Allegheny Plateau and, today, most of its rounded hills remain in forest; dairy, livestock, and general farms as well as residential developments are concentrated in the valleys. Horizontally-bedded, sedimentary rock underlying the region has been mined for bituminous coal.

The eastern panhandle and parts of eastern West Virginia fall into the Ridge and Valley ecoregion. This northeast-southwest trending, relatively low-lying, but diverse ecoregion is sandwiched between generally higher, more rugged mountainous regions with greater forest cover. As a result of extreme folding and faulting events, the region's roughly parallel ridges and valleys have a variety of widths, heights, and geologic materials, including limestone, dolomite, shale, siltstone, sandstone, chert, mudstone, and marble. Springs and caves are relatively numerous. Present-day forests cover about 50% of the region. The ecoregion has a diversity of aquatic habitats and species of fish.

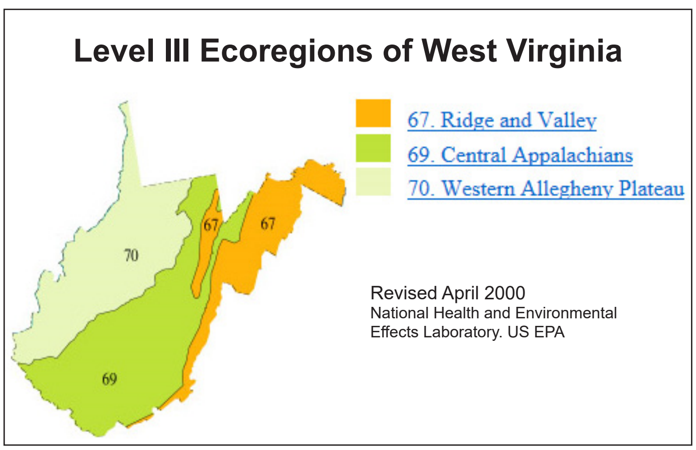


Fig. 8. Ecoregions of West Virginia. Credit: US-EPA

Glossary

Alluvial Stream Terrace: At the point where the speed of a stream slows, sediment is deposited, called alluvium. Over time, the stream channel carves a smaller path through the alluvium, creating terraces on both sides. The terraces are alluvial stream terraces since they consist of deposited sediment that had been translocated, instead of carved into preexisting rock

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 Film: Coatings of oriented clay on the surfaces of peds and mineral grains and lining pores.

Clay Loam: Soil material that contains 27 to 41% clay, 28 to 50% silt, and 28 to 52% 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.

Fragipan: A natural subsurface horizon with very low organic matter, high bulk density and/or high mechanical strength relative to overlying and underlying horizons; has hard or very hard consistence (seemingly cemented) when dry, but showing a moderate to weak brittleness when moist. The layer typically has redoximorphic features, is slowly or very slowly permeable to water, is considered to be root restricting, and usually has few to many bleached, roughly vertical planes which are faces of coarse or very coarse polyhedrons or prisms.

Geology: The study of the physical earth, its composition (materials), history and processes (physical and chemical) that act on it.

Geologic formation: A body of rock of considerable extent with distinctive characteristics that allow geologists to map, describe, and name it.

Horizon: see Soil horizons

Loam: Soil material that contains 7 to 27% clay, 17 to 55% silt, and 25 to 53% sand.

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

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 up to 28% clay, 50 to 90% silt, and up to 55% sand.

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 in all soils.

Topography: The shape of the land surface. (Relief: refers to differences in elevation of different points in a region.)

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

Water table: The top layer of ground water where the soil is filled with standing water. It can move up or down during different seasons.

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/

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