What the Illinois Farmer Can Do to Learn About His Soils

By E. E. DeTurk

Samples of soil are received daily at the Agricultural Experiment Station from farmers in various parts of Illinois, with the request that they be analyzed. Upon inquiry, it is usually found that what is really wanted is not a chemical analysis of the soil, but advice or information that can be furnished from facts which the Station already has at hand.

The purpose of this circular is to tell Illinois farmers how they can learn many facts about the needs of the soil on their farms by studying the soil for themselves, and how the Experiment Station can help them in securing information without their necessarily going to the expense and trouble of individual chemical analyses.
The subsurface and the subsoil, as well as the surface, are feeding zones for crops. In some soils, in fact, the lower levels determine the productiveness of the land. In taking a sample of any stratum of soil for examination, it is important that the bottom of the hole be scraped clean before slicing the sample from the side of the hole.

After the bottom of the hole is scraped clean, the sample is sliced from the side, as shown here. In going down to the next stratum, the hole will be made a little smaller so as to permit cutting back into the side to obtain the sample. See pages 7 and 8 for further instructions.
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By E. E. DeTurk, Chief in Soil Technology

One who owns or is interested in farm land may have heard that the Experiment Station analyzes soils. He may also know some of the recommendations of the Station as to the management of soils. He may realize that his land is less productive than it should be, but he is in doubt as to how he should begin to increase its productive power. He is not sure which of the Station's recommendations fit his case. If his funds are too limited to permit his carrying out in full the recommendations of the Station, he wants to know what sort of limited investment in soil improvement he can make most profitably.

Careful observation of the soil itself and of the behavior of the crops which grow upon it will reveal much of interest and value to every farmer. The following suggestions will help in such a study.

Note Character of Soil Below Plow Line

First of all it should be stated that it is worth while for one to learn something of the characteristics of his soil to a greater depth than that usually reached by the plow. The character of the lower levels of the soil is often as important as that of the surface, and may be of even greater importance. In some cases the character of the subsurface or subsoil determines the productiveness of the land.

Samples of soil from different depths may be obtained with a soil auger. A very useful one is made from an ordinary 1- or 1¼-inch auger. The lips and the screw point are filed off and the length increased to 40 inches by cutting the stem in two and welding in a steel rod. A post-hole auger or a spade is also satisfactory for taking samples.

Color an Index to Fertility and Physical Condition

A dark-colored surface soil indicates a larger amount of organic matter than light-colored soils. This is important, since organic matter is necessary in maintaining conditions favorable to good crop growth. Active organic matter, i.e., that which will decay rapidly in the soil, is particularly valuable for stimulating bacterial activity and liberating materials necessary for crop growth. Furthermore, because of its rapid decomposition, it becomes exhausted in the soil more rapidly than the inactive forms. For these reasons the periodical addition to the soil of farm manure, crop residues, or clover sod, or the growing of a crop especially for green manure and plowing it down, are not merely good farm practice, but are necessary if the condition of the soil for good crop production is to be maintained permanently.
In the lower strata aeration is indicated by color. A yellow or reddish yellow color in the subsurface and subsoil means that it is properly supplied with air—another essential condition in productive soils. On the other hand, poor aeration—an unhealthy condition—is indicated by a gray blue or slate color, the soil often appearing mottled. This last condition is often the result of poor natural drainage during the remote period when the soil was being formed.

**Depth of Surface Soil Associated with Productiveness**

The productiveness of the soil along the back-furrow in a field is well known. The soil is no "richer" than the rest of the field, but is more productive because of the greater depth of the surface stratum, together with its better drainage. The importance of determining the depth to which the dark-colored surface stratum extends is therefore obvious. Also, when one fully realizes the importance of the depth of the surface stratum, he is more likely to take care to prevent its loss by erosion if the land is sloping enough to "wash."

**Need for Lime Detected by Simple Tests**

The satisfactory growth of the most desirable agricultural crops both from the standpoint of financial returns and of maintaining the productive power of the soil, requires that the soil shall be not more than very slightly acid. Large areas in Illinois are acid and should be
given applications of limestone. Usually two or more tons to an acre are required, depending upon the degree of acidity.

The lime requirement of the soil, even within a given type, sometimes varies so greatly as to make a special test of the soil of each individual field necessary if one is to have reliable information with which to work. These tests, fortunately, are simple and inexpensive and can be made by the farm adviser or the farmer in the field as readily as in a laboratory. Since a soil which is acid to a considerable depth will need more limestone to bring it to a state of maximum production than will one which is acid only in the surface, the deeper layers as well as the surface should be tested for acidity.

Certain legumes, particularly sweet clover and alfalfa, will not thrive on acid soils, and the kind of growth made by them is therefore one of the most reliable indications as to the need of a soil for limestone.

**Soil Acidity Shown by Potassium Thiocyanate Test**

To make this test, use a 4-percent solution of potassium thiocyanate in alcohol, that is 4 grams of pure potassium thiocyanate in 100 cubic centimeters of 95-percent alcohol.\(^1\) Partially fill a test tube or

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\(^1\)Since undenatured alcohol is usually difficult to obtain, some of the denatured alcohols have been tested for use in making this solution. Completely denatured alcohol made over either U. S. Formula No. 1 or No. 4\(^1\) has been found satisfactory. The other formulas contain either pyridine bases or aniline oil, which destroy the reliability of the test. Some commercial firms are offering prepared solutions of potassium thiocyanate which are quite satisfactory.
small glass vial with soil and add about twice the volume of solution. Shake thoroughly. If after standing fifteen minutes, the solution takes on a red color, the soil is acid and limestone should be applied. If the solution remains colorless, the soil is not acid. A deep red color indicates a more acid soil than a lighter shade, but fine distinctions as to the amount of limestone needed cannot be made on a basis of color intensity.

Since an excess of water interferes with the test, the soil when tested should be at least as dry as it would be when in good, tillable condition. For a prompt reaction, the temperature of the solution must be comfortably warm (60 to 75 degrees Fahrenheit).

Presence of Limestone Shown by Hydrochloric Acid Test

Pour upon a small portion of soil a few drops of hydrochloric (muriatic) acid, prepared by diluting the concentrated acid with an equal volume of water. The presence of limestone or other carbonates will be shown within two or three minutes by the appearance of gas bubbles. A lack of carbonates is not in itself evidence that the soil is acid or that limestone is needed, but it indicates that the potassium thiocyanate test, which definitely ascertains acidity, should be made.

How the Experiment Station Can Help the Farmer

The detailed survey of Illinois soils by the Experiment Station has now been completed in over eighty counties. In this survey, the extent, location, and boundary lines of each soil type covering as much as five acres or more are determined and mapped. Soil samples are collected by Station men from every type in every county and subjected to chemical analysis, which reveals their content of plant-food elements.

The composition of a soil, however, is only one of the many factors which, taken together, determine its adaptability to various crops and its needs as to management. Field experiments are carried out to determine the best methods for maintaining and increasing the productive power of the different types of soil.

The results of these various investigations are being published in the form of Bulletins, Circulars, and County Soil Reports, but whether published or not, the information secured is available to all residents of the state thru correspondence or personal consultation without charge. Soil reports have been published for the 30 counties in the following list and others are in progress:

25. Livingston
26. Grundy
27. Hancock
28. Mason
29. Mercer
30. Johnson
31. Rock Island
Specific Information Needed as Basis for Advice

If the Station is to give prompt and satisfactory attention to the problems submitted, the correspondent must be careful to state concisely the specific questions on which information is wanted, such as methods of soil management, fertilizer needs, or suitable rotations, and give full information on the following points:

(1) *Exact location of land*, including the township, range, and section number, and the part of the section in which the land lies. In counties where the soils have been mapped, such a description makes it possible quickly to identify the types of soil included in the area.

(2) Any other information about the soil or the lay of the land that has a bearing on the questions asked.

(3) Submit a representative sample of soil if possible. This is always useful in determining physical condition and is necessary for the acidity test. Directions for taking samples are given below.

(4) Give a brief description of the *type of farming* carried on, whether general, livestock, dairy, grain, truck garden, or some other specialized line; the crops which have been grown and any peculiarity in their growth; the crops which it is desired to grow; and any fertilizer treatment which the land has received.

With this information the Station will answer the questions so far as it has the information with which to do so.

Consultation with the farm adviser of the county about soil problems has certain advantages because the adviser has lived in the county and has had the opportunity to become more familiar with local problems and conditions than usually has the experiment station worker. Frequently, also, a personal inspection of the farm or field in question may be arranged.

*Take Soil Samples from Three Different Layers*

There usually are three or more distinct layers, or strata, of soil within the depth which should be sampled. These layers differ markedly from each other in color, texture, and other characteristics that can readily be noted by examination in the field. They are designated as surface, subsurface, and subsoil strata. Soil samples should therefore be collected from each of these three natural layers, and a notation made to show the thickness of each layer.

The dividing line between the surface and subsurface can usually be recognized by a change in color, the surface soil being the darker.

The change from subsurface to subsoil is generally marked by differences which are readily recognized, but a change of color is not so often an indication as it is in the separation of the surface and the subsurface. The subsoil, which is ordinarily encountered at a depth of 16 to 28 inches, is usually characterized by greater compactness, plasticity, or stickiness, this quality resulting from accumulations of
clay gradually worked down from the layers above. It may consist, however, of sand, gravel, solid rock, or other material distinctly different from the overlying subsurface.

If it is not possible to get samples of all three strata, the surface and subsurface samples should always be submitted.

Samples Must Be Representative

A soil sample is of no value unless it represents, with some degree of accuracy, the entire area about which information is desired. To get a truly representative sample, each layer of soil should be sampled at ten or more places well distributed over the area, the same amount of soil being taken at each place. The ten or more samples from each separate stratum should be thoroly mixed together and a half-pound sample taken from each of the three composites. These half-pound samples representing the three strata must be kept distinct—soil from different layers or from different soil types should never be mixed to form one sample. Care must be used in packing to prevent the different samples from becoming mixed in transit.

Samples of soil are most easily collected with a soil auger, only a few inches of soil being withdrawn from the hole at a time. Description of an auger is given on page 3 and illustrated on pages 4 and 5. If a spade is used, a hole should be dug with one side vertical. Then a thin slice of soil is cut from the vertical side of the hole and retained.

Results of Soil Investigations Available to All

It is seldom necessary for an individual to have samples of soil from his own fields subjected to complete chemical analysis. While it will never be possible for the Experiment Station to analyze the soil from every field, or even from every Illinois farm, it is possible and practicable to map the soils of the state in detail, and then to carry out laboratory and field investigations on representative soils. From the results of these systematic investigations, which are already well along, every farmer in the state ultimately can know what type or types of soil are included in his farm, the average composition of each type, the crops best adapted to the different soils, and the fertilizer treatments and management practices which may reasonably be expected to maintain crop yields at the most satisfactory level.

In cases where a chemical analysis is necessary, the services of a commercial chemist can be secured. The Experiment Station, on request, will furnish the addresses of firms doing this work, and will aid in the interpretation of results. The Station cannot make chemical analysis for private parties because the expense involved would make it impossible to serve in this way all who might wish such service. The minimum cost of analyzing a single soil sample is $15 to $20. That farmers generally understand this is shown by the fact that there are few demands by Illinois citizens for such private work at public expense after the situation is explained.