Stuttgart

Arkansas State Soil

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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 "Stuttgart" is the official state soil of Arkansas. Let's explore how the Stuttgart is important to Arkansas.

History

Stuttgart soil series was adopted as the official state soil by the Eighty-first General Assembly of Arkansas in 1997. Named for the city of Stuttgart in southeast Arkansas, these soils occur in the Grand Prairie and are of similar age, on large upland terraces within the Lower Mississippi Valley.

What is Stuttgart Soil?

The region that Stuttgart soil formed in has silty and clayey alluvium parent material (transported/deposited by running water), an upland landscape position, prairie grasses as native vegetation, and high annual rainfall (see ClORPT page 3). The silty portion of the parent material is believed to be the result of loess (wind-blown silty sediments, pronounced "luss") which had been redistributed by rivers. Stuttgart soils are very deep, moderately well to somewhat poorly drained, slowly permeable soils. They are found on Prairie terraces with up to 5% slope in some places, but 3% or less is most common.

Every soil can be separated into three separate fractions called *sand*, *silt*, and *clay*. They are present in all soils in different proportions and say a lot about the soil texture and character of the soil. In Stuttgart soil, the topsoil or A horizon (the layer of soil that we plow or plant seeds in) is a thin layer of silt loam. An E horizon is also present (the layer immediately below an A horizon that has been extensively leached by the action of percolating water). The E horizon is a silt loam that has lower concentrations of iron and higher concentrations of acidity. The subsoil or B horizon has an increase in clay, and is a mixture of clay loam and silty clay loam textures (**Figure 1**).

Fig. 1 The Stuttgart soil profile shows the surface layer of dark grayish brown and grayish brown silt loam; the subsurface layer of yellowish brown silt loam; the subsoil (upper) of red silty clay; and the subsoil (lower) of grayish brown and light brownish gray silty clay loam. Credit: USDA NRCS.

Fig. 2 Stuttgart soil series is the official state soil of Arkansas. Credit: Smithsonian Institution.

Where to dig a Stuttgart

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 actually called soil horizons.

Stuttgart soils occur on about 80,937 hectares (200,000 acres) of the state in Arkansas, highlighted in the map above **(Figure 2)**. This does not mean that other types of soil are not found in that portion of the state, just that Stuttgart is very common.

Uses and Importance

Soils everywhere are used for agriculture (growing fibers, fuels, and foods for people and animals); support engineering (roads, buildings, tunnels); recreation (ball fields, playground, and camping areas); natural ecosystems (wetlands); and more. Unique factors of soil formation, which include parent material, climate, topography, living organisms and time, have combined to produce soils across the state that are fertile, unique, and reflective of local ecosystems.

Soil is one the most precious natural resources in Arkansas as it is the foundation of our most important activity – agriculture **(Figure 3)**. The primary crops grown on the Stuttgart soils are rice (the state grain symbol of Arkansas) and soybeans, and it is one of the most productive soils in the state, responsible for millions of dollars of crop harvest each year.

Soils affect the type and amount of vegetation that is available to wildlife as food and cover; they also affect the construction of man-made waterways. The type and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants. Crops grown on the Stuttgart soil help sustain wildlife habitats that support a large fall and winter population of ducks and geese **(Figure 4)**. As the sign says "Welcome to Stuttgart, Arkansas the Rice and Duck Capital of the World." Other towns in Arkansas are settled on Stuttgart soil. How would you feel if your house is built on the State Soil? Special, I think.

Fig. 3. Rice grown on Stuttgart soil (foreground). Soybeans are shown growing on Stuttgart soil (background). Credit: USDA NRCS

Limitations

While soil underlies nearly everything humans do, some soils cannot be used for one or more of the uses (discussed in the use and importance section). This is referred to as a "limitation".

Soil experts, called Soil Scientists, have studied the suitability of Stuttgart soils for various uses. They have determined that there are few limitations that restrict the use of Stuttgart for crop production; urban development, such as houses, buildings, and roads; and wildlife habitats and recreational uses including parks, trails, and golfing facilities. Major limitations are seasonal wetness and high sodium content for crop production; planting and managing the appropriate vegetation and maintaining existing plant cover for wildlife; and in urban development, structural damage caused by flooding and erosion, and in some locations these clayey soils have shrink-swell effect. The average annual soil temperature is between 15° to 22°C (59° to 72°F).

Soil Management

Management concerns in Arkansas focus on reducing erosion, primarily by water, and on having adequate moisture for crop production. On agricultural lands, both of these problems can be solved by reducing tillage and increasing ground cover that is, leaving more crop residue on the field. Similarly, a reduction of soil disturbance and an increase in cover (gravel, mulch, straw) can reduce erosion at urban sites.

Soil testing have identified the chemicals needed to improve crop productivity of the Stuttgart soils. With a seasonal high water table at a depth of 0 to 1 foot (saturated) from December through April and saturated in all underlying layers below the surface, there is the potential for leaching or runoff of chemicals into waterways. Using minimum tillage and returning all crop residue to the soil or regularly adding organic matter can help to improve fertility, maintain tilth and organic matter content, and reduce the effects of leaching or runoff.

Fig. 4 Pintail ducks take flight at Bald Knob National Wildlife Refuge in northeast Arkansas. Photo credit: Jim Daniel. US Fish and Wildlife Service.

Stuttgart Soil Formation

Before there is soil there were rocks and in between, ClORPT. Without ClOPRT, there will be no soil. So, what is ClOPRT? There are five major factors that are responsible for forming a soil like the Stuttgart series. These are Climate, Organisms, Relief (topography), Parent material, and Time – ClORPT, for short. ClORPT is responsible for the development of soil profiles and chemical properties that differentiate soils. So, the characteristics of Stuttgart soil (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 fracture and break into pieces. ClORPT now 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. Stuttgart soils average annual air temperature ranges from about 60 to 65 degrees F., and average annual precipitation ranges from about 50 to 55 inches.

Organisms – This refers to plants and animal life. Plant roots spread, animals burrow, 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. Stuttgart soils formed under native tallgrass prairie which led to being moderate in organic matter (fertile).

Relief – Landform position or relief describes the shape of the land (hills and valleys), and the direction it faces 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 than at the top because gravity and water move soil particles downhill. Stuttgart soils formed on level to gently sloping terraces. Soils on flat surfaces are more stable and more developed than those found on slopes.

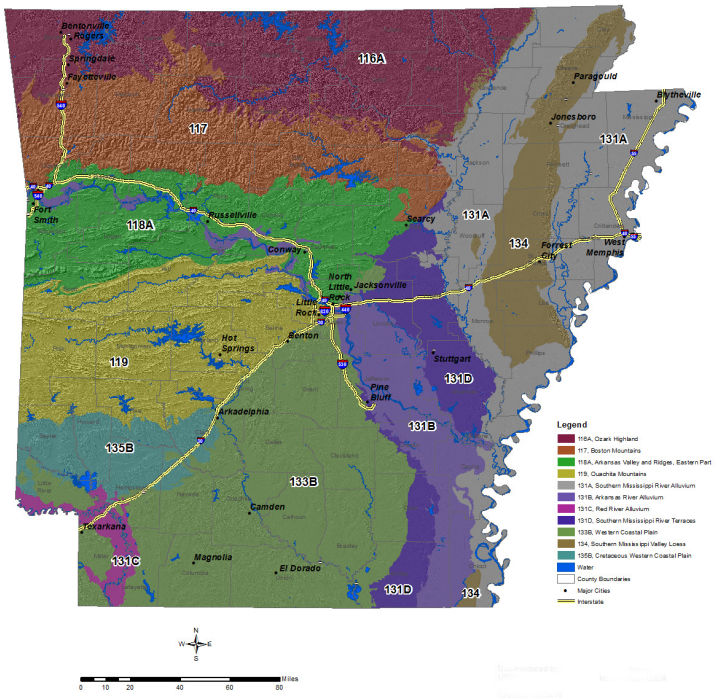

Fig. 5. Major resource areas of Arkansas. Credit: USDA-NRCS

Parent material – Just like people inherit characteristics from their parents, every soil inherited some traits from the material from which it forms. Some parent materials are transported and deposited by glacier, wind, or water. Some parent materials are just deposited by gravity (for example, volcanic lava). Stuttgart soils formed on the Grand Prairie of Arkansas and other similar age terraces in the Lower Mississippi Valley. The terraces are made up of alluvial sediments from the Arkansas River system with a silty mantle that was originally deposited as windblown loess, but was reworked by rivers as alluvium.

Time – All of these factors act together over a very long 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. The Stuttgart soils formed on a Pleistocene-aged stream terrace.

Major Land Resource Areas in Arkansas

The Stuttgart soils are located in eastern Arkansas in the Grand Prairie on the Southern Mississippi River Terraces Major Land Resource Areas (MLRA) (**Figure 5**). The areas feature the terms highland, mountains, coastal plain alluvium, and loess. These areas contain different soil parent materials that develop different soils. The highlands and mountains have soil parent materials named residuum and colluvium. These type of soils developed from hard rock (residuum) or rock that has been moved by gravity (colluvium), and are used mainly for forests and pasture. The coastal plains have unconsolidated marine sediments as its soil parent material. These areas are mainly used for forests and pasture. Those areas with the term alluvium and terraces in their name consist of soils that formed from sediment that was depos-

ited by running water. Sediment deposited by large rivers make up a good portion of Arkansas and these areas are used extensively for row crops, such as rice, soybeans, corn, cotton, and wheat. Loess indicates that soils in that area formed from wind-blown silty sediments. The soils developed from loess are used primarily for row crops, such as, rice, soybeans and wheat. The Stuttgart soils have alluvial parent material.

Glossary

Alluvial: Pertaining to processes or materials associated with transportation or deposition by running water.

Clay: A soil particle that is less than 0.002 mm in diameter. They can be separated from most soils and used to determine soil textural class. A clay soil is a soil that has more than 40% clay, less than 45% sand and less than 40% silt.

E horizon: Mineral horizons in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these, leaving a concentration of sand and silt particles of quartz or other resistant materials.

Horizon: See Soil horizon.

Loess: Parent material transported to and deposited in its current location by wind.

Organic matter: Soil 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.

Silty Clay Loam: A classification for soil material that contains 27-40% clay, 0-15% sand, and 42 to 75% silt.

Silt Loam: A classification for soil material that contains 0-27% clay, 0-55% sand, and 55-90% silt.

Soil Forming Factors: The surrounding environment that leads to differences in soil properties. The factors include Parent Material, Climate, Relief (Topography), Biological Activity, Time, and in some cases, Human Activity.

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

Soil Management: The sum total of how we prepare and nurture soil, select types of crops that suitable for a type of soil, tend the crop and the soil together, determine types of fertilizers and other materials added to soil so as to maintain productivity and preserve the soil.

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.

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 leached down from the horizons above it. Not present in all soils.

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

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:

Smithsonian Soils Exhibit—http://forces.si.edu/soils/Stuttgart OSD, USDA NRCS

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

Arkansas NRCS—http://www.ar.nrcs.usda.gov/

Encyclopedia Britannica—http://www.britannica.com/science/E-horizon

Extent map of Stuttgart soils—statesymbolsusa.org

K-6 Activities—http://www.ar.nrcs.usda.gov/news/soil_does_more/index.html

National Cooperative Soil Survey, Official Series Description-Stuttgart Series—https://soilseries.sc.egov.usda.gov/OSD_Docs/R/STUTTGART.html

USDA NRCS Web Soil Survey—http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

ARKANSAS LINKS:

The Encyclopedia of Arkansas History & Culture—http://www.encyclopediaofarkansas.net/encyclopedia/entry-detail.aspx?entryID=5141

University of Arkansas, Division of Agriculture, Cooperative Extension Service—http://www.uaex.edu/environment-nature/soil/

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