Harney
Kansas 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 "Harney" is the official state soil of Kansas. Let's explore how the Harney is important to Kansas.

History

The Harney Soil was adopted as the Official State Soil of Kansas on April 12, 1990, when Governor Mike Hayden signed Senate Bill 96, five years after the grassroots movement to name the Harney as the official soil began. The name "Harney" is derived from "harahey," a Wichita Indian term for the Pawnee people.

What is Harney Soil?

The region that Harney soil formed in has *loess* (wind-blown sediments, pronounced "luss") parent material, an upland landscape position, prairie grasses as native vegetation, and little annual rainfall (see ClORPT below). Harney soils are deep, well-drained soils. They are found on upland landscapes with up to 8% slope in some places, but 0-3% 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 Harney soil, the *topsoil* or A horizon (the layer of soil that we plow or plant seeds in) is a *silt loam*. The *subsoil* or B horizon has an increase in clay, and is a *silty clay loam* texture.

Where to dig a Harney

Yes, you can dig a soil. It is called a soil pit and it shows you the *soil profile* (Figure 1). The different horizontal layers of the soil are actually called *soil horizons*. Harney soils occur on about 1.6 million hectares (4 million acres) in west-central Kansas, highlighted in the map below (Figure 2). This does not mean that other types of soil are not found in that portion of the state, just that Harney 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.

Photo: Chip Clark/Smithsonian Institution

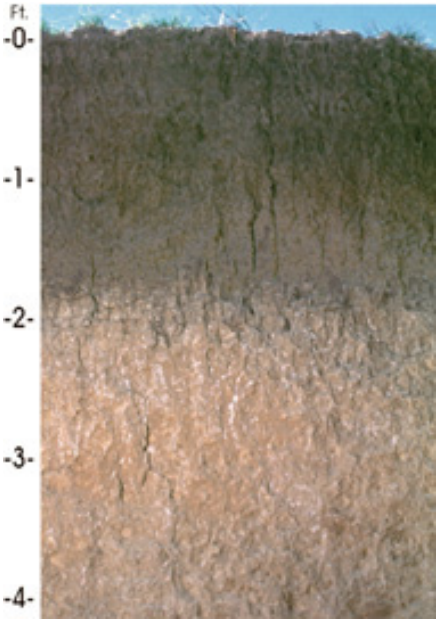

Fig. 1 Soil profile of a Harney Soil.
Credit: Smithsonian Institution's *Forces of Change*.

Fig. 2 Location of the Harney Soil series in West-Central Kansas. Credit: Smithsonian Institution's *Forces of Change*.

Fig. 3 A crop of sorghum located on the Harney soil. Credit: Meghan Sindelar

Kansas is one of the United States' leading agricultural states, and Harney soils have excellent properties, such as high natural fertility and high water storage capacity, for producing food and fiber crops so most are used for cultivation. Crops grown on Harney soils are very important to Kansas' multi-billion dollar agricultural industry. Wheat and sorghum **(Figure 3)** are the principal crops; however, alfalfa, corn, soybeans, sunflower, and canola are also grown.

In some instances, Harney soils are used for rangeland, with native vegetation consisting of mixed- and short-grass prairie for feeding cattle and bison herds. Some towns are settled on Harney soil. How would you feel if your house is built on the State Soil? Special, I think.

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 Harney soils for various uses. They have determined that there are few limitations to restrict the use of Harney for crop production. The major limitation is due to climate (the lack of natural precipitation.)

Harney soils have been determined to have limited usefulness for construction of buildings or roads because of the type of clay found in Harney may expand when wet and shrink while drying resulting in unstable and cracked foundations. Harney soils are also not ideal for onsite sewage treatment and dispersal fields because of the moderately slow rate at which water moves through them.

The Harney has no limitation for most recreational uses including development of parks, trails, and golfing facilities.

Soil Management

Management concerns in Kansas focus on reducing wind and water erosion, 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.

Kansas was one of the states most severely affected by the 1930's dust bowl **(Figure 4)**. While efforts to reduce wind erosion have been successful, the potential for soil loss remains, especially on soils with silty or fine sandy textures in dry areas of the state.

As Harney soils were developed under prairie grasslands, they tend to have a deep topsoil layer with high fertility. Fertilizer can be added to increase yields and maintain fertility.

Irrigation and fallow (not growing a crop for a period of time) can be used to reduce *moisture deficit* problems. Wind breaks can slow erosive winds and reduce the amount of the field exposed to wind erosion. Retaining ground cover, particularly after crop harvest **(Figure 5)** is an important management tool to increase moisture in fields (by reducing evaporation and by trapping snow) and decrease erosion by water.

Fig. 4 Wind erosion during the Dust Bowl which took place in the 1930s. Credit: Kansas Department of Agriculture

Harney 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 Harney series. These are **Cl**imate, **O**rganisms, **R**elief (topography), **P**arent material and **T**ime – ClORPT, for short. ClORPT is responsible for the development of *soil profiles* and chemical properties that differentiate soils. So, the characteristics of Harney 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. Harney soils formed in areas with low annual rainfall, resulting in less horizon development than wetter regions and therefore are considered young soils. Harney soils often have more calcium carbonate and other salts than would a soil which received more rain to wash these away. Light colors can indicate the presence of *carbonates*.

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* **(Figure 6)**. 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. Harney soils formed under prairie grasses, which led to being high in organic matter (fertile) and excellent for crop production. Darker soil colors indicate greater organic matter content.

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. Harney soils formed on relatively flat upland landscapes. Soils on flat surfaces are more stable and more developed than those found on slopes.

Fig. 5 Corn residue on this filed provides ground cover against soil erosion from both wind and water. Credit: Wale Adewunmi.

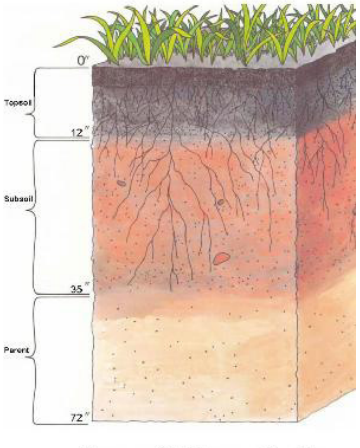

Fig. 6 Harney silt loam profile. Credit: Kansas NRCS

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). Harney soils formed in *loess* (pronounced "luss"), which is fine grained material (typically the size of *silt*) that has been deposited by blowing wind.

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.

More time is required for the formation of a well-defined *soil profile* in fine textured material than in a coarse-textured soil material. The well-developed horizons of a harney indicate that it formedover a long period of time.

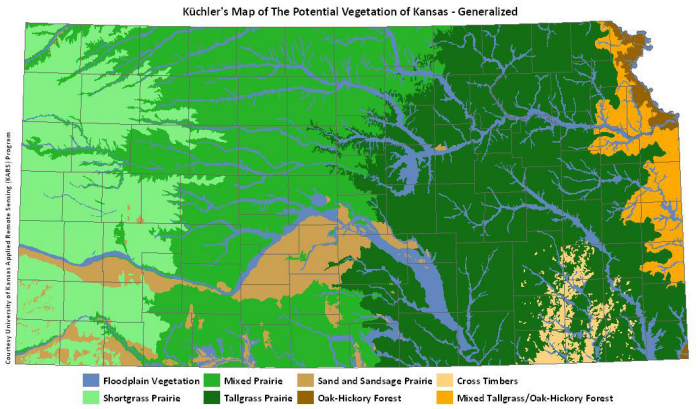

Fig. 8 The influence of moisture on vegetation across the state. Credit: Kansas Applied Remote Sensing (KARS)

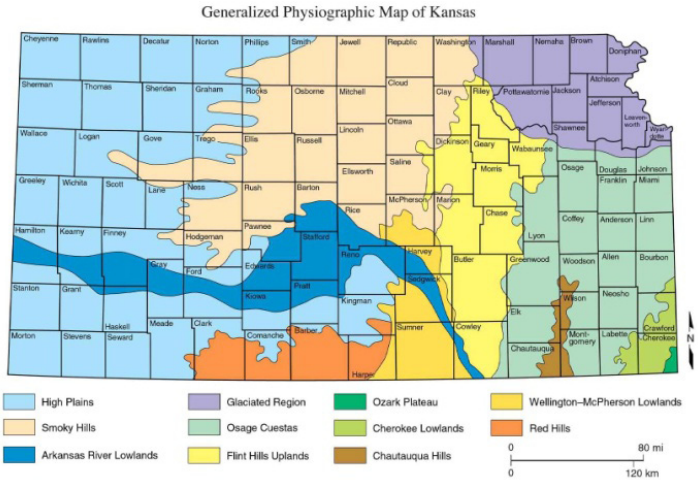

Fig. 9 Physical geography of Kansas. Credit: Kansas Geological Survey.

Ecoregions and Land Use in Kansas

The soils and associated land use in Kansas are strongly influenced by moisture patterns. The state of Kansas experiences great variation in moisture with an average annual precipitation of <381 mm (<15 inches) in the southwest and >1143 mm (>45 inches) in the southeast. This gives rise to the vertical stripes visible in most vegetation and land use maps of Kansas **(Figure 8)**.

Increased moisture in the east has allowed for deeper rooting vegetation and greater soil development. The drier soils of the west support short grass prairie or crop rotations that include fallow. These western soils also commonly have basic pHs due to *carbonates* that haven't washed below root zones.

The physical geography, or landscape features, also influences the ecoregions of Kansas **(Figure 9).** Noteworthy landscape features include the glaciated region of northeast Kansas where mixed to coarse soils are present as well as occasional large rocks, and the flint hills region where depth to bedrock is quite shallow. The shallow depth to bedrock prohibited use of plows and this region is now home to some of the largest areas of native tall- and mixed-grass prairie in the United States.

With its varying precipitation and geology, Kansas has 8 ecoregions **(Figure 10).** Harney soil is found in the ecoregion known as the Central Great Plains.

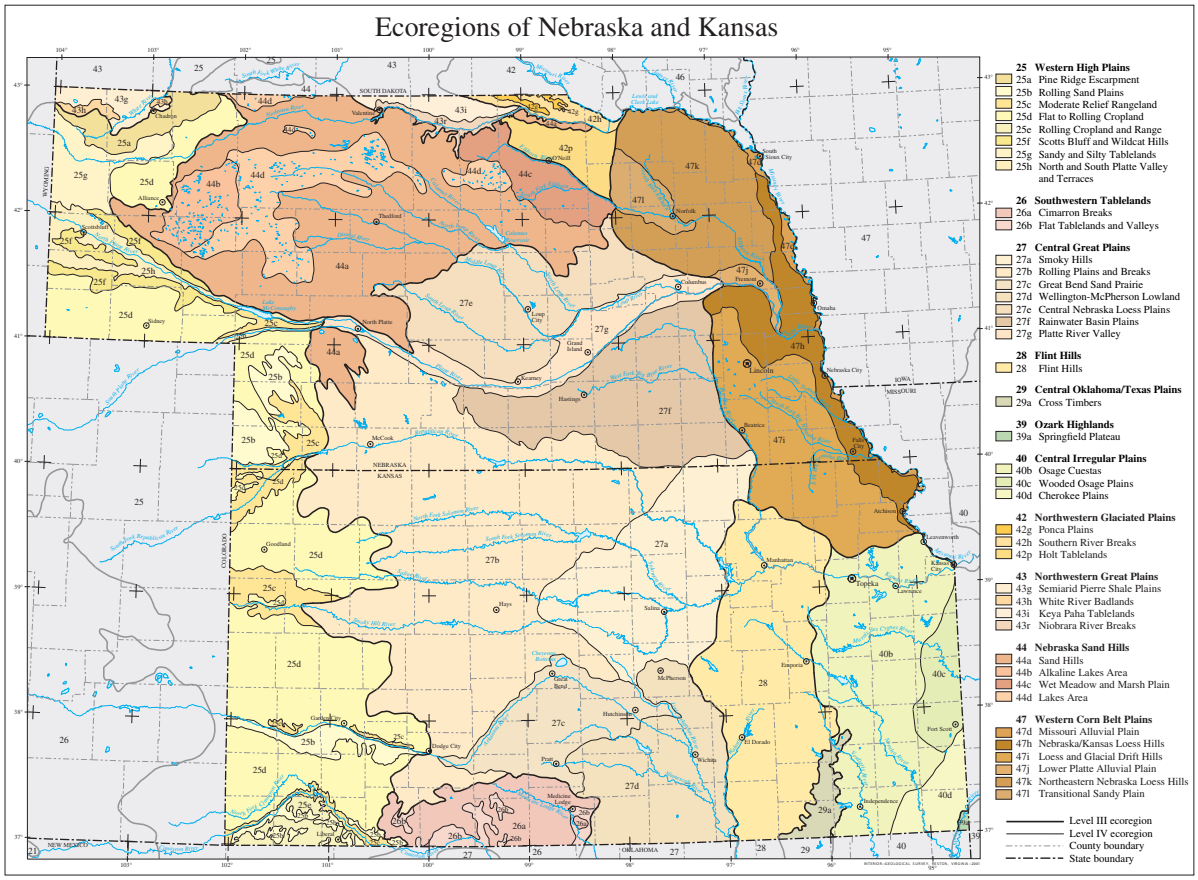

Fig. 10 Ecological regions of Kansas. Credit: http://www.epa.gov/wed/pages/ecoregions/ksne_eco.htm

Glossary

Carbonate: An accumulation of calcium carbonate (CaCO3) in the soil.

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.

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

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

Moisture deficit: The amount of water that is needed to bring soil to field capacity or to the amount of water the soil can hold against gravity.

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 eluviated, or 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.

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Additional Resources

Lindbo, D. et al. 2008. *Soil! Get the Inside Scoop*. Soil Science Society of America, Madison, WI.
Lindbo, D. L., D. A. Kozlowski, and C. Robinson (ed.) 2012. *Know Soil, Know Life*. Soil Science Society of America, Madison, WI.

Web Resources

SOIL SCIENCE LINKS:
Soil Science Society of America—http://www.soils.org/

Soils4Teachers—http://www.soils4teachers.org/

Soils4Kids—http://www.soils4kids.org/

Smithsonian Soils Exhibit—http://forces.si.edu/soils/

NRCS LINKS:
Kansas NRCS—http://www.ks.nrcs.usda.gov/
K-6 Activities—http://www.ks.nrcs.usda.gov/news/soil_does_more/index.html
Web Soil Survey—http://websoilsurvey.nrcs.usda.gov/

KANSAS LINKS:
Kansas State University Extension—http://www.ksre.k-state.edu/

Kansas Department of Agriculture—http://agriculture.ks.gov/

Conservation Educational Resources—http://agriculture.ks.gov/divisions-programs/division-of-conservation/conservation-education-resources

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