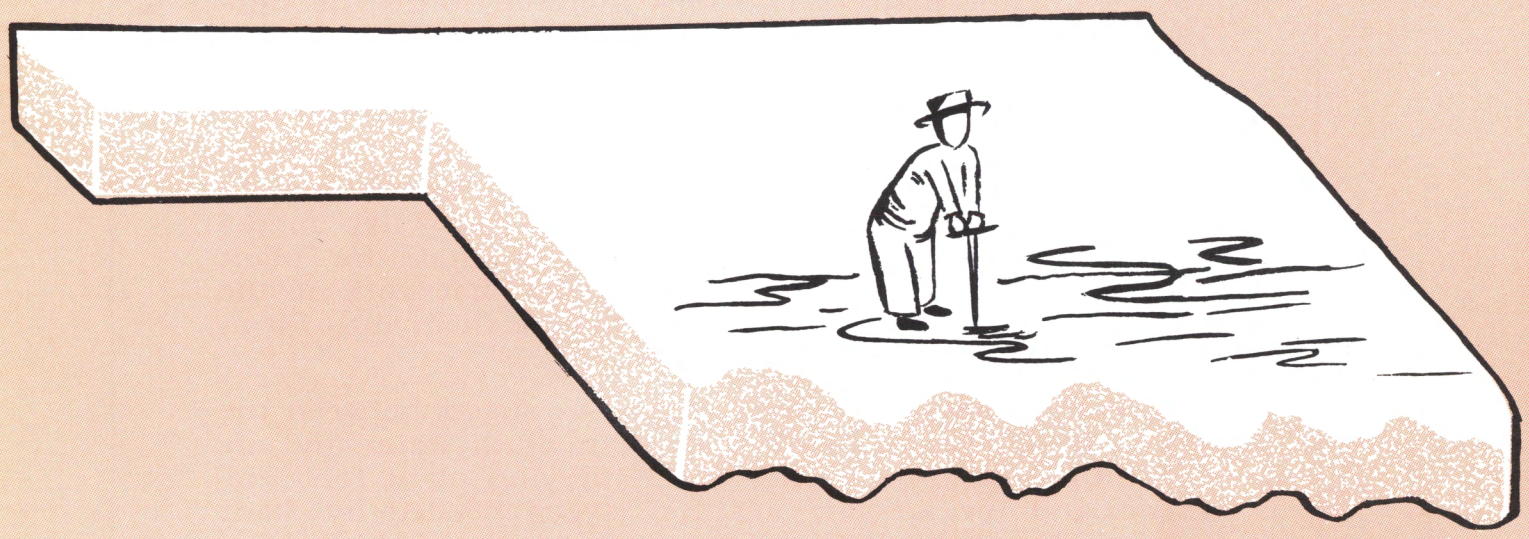
Circular E-509

KNOW YOUR SOIL



Oklahoma's Basic Resource

OKLAHOMA STATE UNIVERSITY EXTENSION

Your Soil Is More Than "Just Dirt"

Soil is the upper few feet of the earth's crust. It is composed of residue of weathered rocks, minerals and decaying organic matter. The rock material forms the bulk of the soil. As plants and animals live and die, they return to the earth, thus becoming a part of the soil. Nature requires hundreds of years to produce an inch of top soil.

Soil also contains organic matter, air and water. Organic matter in the soil is derived from the residues of plants, small animals and insects. Soil bacteria live on the organic matter and release the necessary food for plant growth. The organic matter creates acids that work on the mineral elements in the soil and change them into forms that the growing plants can use.

Water and air are held within the spaces between the grains of soil and around each grain. Both water and air move through the soil, the water carrying plant food elements and the air carrying the oxygen needed by plant roots and useful bacteria. Therefore it is desirable to have a soil that will take air and water freely.

Know Your Soil

Edd Roberts

Extension Soil Conservationist

Soil is a basic resource. Land has always been, and always will be, a most important item in our individual and national security.

Soils differ in their respective ability. Fields and farms vary in value and in the uses to which they can be put, due to the varying productivity of the soil. Therefore the person responsible for any piece of land needs to know land characteristics and be able to recognize them. This applies to the investor and the home gardner, as well as to those who manage farms. Knowledge of soil characteristics is necessary for determining the value of a piece of land, and for selecting the type of crops to grow, the conservation measures needed, and the proper use of the land.

Different soils can be described in somewhat the same way we describe different types and classes of livestock. We speak of a fat hog, a canner cow, a feeder steer, and use many other terms in describing animals in the livestock industry. Soil also has different characteristics. They mean just as much to a farmer or rancher in production of crops, grasses or fruits as the different kinds of livestock or dairy cattle mean to him.

Once we have learned the proper terms for describing soil characteristics, it is as easy to describe land as it is for one rancher to describe a beef animal, such as a canner cow, to another rancher.

First, we must know several things about our soils. From this knowledge we can learn how suitable they are for different uses. Soil differs according to its various characteristics, such as color, texture, structure, workability, depth and nature of slopes. Soil bodies with certain sets of these characters are known as soil types. While there may be 50 or more types in a single county and 5 to 10 on a single farm, they can be recognized by trained people. You can train yourself to see the more important characters of them.

Groups of similar soil types will be suited for the same conservation farming uses. We can arrange those groups into a land capability classification. In this bulletin we will first define the soil characteristics, then describe this capability classification.

Acknowledgement

Grateful acknowledgement is made for ideas and material contributed to this circular by various individuals in the U. S. Soil Conservation Service and in the Extension Service and Agricultural Experiment Station of the Oklahoma State University.

Soil Characteristics

PARENT MATERIAL

Parent material is the substance from which soils develop, such as sandstone, shale, limestone, gypsum, or granite. The type of soil reflects its parent material, just as a Hereford calf reflects its sire and dam. Thus sandy soil is generally developed from sandstone or other course materials. Red land is developed from red sandstone, red shale or red clay. Black lands are developed from limy clays and limestone.

Sometimes only one type of parent material is found on a farm. However, there may be a combination of parent materials on one locality. Some soils develop along stream valleys in material washed from surrounding uplands. Sometimes this material was deposited into places through wind action and therefore lies high above the present stream bottoms.

Top Soil

The top soil is the crust of the earth found on the surface. The depth varies from a few inches to several feet. Generally speaking, the average top soils in Oklahoma are approximately 4 to 9 inches in depth.

The top soil contains most of the organic matter and available mineral supply. Due to the higher organic matter content, the top soil has a richer and darker color.

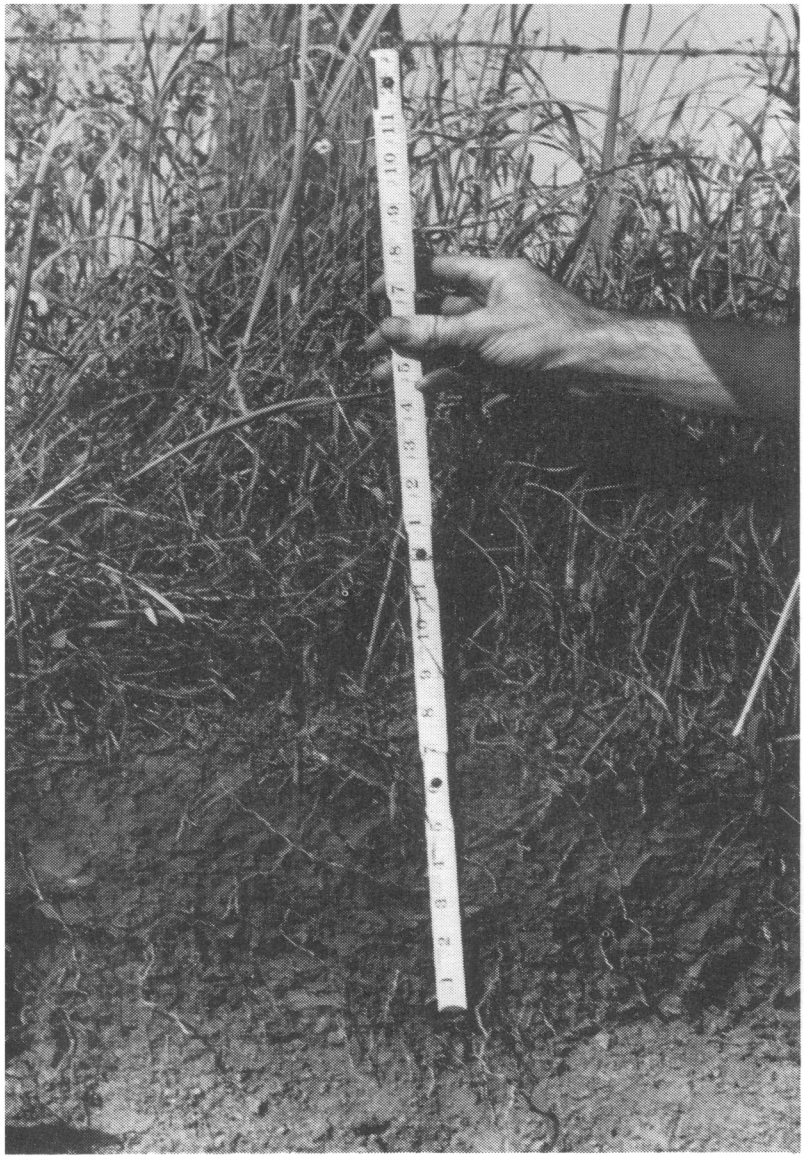
The top soil is the zone in which most of the feeding by the plant roots take place. A deep top soil provides capacity for water and minerals and in addition, space for plant root development.

Subsoil

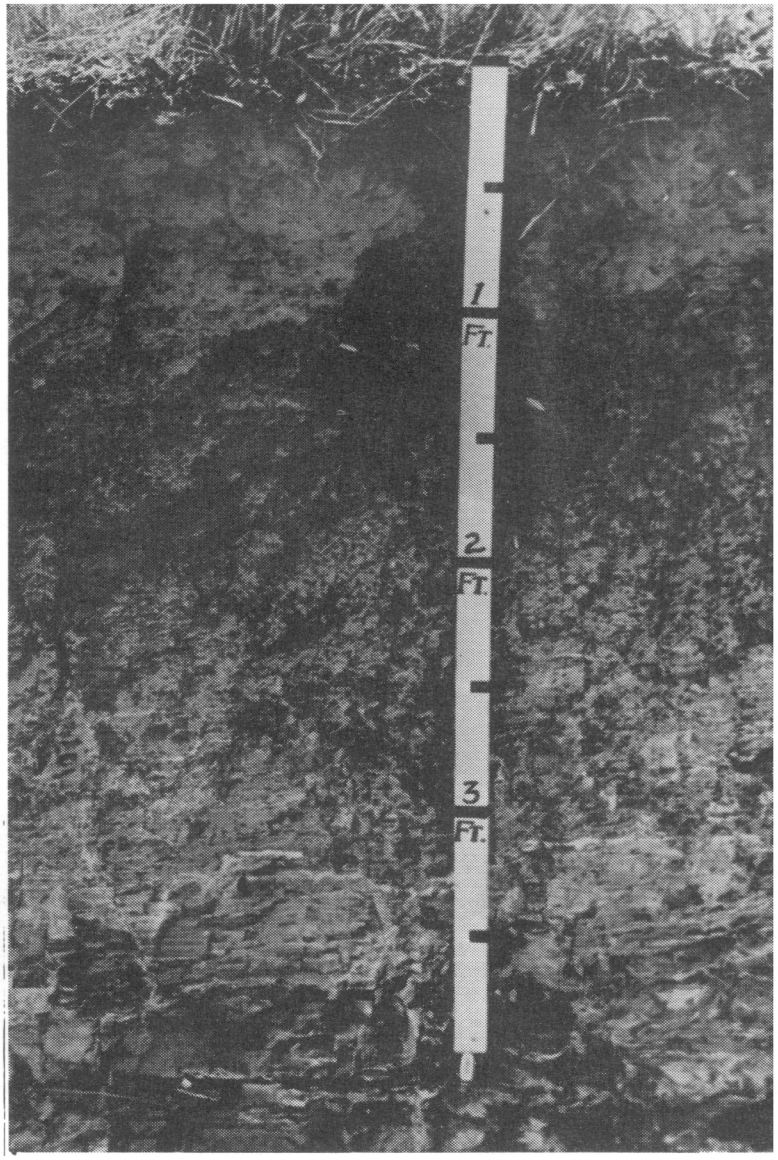
The subsoil lies beneath the top soil. It is the storage place for potential plant food such as phosphorus, calcium, potassium, and other elements. Some of the minerals which contain these elements also occur here. Subsoil is also a reservoir for soil moisture and root development. The depth of subsoil varies from nothing to several feet. The subsoil lacks the organic matter found in the top soil. It fails to have that "lively," rich color. It contains little humus and is usually low in available plant food. When the top soil has eroded, all that remains is subsoil which is a poor medium for plant growth.

Depth of Soil

The depth of soil means the total of both the surface soil and the subsoil. The depth of usable soil is determined by the depth of soil layers readily penetrated by plant roots or by some particular layer, such as dense clay, subsoil or rock that would restrict root penetration. In



The upper crust of the earth is the top soil. It usually has a "richer" color. This is the area from which the plant's roots take in a large amount of moisture and plant food. In this photograph the darker portion is the 7 inches of top soil. The subsoil lies underneath the top soil.



This is a soil profile. The first foot is surface soil or top soil. The second and third feet are the subsoil. From the third foot down is parent material which is sandstone and shale.

general, depth of soil means the total of the present surface soil and subsoil down to parent materials.

The depth of a soil may be compared to the depth of a body of a beef animal. In selecting a beef animal, the depth of body is considered because it is a factor in producing more beef. Depth of soil might also be compared with the barrel of a milk cow. Dairymen select dairy cows

with a large barrel in order that they will have an enormous capacity for food and water. This makes it possible for the animal to manufacture a larger amount of milk.

Fields or areas which have a deep soil have a capacity for more plant food, a larger area for root penetration and development, and more capacity for moisture.

The four important variations of soil depth are:

Deep—Deep soils have surface and subsoil layers more than 36 inches deep that can be readily penetrated by plant roots. They are sufficiently deep to provide good moisture and mineral storage during normal seasons.

Moderately Deep — Moderately deep soils are 20 to 36 inches deep. They have less storage capacity for moisture and tend to be more droughty than deep soils.

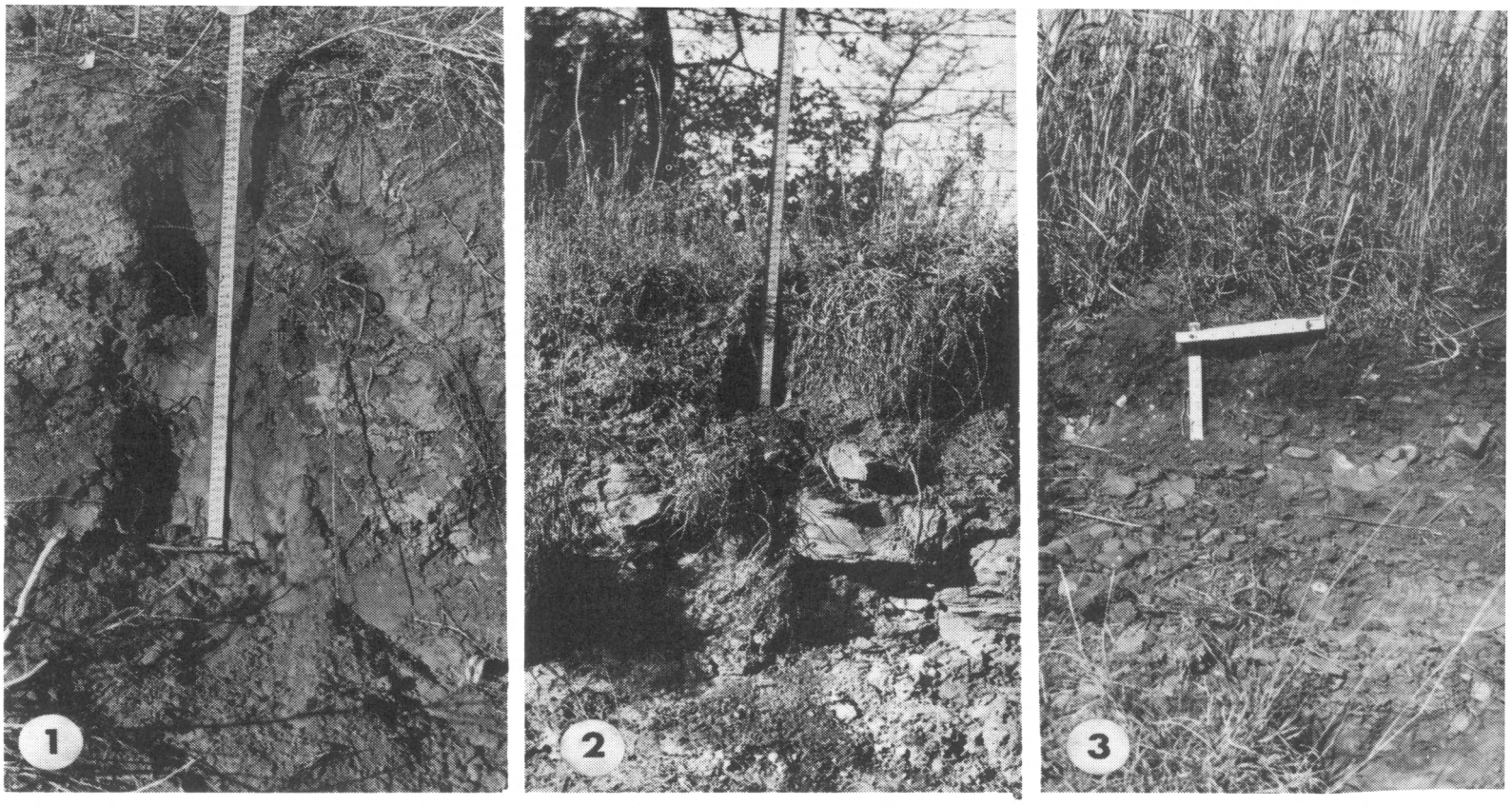
Shallow—Shallow soils have surface and subsoils less than 20 inches deep, but more than 10 inches deep. They have small storage space for moisture and minerals and are sure to be more droughty and of lower productivity than the deeper soils.

Very Shallow—Very shallow soils have less than 10 inches of soil over rock or dense, heavy clays. They are not suited for cultivated crops.

Knowing the depth of soils helps a farmer in selecting the type of crops adapted to the proper land use. For example, if a certain field has a very shallow soil, then it is not practical to plant alfalfa or other deep-rooted crops on that land. It would be wise to use this land for pasture grasses, or some clovers. If the subsoil is easy to penetrate, as are gravel beds and deeper sands, soils too droughty for crops may be useful for deep-rooted trees.

SLOPE

Slope is another factor to be given consideration in selecting land for cultivation. Every farmer who has sloping fields has a problem of erosion, because the water runs down the slope. The longer the slope and the greater the speed of water runoff, the more erosion will occur. Hard, beating rains that fall in a short length of time bring about serious erosion. For example, when the speed of water is doubled as it runs down a slope, the cutting capacity is tripled. Nearly level land is not affected as seriously by water erosion as steep land. On sloping land it is necessary to apply a mechanical or vegetative conservation practice which will resist the water runoff.



Some soils were naturally shallow, while others were deep. These views show virgin soils of different depths.

1. This is a deep soil. It was photographed along a creek bottom. This has a total depth of better than five feet of top soil and subsoil combined. 2. shallow soil. The total of both the top soil and the subsoil is between 10 and 20 inches to the parent material which is sandstone in this particular case. 3. Very shallow soil. The total of the top soil and the subsoil is 10 inches or less down to the parent material, which is rock. The carpenters rule indicates that the top soil is approximately six inches in depth. This is a profile of virgin grass land.

The slope of land is considered as the number of feet of fall in each 100 feet. There are six different degrees of slope which are considered with regard to land. They are as follows:

Nearly Level—Less than one foot fall in each 100 feet.
Steep—Eight to 12 feet fall in each 100 feet.
Gently Sloping—One to three feet fall in each 100 feet.

Moderately Sloping—Three to five feet in each 100 feet.

Strongly Sloping—Five to eight feet fall in each 100 feet.

Very Steep—More than 12 feet fall in each 100 feet.

EROSION

Erosion is the loss of soil by water and wind. The way to determine erosion is to observe an area of soil under virgin conditions next to a cultivated field. Comparing the two soils will give an idea of the amount of soil removed by erosion.

Water Erosion

The following are definitions of water erosion terms:

None—No sign of soil removal.

Slight—Less than 25 percent of surface soil removed with no gullies.

Moderate—25 to 75 percent of surface soil removed with or without gullies, but not including uncrossable gullies.

Severe—75 percent or more of surface soil removed with occasional uncrossable gullies.

Very Severe—75 percent or more of surface soil removed with frequent uncrossable gullies.

Sloping fields which have been in cultivation a long time usually shows signs of water erosion. This will be noticed in the form of gullies. Some fields erode but gullies are not formed. Where gullies are not formed on sloping fields, the erosion is usually termed "sheet erosion." This means the loss of a thin layer of soil all over a field. Sheet erosion may be explained by comparison with a notebook. Suppose you tear out two or three sheets of a notebook. It is hardly noticeable because of the thinness of each sheet. But if several dozen sheets are withdrawn from the notebook, then it will be noticeable and the thickness of the notebook will be noticeably reduced. Each hard rain on a sloping, bare field brings about a loss of soil by erosion. It may be only a thin layer. During a long period of cultivation, many inches of top soil may be lost.

Left—Slope is a factor in water erosion. Notice how the rain has washed away the top soil and left little rills on the surface of the soil. Right—This view from an airplane shows a field ruined by water erosion. The many gullies seem to produce a "bleeding effect" upon the land. The soil has been seriously depleted due to the steepness of the land which was in cultivation.

Wind Erosion

The signs of wind erosion are different from those of water erosion. Sandy fields are easily disturbed by winds. The wind moves the soil particles and often sand drifts are observed along fence rows.

Wind erosion may be described by the following terms:

None—No signs of soil removal or accumulation by wind erosion.

Slight—Less than 6 inches of accumulation, either on the level or in hummocks; or removal of less than 25 percent of top soil.

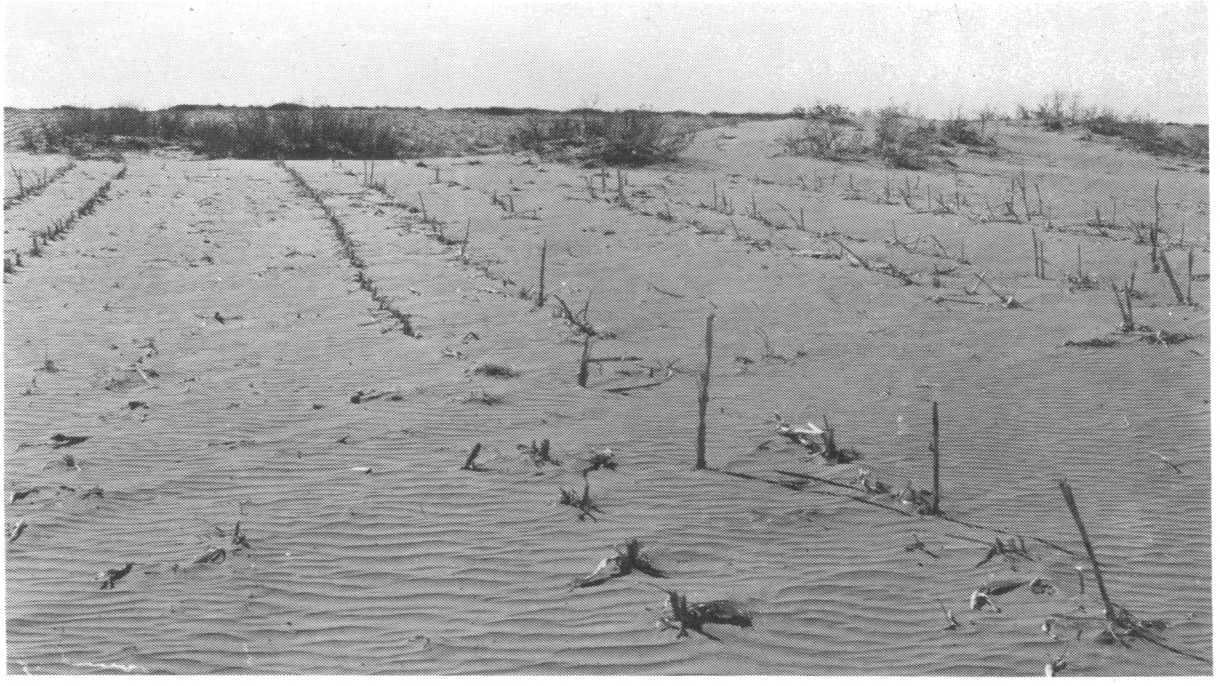
Moderate—Accumulation on the level of 6 to 36 inches; or removal of 25 to 75 percent of top soil.

Severe—Accumulation of small dunes, 36 to 72 inches in height; or removal of all of the top soil and 25 percent of the subsoil.

Very Severe—Accumulation of large sand dunes 72 inches or more in height; or the removal of all of the top soil and 25 to 75 percent or more of the subsoil.

Land which is bare of vegetation is very susceptible to wind erosion. Nature checks wind erosion by the growth of vegetation.

Generally, there are two methods of checking wind erosion. One is by using vegetation to cover the land and to offer resistance to the force of wind. Pasture grasses offer permanent control. Strips of sor-



Soil of sandy texture is especially subject to wind erosion.

ghum planted across prevailing winds between strips of clean-tilled crops may control blowing from one season to another. The other method involves tillage and stirring the land by plowing or making furrows crosswise to the direction of the wind. This is only an emergency measure which offers temporary control.

SOIL STRUCTURE

The structure of a soil is important because it implies the natural arrangement of soil particles. Soil may be in single grains, or several grains may stick together into groups called granules, like granulated sugar. Granular soil is "mellow" and has good "tilth." The grains are grouped together in granules principally by humus.

A granular soil takes in water faster, holds more of it, and contains more organic matter than a single-grained soil. It also farms easier. We should farm so as to maintain the granular structure of the soil. This can be done by continually adding organic matter to the land. Growing legumes and leaving as much residue as possible from any crop grown are the most practical ways to add organic matter.

The soil structure should be especially considered before irrigation systems are established.

SOIL TEXTURE

The texture of a soil is determined by the percentage of sand, silt and clays that make up the soil. These three types of soil particles can be identified by the sense of touch, by ribboning a piece of moist soil between your fingers.

Sand is the gritty material which is felt.

Silt is the floury material.

Clay is the sticky material.

A combination of sand, silt and clay is called loam.

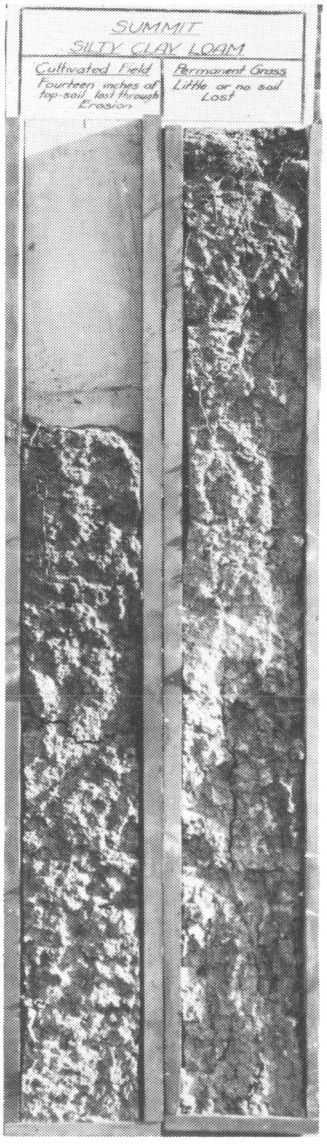
The various combinations of sand, silt and clay are usually described as follows:

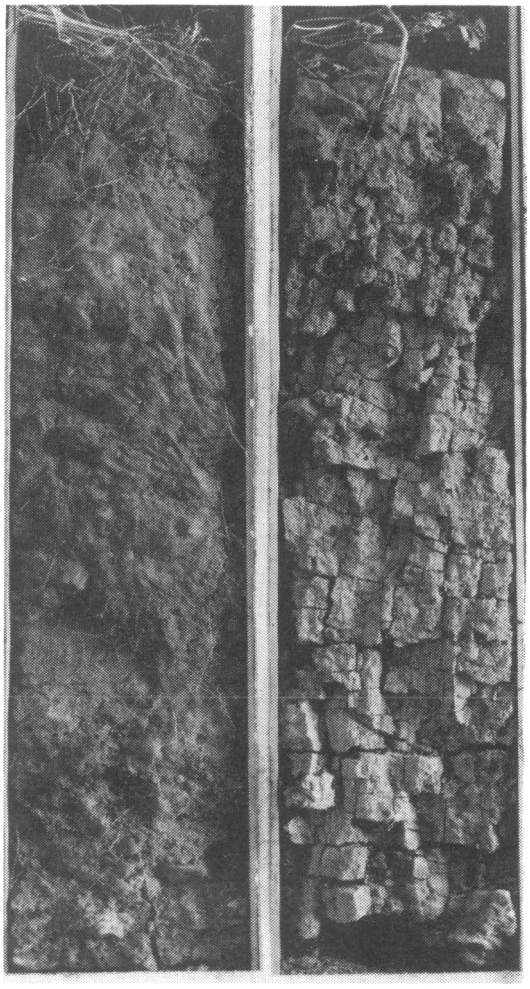
Fine texture—There are the clay soils.

Medium texture—These are the silty or loamy soils.

Coarse texture—These are the very sandy soils.

The soil takes most of its characters of workability from the structure and texture of the topsoils.





Left—Here are two soil profiles taken from adjoining fields, one under cultivation and one is permanent grass. The one on the left has lost 14 inches of top soil due to sheet erosion. It has been cultivated with the slope. The profile on the right has remained in permanent grass. There is little or no soil erosion.

Right—Here are two soil profiles. The one on the left is virgin soil which was shielded with thousands of vegetative and grass roots. It contains a lot of organic matter. Compare this with the profile on the right which has been cultivated. It contains less organic matter. There are fewer roots of the native grass found in this profile.

Clay soils will hold more water than sandy soils. This is because the particles are smaller. In clay soils there is a larger surface area to absorb the water because it has a larger number of small particles than the sandy soil. This can be illustrated by comparing two gallon buckets, one filled with golf balls to represent sand and the other with buckshot to represent clay.

There is more surface space on the buckshot than on the golf balls; and, since the water in soil is held on the surface of the soil particles, the smaller particles will hold more water.

A study of the texture of soil is important because of its relationship to the rate of water absorption. For example, many sandy fields (coarse textured soils) will wet down one foot from one inch of rain while a clay top soil (fine textured soil) may only wet down four to six inches from one inch of rain. An inch of rain will wet the sandy land down deeper than it will a clay soil. There is less possibility for rapid evaporation at this depth and the sand does not dry as quickly during the hot summer days. Hot, dry weather will cause the clay soil to lose its moisture content and form cracks whereas the sand does not crack. The loamy soil (medium texture) is a mixture of both clay and sand and therefore is not an extreme in either direction, with regard to moisture absorption. Loamy soil is the choice texture of soil. It has neither too much sand nor too much clay, but is an ideal combination for moisture conditions and tillage operations.

PERMEABILITY OF SUBSOIL

Permeability is the ability of soil to take in water and air and to give up water and air to plant roots.

The following terms are used to describe subsoils according to their permeability:

Very Slowly Permeable—Soils with dense, heavy clay or clay-pan subsoils.

Slowly Permeable—Soils with crumbly clay subsoils.

Moderately Permeable—Soils with highly granular, clay-loam subsoils.

Rapidly Permeable—Soils with sandy subsoils.

The permeability of a subsoil has a great deal to do with water penetration and consequently with crop production. A droughty soil may be one with a very slowly permeable subsoil which only becomes filled with moisture under ideal conditions. Such soils dry out and crack badly during droughts. The tight subsoils may also hinder plant root development. At the opposite extreme rapidly permeable subsoil allows rainfall and fertilizer to pass through the soil too quickly.

The permeability of a subsoil can be estimated by examining it in a pit or hole. If the structure is of closely spaced blocks with few holes or channels the chances are that the layer will take water only very slowly. Often the texture is a clay which can be very shiny or may have dark shiny organic coatings. Where the structure is of more rounded shapes and the mass is crumbly, permeability may be better, even though the clay content is still high. Larger space occurs between these rounded soil bodies and allows air and water to move more freely. These form slowly permeable subsoils. When subsoils are moderately permeable, they have a granular structure and many pores, and have a sense of feeling like crumbled cornbread. Rapidly permeable subsoils are composed of sand or gravel.

The information just mentioned can be used from a practical standpoint in recognizing good land of high productivity. Land which has moderately permeable subsoil is valuable. This is the type of soil which is ideal for irrigation purposes due to its water absorption qualities. Slowly and very slowly permeable subsoils are choice for use in an earthen dam for the construction of ponds and lakes.

A slowly permeable subsoil may be a beneficial factor even in an irrigation soil if a thick well-structured surface soil occurs above it.

SOIL DRAINAGE

There are two kinds of drainage, surface and internal. Surface drainage has reference to the drainage from the top soil. Land having some slope will have adequate surface drainage.

Internal drainage has reference to the drainage of the soil underneath the surface and depends on the subsoil as described previously.

The color of subsoil in many cases is some help in determining the internal drainage conditions. Generally, reddish and brownish subsoils without much mottling have adequate drainage. Gray soils with mottled subsoils are often wet for short periods. Gray soils which are mottled with yellows and browns close to the surface probably are wet a considerable part of each year. Look at your soil colors. They will indicate its drainage.

Land Capability Classes

The land capability classes indicate two things about soil. First, the land is classified with regard to its productive capacity. Second, the amount of conservation treatment needed on the land to check erosion, is determined. These two factors, when combined, give a good indication of capability of soil and the farming practices which should be applied—that is, how the land should be used.

Misuse of land costs money. It makes the soil susceptible to erosion by water or wind. The loss is immediate and permanent, although sometimes so gradual that it is scarcely noticed. If the misuse is failure to grow crops on land suitable for cultivation, the farmer, at least, obtains less than the maximum return for his labor, seed and fertilizer. Such waste can be prevented by farming according to land capability, using practices that have been tested and proved by practical farmers and by agricultural experiment stations.

Land capability classifications are based primarily on type of soil, degree of slope, and degree of erosion, but with consideration also given to the amount of rainfall, the growing season, and general climatic conditions.

Land is divided as to capability into eight classes. Classes I through IV are considered suitable for cultivation, grazing or forestry when properly managed. Classes V through VII are not suited for cultivation, but when properly managed can be used for grazing or forestry. Class VIII land is suited only for wildlife, recreation, or watershed protection uses.

Following are brief descriptions of each capability class and of the chief conservation practices needed on each.

LAND SUITABLE FOR CULTIVATION

Class I Land—Flat, uneroded, and productive; highly suitable for cultivation.

Class I land.

Description: Suitable for cultivation over a long period of time. Well drained, deep productive bottomlands and uplands — soils which are nearly level; and not subject to more than slight erosion regardless of treatment; free from overflows that interfere with planting, growing, or harvesting of crops.

Practices Needed: Planting legumes, conserving all crop residues and use of fertilizers and lime where needed.

Class II Land—On the left, Class II bottomland which needs surface drainage. On the right, Class II upland. Both areas are fairly flat and only slightly eroded. They are productive, and suitable for cultivation with moderate conservation measures.

Class II land

Description: Suitable for cultivation over a long period of time; but having some hazards and limitations such as gentle slopes or slight erosion, or being moderately wet.

Practices Needed: Some of the practices which may be needed to overcome the hazards and limitations of this type of land are rotations including legumes, surface drainage, contour sloping lands, diversion of overhead water, applying fertilizers and lime where needed and carefully conserving all crop residues.

Class III land

Description: Moderately good land which can be used safely for cultivated crops, but having severe limitations in use.

Practices Needed: Treatments which may be needed include terracing and contouring, strip cropping and residue management. It also needs intensive crop rotations, including legumes, diversion of overhead water, application of fertilizers and lime where needed. If the land is permanently wet, it will need drainage for crop production.

Class III Land—It is usually sloping or moderately eroded, fairly productive land and is suitable for cultivation and intensive practices.

LAND SUITABLE FOR OCCASIONAL CULTIVATION

Class IV land

Description: Fairly good land, but having severe limitations and restrictions in use. As a rule, it is best for pasture or hay.

Practices Needed: This land should not be cultivated more than one year in a five-year rotation. When cultivated, it should be sown to a close grown crop. If not utilized for permanent vegetation it will require practices such as terracing, contour farming, conserving all organic residues, and application of fertilizer and lime where needed.

Class IV Land—It is usually steep, is sometimes shallow and may be moderately eroded. This is moderately productive land, suitable for occasional cultivation with intensive conservation treatment.

LAND SUITABLE ONLY FOR PERMANENT VEGETATION

NOT SUITABLE FOR CULTIVATION

Class V land

Description: Suitable for permanent vegetation and only slightly susceptible to deterioration, thus requiring no special practices or restrictions in use. This includes frequently flooded, poorly drained, or level stony land.

LEFT:

Class V Land—It is flat, overflow, poorly drained or stony land and is suitable for productive pasture meadow or woodland without special conservation treatment.

RIGHT:

Class VI Land—It is sloping eroded land generally unsuitable for cultivation, but can be used for pasture and range. It is practical to apply pasture or range improvement if needed.

Class VI land

Description: Generally unsuited to cultivation but having severe limitations and used for pasture or range, woodland or wildlife food and cover.

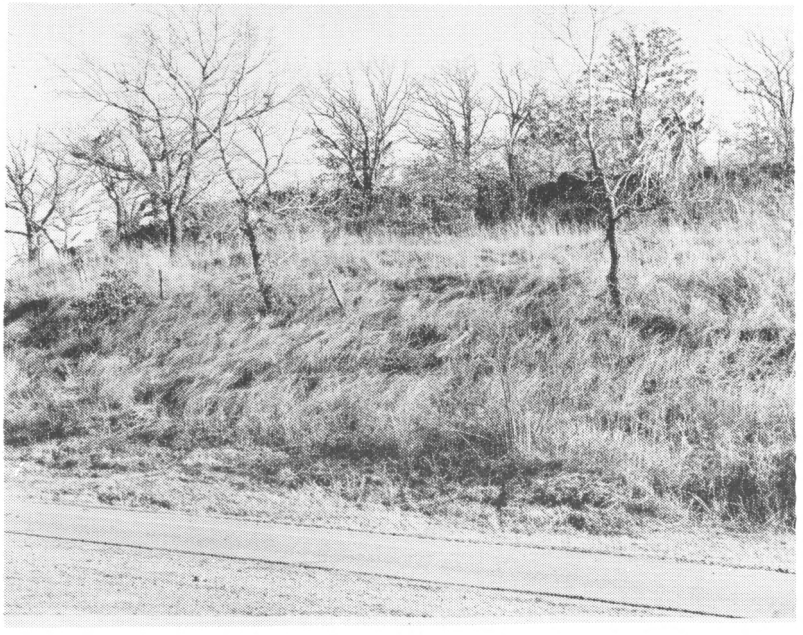
Practices Needed: Physical conditions of soils placed in Class VI are such that it is practical to apply range or pasture improvements, if needed; such as, seeding, liming, fertilizing and water control practices.

Class VII land

Description: Unsuited to cultivation with very severe limitations that restrict their use largely to grazing, woodland, or wildlife.

Practices Needed: Physical conditions are such that it is impractical to apply such pasture or range improvement as seeding, liming, fertilization and water control practices.

Class VII Land — It is steep, eroded, rough or very shallow land.

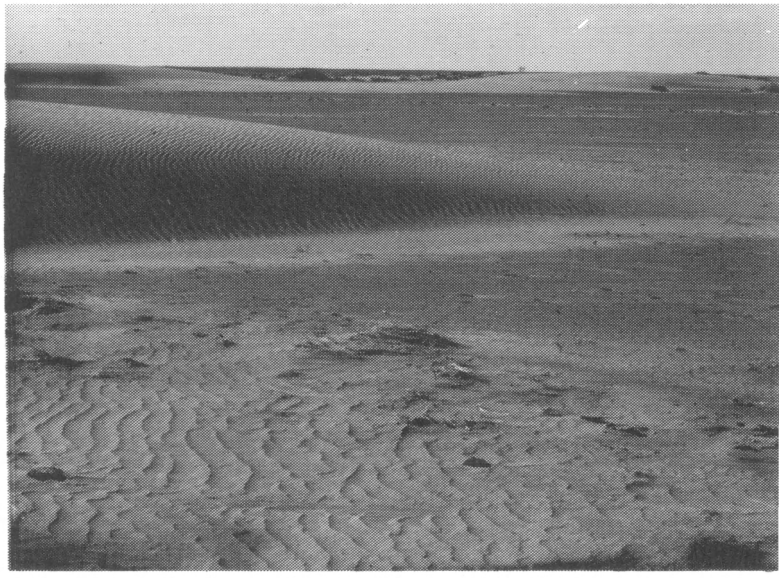


LAND NOT SUITABLE FOR CULTIVATION, GRAZING, OR WOODLAND

Class VIII land

Description: This is land that is not suitable for cultivation and not suitable for useful permanent vegetation or woodland. It is land of little or no economic value except for wildlife and watershed protection purposes.

Practices Needed: Protection from fire and restriction from grazing.



Class VIII Land. Two types are illustrated here. This class also includes steep, rough, barren or broken areas, and land that is permanently swampy. It has no agricultural use, other than for wildlife.

Your Information—

Oklahoma State University's Cooperative Extension Service is making this publication available. Facts contained herein are based on research, and at the time of printing are the latest available at OSU.

Similar publications are available on a wide variety of subjects in county Extension offices in each county seat town. They are available free of charge to everyone—townspeople, farmers, women and children.

Unique among educational enterprises, county Extension offices are the front door of Oklahoma State University. Through them the vast store of knowledge at OSU is available to the people of Oklahoma. County and home demonstration agents are skilled in practical teaching. They work with youth, principally through 4-H Clubs, and with adults through groups and individually. Their techniques are many and varied: demonstrations, tours, meetings, individual conferences, newspapers, magazines, radio and TV. Their services are available to you. Drop by their office for a friendly visit, free bulletins, or other assistance.

More Information

For more information about Soils, Soil Conservation, Range Conservation, Land Judging, Pasture and Range Judging and Water Conservation refer to the following publications:

E-732 Stubble Mulch Judging Guide for Oklahoma
E-729 Fertilizer and Lime Requirements for Oklahoma
E-721 Trees for Wind Protection in Northwest Oklahoma
E-706 Stubble Mulching
E-702 Grass Waterways
E-700 Irrigated Native Grasses
E-696 Watershed Protection
E-677 Range Management in Oklahoma
E-674 How to Put More Rainfall Into the Soil
E-667 Wind Erosion in Oklahoma
E-662 Gullies—Cauce, Prevention and Control
E-658 The ABC's of Soil and Water Conservation
L-69 Adjustment and Operation of Sweep Machines
L-68 Questions and Answers on Stubble Mulching
L-55 How to Take a Soil Sample

You Can Get These Publications From Your County Agent or write to:

Agricultural Mailing Room
Oklahoma State University
Stillwater, Oklahoma

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U. S. Department of Agriculture, J. C. Evans, Vice President for Extension, Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma.

2-69/5½M (Reprint)