CRIDER

Kentucky 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 "Crider" is the official state soil of Kentucky. Let's explore how the Crider is important to Kentucky.

History

Crider soil was first identified and established as a soil series in Caldwell County in 1957 on the University of Kentucky's Western Kentucky Agricultural Experiment Substation in Princeton, Ky. It was established to represent the well-drained upland soils on areas having *loess* (windblown) silt over limestone bedrock primarily on the Pennyroyal section of Southern Indiana, Western Kentucky, and West Tennessee. It is named after the small community of Crider in Caldwell County, KY.

The Crider soil was selected as a possible state soil by the Soil Science Society of Kentucky in 1990. A proposal was sent to the KY legislature and Crider officially became the State Soil in 1990.

What is Crider Soil?

Crider soils consist of very deep, well-drained, moderately permeable soils on uplands of the Pennyroyal. They are formed from a loess mantle of windblown silt and the underlying *residuum* from limestone. Originally, the land area had developed from older limestone rock formations before the loess was deposited over it. The loess, ranging from about 1 to 6 feet thick, became soil as it weathered (see CLORPT below) and plants, animals, and microorganisms began to add organic matter to the top layer over thousands of years. Crider soils are found on nearly level to rolling uplands with slopes up to 20%, but most often have slopes ranging from 0 to 12%.

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 Crider soil, the *topsoil*, or A horizon (the layer that we plow or plant seeds in), is brown *silt loam* up to 11 inches thick. The upper *subsoil*, or the part of the B horizon that formed from weathered loess, is reddish brown silt loam or *silty clay loam*. The lower subsoil, or 2B horizon (the 2 representing a change in parent material) that formed from weathered limestone bedrock, is red to dark red *silty clay* or clay. It is then underlain by hard limestone bedrock at a depth of 6 to more than 8 feet (**Figure 1**).

Photo Soil Monolith: Chip Clark/Smithsonian Institution

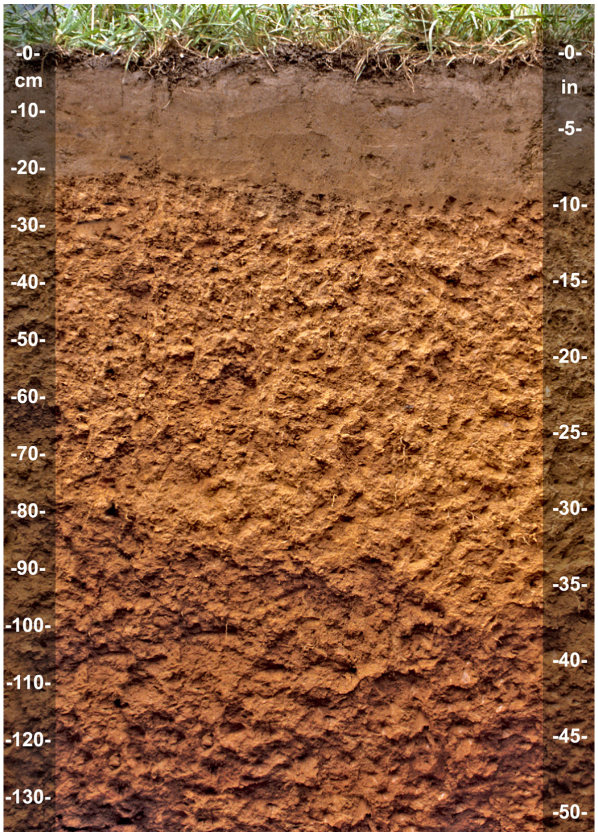

Fig. 1. Typical Crider profile. Credit: USDA-NRCS.

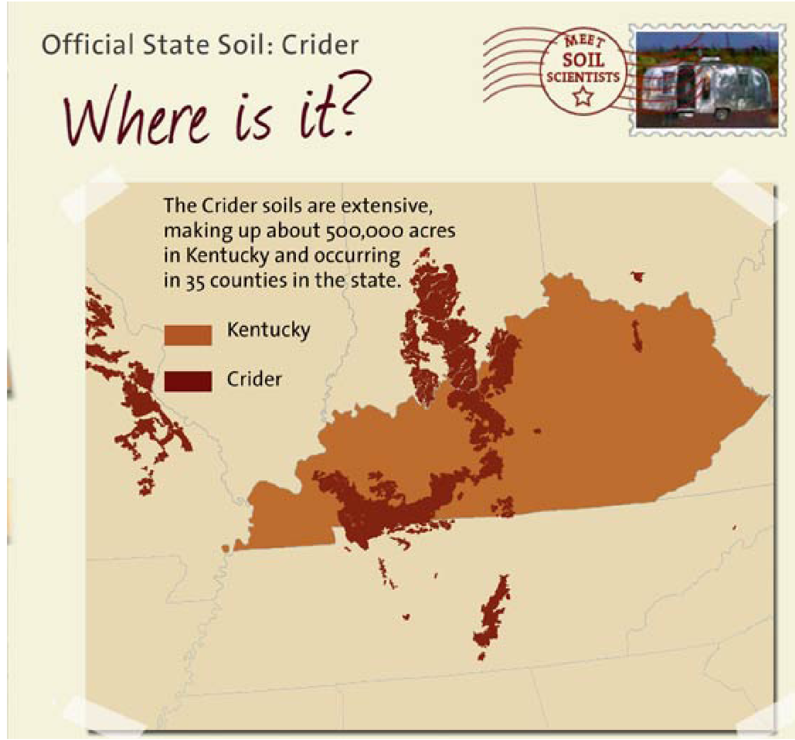

Fig. 2. Location of Crider soils. Credit: Smithsonian Institution's Forces of change. http://forces.si.edu\soils\interacftive\statesoils\index.html

Where to dig Crider

Crider soils occur on over 500,000 acres in Kentucky, or 2% of the state, in parts of 35 counties in Kentucky, as well as occurring on tens of thousands of acres in Indiana and Tennessee (**Figure 2**). They're most extensive in the portion of Kentucky known as the Pennyroyal. They are most often mapped on broad ridgetops and upper side slopes with slopes dominantly between 2 and 12 percent. The gently sloping to sloping uplands often have a convex shape and are underlain by highly fractured limestone. These landscapes tend to develop deep, well-drained soils that do not accumulate water or have a high water table, soils such as Crider. In these landscapes, iron oxides are commonly observed in the soil profile, explaining the red color of Crider.

Importance

What makes the Crider soil so important is its use and prevalence in the State. Most Crider soils are used for crops and pasture (**Figure 3**). Since it is a deep and well-drained soil, it is well suited to vegetables, corn, small grains, soybeans, tobacco, hay and many other uses, including urban development. The non-urbanized areas of Crider soils with 0 to 6 percent slopes are considered prime farmland, and areas with 6 to 12 percent slopes are considered statewide important farmland by the Natural Resources Conservation Service of the United States Department of Agriculture (USDA-NRCS).

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. Overall, the Crider Series is well suited to a variety of land uses. It has high natural fertility and will produce above average yields when properly managed. Pasture is common on the more sloping areas with some small areas remaining in woodland. As urban development increases, areas of Crider soils are often converted from agricultural or *silviculture* to highways or subdivisions.

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 Crider soil and identified that it has few limitations for most land use. The limitations that do exist are related to the increased clay amount in the lower subsoil that can decrease *permeability* in lower horizons and to the susceptibly to or history of past erosion in the surface horizons. Permeability issues are most often seen in urban land uses. These can be overcome by use of proper construction techniques. Conservation tillage and related agricultural and silviculture techniques are used to minimize erosion risks.

Management

The Crider soil has few management issues. Since it occurs in landscapes that do not accumulate water or have a high *water table*, it is considered to be well-drained.

Fig. 3. Agriculture field on Crider silt loam. Credit: USDA-NRCS.

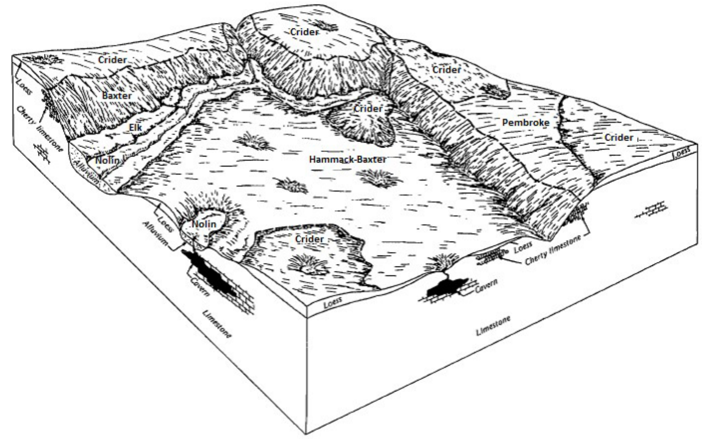

Fig. 4. Relationship of soils, landform position (relief) and parent material. Crider soils are located on the ridgetops and upper side slopes. (USDA-NRCS)

Crider 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 Crider 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 Crider (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 typical climate that the Crider Series has developed in is that of the warm, humid SE USA. This area has an average rainfall of 143 centimeters (57 inches), increasing to the south. Humidity is often high during the summer months. The mean annual temperature is approximately 57 degrees Fahrenheit, although summer temperatures can exceed 95 degrees with winter temperatures that often dip below freezing. The average growing season (last frost in the spring to first frost in the fall) is about 237 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. Prior to European settlement, this part of Kentucky was under a mixed hardwood forest consisting mostly of upland oaks and hickories with scattered grasslands and cane breaks.

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. Crider is well-drained because it formed on the convex ridgetops and upper convex side slopes of the landscape (**Figure 4**).

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 upper horizons of the Crider Series developed in wind-blown silt or loess from the last major glacial period and the lower horizons developed in clayey residuum weathered from *Ordovician* to *Mississippian*-age limestones and dolomites.

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. Although the limestone rocks of the Pennyroyal are 100's of millions of years old, the loess deposits over them are much younger, having been deposited about 15 to 25 thousand years ago. The Crider Series developed in both these materials, the surface layers and upper subsoil are much younger, having formed in the loess, than the lower subsoil that formed from weathered limestone.

Ecoregions, Soils and Land Use in Kentucky

Kentucky is divided into seven general *ecoregions* (The *Knobs* being a sub-region of the Outer Bluegrass) and nine general soil regions. The major differences in these regions is that the general soil regions separate out the flood plain and terrace soils along the major rivers and separate the Western Pennyroyal soils from the Eastern Pennyroyal (Mississippian Plateau) soils. Regardless of the regions – ecoregions versus soil regions – they represent similarities in formation and provide a more homogeneous framework for understanding the environments including hydrologic and related parameters. The river basins cut across different regions. The Crider Series is located almost exclusively in the Western Pennyroyal or Western Mississippian Plateau (ecoregion and soil region). **(Figure 5)**

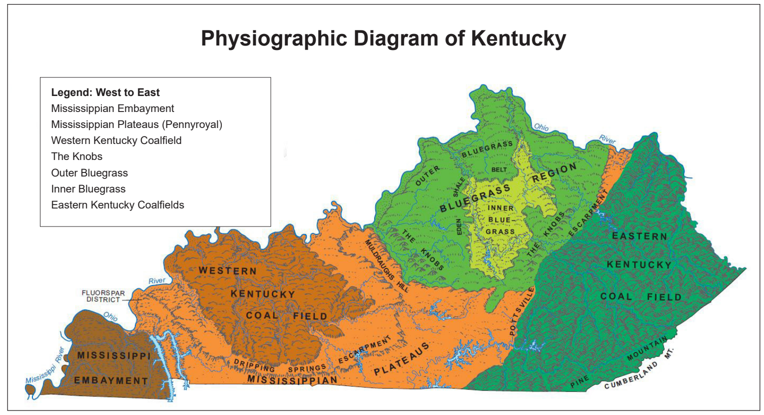

Fig. 5. Physiographic Regions of Kentucky (Source: Kentucky Geological Survey, University of Kentucky)

Glossary

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.

Dolomite: A sedimentary rock that is composed chiefly of calcium and magnesium carbonate in the form of the mineral dolomite.

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.

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.

Geomorphology: A branch of geology and geography that studies the development of landforms.

Horizon: see Soil horizons

Knob: A low, rounded hill rising above adjacent landforms.

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

Limestone: A sedimentary rock consisting chiefly of calcium carbonate, primarily in the form of calcite.

Loamy sand: Soil material that is a mixture of between 70-90% sand, up to 30% silt, and less than15% clay. It has more sand than sandy loam.

Loess – Fine grained material, dominantly of silt-sized particles, deposited by wind.

Mississippian: The fifth period of the Paleozoic Era of geologic time extending from the end of the Devonian Period (about 345 million years ago) to the beginning of the Pennsylvanian Period (about 310 million years ago).

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

Physiographic regions: Broad-scale subdivisions based on terrain texture, rock type, and geologic structure and history.

Ordovician: the second period of the Paleozoic Era of geologic time, extending from the end of the Cambrian Period (about 500 years ago) to the beginning of the Silurian Period (about 425 million years ago).

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

Residuum: Unconsolidated, weathered, or partly weathered mineral material that accumulates by disintegration of bedrock in place.

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: Soil material that contains 40 percent or more clay and 40 percent or more silt.

Silt loam: Soil material that contains 50 percent or more silt and 12 to 27 percent clay (or) 50 to 80 percent silt and less than 12 percent clay.

Silty clay loam: Soil material that contains 27 to 40 percent clay and less than 20 percent sand.

Silviculture: The science of controlling the establishment, growth, composition, health, and quality of forests and woodlands to meet the diverse needs and values of landowners and society such as wildlife habitat, timber, water resources, restoration, and recreation on a sustainable basis.

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

Sandy Loam: Soil material that contains between 43-85% sand, 0-50% silt and 0-20% clay. It has less sand than loamy sand.

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

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/

References

Natural Resources Conservation Service (Official Soil Series Descriptions). www.nrcs.usda.gov/wps/portal/nrcs/detailfull/soils/home/?cid=nrcs142p2_053587

Natural Resources Conservation Service (Published Soil Surveys by State). www.nrcs.usda.gov/wps/portal/nrcs/surveylist/soils/survey/state/?stateId=KY

Kentucky Geological Survey – University of Kentucky. www.uky.edu/KGS/

State Symbols USA. www.statesymbolsusa.org/symbol-official-item/kentucky/soils/crider-soil-series

U.S. Forest Service. www.fs.fed.us/forestmanagement/vegetation-management/silviculture/index.shtml

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