Investigating What's In Soil

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Today I began my investigation of a new soil. Some homeowners want to know how to *best* grow grass in their backyard. They brought a sample of their soil to the laboratory. I labeled the sample of soil A98-25, because it is the twenty-fifth soil sample I have tested in April, 1998. Here is information about the soil and its location.

Soil sample number:	A98-25
Sample location:	Sanders Drive, Superior Township, MI
Desired crop:	Turf (Lawn)

To find out what type of soil is best for growing grass for a lawn, I looked at my soil reference book, which describes the best soils for growing different plants. The notes below tell what I found out about good soil for growing grass.

The best lawn soil is called loam. It contains some sand, some clay, and a small amount of humus, but not too much of each.

Sand is made up of small pieces of rock. You can see the pieces with your eye. Sand can be white, tan, pink, brown, and black.

Clay is made up of tiny pieces of rock. You cannot see the pieces with your eye. Clay can be white, red, orange, brown, and black.

Humus is made up of decaying, or rotting, plant and animal parts. Humus is usually black.

Good lawn soil should have a pH between 6 and 8. It should contain chemical elements such as phosphorus, potassium, calcium and magnesium.

Now I need to figure out if soil A98-25 contains these parts and characteristics. I can do that by testing the soil, using procedures that soil scientists use. The first test that makes sense to do is to examine the look and feel of the soil. That can tell me if the soil has sand, clay, or humus.

TEST 1: Soil Appearance When Dry

The way soil looks when it is dry can tell us something about its makeup. The table below tells what sand, clay, and humus would look like in a dry soil sample.

Table 1. Descriptions of the appearance of humus, clay, and sand when dry.

Material	*What it looks like when dry*
Humus	Small or large clumps of fibrous, or stringy, material; very dark brown or black in color.
Clay	Tiny specks; can be red, orange, brown, or black. Particles may be stuck together into larger lumps.
Sand	Sort of large particles; can be clear, white or cream colored, pink, light or dark brown, or black.

Observation of soil A98-25:

Just using my eyes I saw very small particles that seemed to be of several different colors and of different sizes. To get more information I used a hand lens (small magnifying glass). With the lens I saw big pink, cream, and black particles that looked like little pieces of rock. I also saw very small specks, with some larger lumps of the same color.

I used a microscope to see these specks more clearly. With the microscope, I still saw small specks that seemed to be brown. I found that lumps of the same color could be broken down into small bits when I pressed down on them with a probe. [A probe is a small metal rod with a blunt tip that is used to carefully work with materials.]

Finally, I also saw bits of very dark or black stuff that did not look like bits of rock. Some of it looked like little threads of material.

When I compared these observations with Table 1, I concluded that I probably had sand, clay, and humus in this soil sample. I will conduct more tests to see if these results are accurate.

Test 2: Feeling the Soil in the Dry Sample

The way the soil feels when I rub it between my fingers can also tell us something about its makeup. The table below tells what sand, clay, and humus would feel like in a dry soil sample.

Table 2. Descriptions of the feel of humus, clay, and sand when dry and rubbed between the fingers.

Material	*Feeling when the soil is dry*
Humus	Spongy soft
Clay	Soft or powdery
Sand	Rough or gritty

Observation of soil A98-25:

When I rubbed the soil between my fingers I felt several things. Part of the soil seemed bumpy and part of it felt soft. The little brown lumps I observed felt soft when I broke them up with the probe.

When I compared the results from this test with the information in Table 2, I concluded that there is probably both sand and clay in soil sample A98-25. I m not sure whether there is humus in the soil. I couldn t tell by the feel of it. It looked like there might be some when I did Test 1, so I need to do further tests to figure out what s in this soil.

Test 3: Feeling Soil When Wet

You can also tell about a soil by examining it when a little water has been added to make it wet. One test is to feel the soil between your fingers. There are several parts to this test. One part is to observe whether the soil sticks together, a second part is what it feels like, and a third part is called the ribbon test. In the ribbon test, a small amount of the wetted soil is pressed together and rolled between the fingers. We can tell what s in the soil by whether it can be made into a ribbon and how long the ribbon is. These tests tell us about the texture of the soil in a sample. The table below describes what the results of these tests tell us about the different materials that can be in the soil.

Table 3. The texture of soils when wet.

SOIL TYPE	*Lumpiness when Wet*	*Feel of Soil*	*Ribbon Test*	What the Soil Contains:
Sand	Loose, single grains only	Gritty	No ribbon	Almost all sand
Sandy Loam	Starts to stick together	Gritty, slightly sticky	No ribbon	Mostly sand, some clay and humus
Clay Loam	Sticks together wet and dry	Sticky	Short ribbons (less than 3 cm)	Equal sand and clay, some humus
Clay	Sticks together wet and dry	Very sticky	Long ribbons (more than 3 cm)	Mostly clay
Organic	Varies	Varies	Varies	Mostly humus

Observation of soil A98-25:

I took a small amount of the soil and added a few drops of water to make it wet. I used a toothpick to mix the water and soil together, and I noticed that the wet soil stuck together. When I felt the wet soil, it was sticky, but it did not seem gritty. When I pressed the wet soil between my thumb and finger, it held together, and when I rolled it between my fingers, it formed into a short ribbon. The ribbon measured less than 3 centimeters. When I let the soil dry, it stayed together in the shape of the ribbon that I formed.

Using Table 3, I looked to see what my results told me about the soil type I had. Its stickiness and the fact that it stayed together when dry matched the lumpiness and feeling results for clay loam and clay. The results from the ribbon test suggested that my soil was clay loam. This type of soil contains sand, clay, and a small amount of humus.

This result matched with the results from Tests 1 and 2, which gives me confidence that I am accurately identifying what s in the soil sample. There is one more test to conduct on wet soil, which I will do next and see how those results compare.

Test 4: Smear Test

The smear test is also conducted on a sample of soil that has been wetted. To do this test you take a small amount of wet soil and smear it on a piece of white paper. The type of smear the soil makes can also tell us about what s in a soil. Table 4 shows what the smears look like for the different parts that can be in a soil.

Table 4. Descriptions of the smears of sand, clay, and humus.

Material	*Appearance of the Smear*
Sand	Very little smear
Clay	Sticky orange smear
Humus	Watery brownish black smear

Observation of soil A98-25:
This soil made a sticky, brownish-orange smear with a streak of black in it. From this test, I concluded that the soil has both clay and humus in it, and these results are consistent with the results of the previous tests that I performed.

So, how do all these results fit together?

Summary of test results:

From the appearance (Test 1) and smear (Test 4) tests, I concluded that there is *clay* and *humus* in the sample.

From the appearance (Test 1) and feel (Test 2) tests, I determined that there is *sand* and *clay* in the sample.

These results are consistent with the conclusion from the tests examining the texture of the soil (Test 3) from which I determined that the soil was clay loam, which is known to contain *sand*, *clay*, and a small amount of *humus*.

Since loam is a good soil for growing grass and this soil is a type of loam, I concluded that this soil could be good for growing grass. I can t know for sure yet because I know that there are other characteristics that make a soil good for growing particular plants.

From my notes before (see notebook page 1) I know there has to be a particular pH and particular chemical elements in the soil for it to be good for growing grass. Soils can be tested for these characteristics, and I know that if these tests show that the soil is not good for growing grass, these tests will also help me determine what needs to be added to the soil to make it good for growing grass. The pH and amount of chemical elements in a soil can be adjusted by using fertilizer. So, I will conduct these tests and determine whether soil A98-25 needs fertilizer in order to be good for growing grass.

In order for plants to grow in a soil, it needs to have the right nutrients for the plants. Scientists have identified 16 chemical elements that plants need to grow well. Of those there are four that are key: phosphorus (P), potassium (K), calcium (Ca), and magnesium (Mg). (The letters following the names are scientific abbreviations for these chemicals.) Scientists have identified the amount of each of these chemicals that is needed for grass to grow well (see Table 5).

Table 5. Amount of each chemical element needed for grass growth.

Element	*Amount*
Phosphorus (P)	40 pounds per acre
Potassium (K)	250 pounds per acre
Calcium (Ca)	500 pounds per acre
Magnesium (Mg)	30 pounds per acre

Test 5: Chemical testing

Soil can be tested for the presence of chemical elements using a chemical solution called an extractor. This type of chemical test shows how much of an element is in a soil. If there are not enough elements, the soil can be improved by adding fertilizer.

I will use an extractor to test for the most important elements for grass and other plants: P, K, Ca, and Mg. Table 6 shows my results.

Table 6: Amount of key nutrients in soil A98-25

Element	*Amount*
P	124 pounds per acre
K	240 pounds per acre
Ca	964 pounds per acre
Mg	65 pounds per acre

My results, compared to Table 5, tell me that the soil has plenty of potassium, calcium and magnesium for growing grass. However, there is **not enough potassium**. Thus, this soil needs fertilizer that contains potassium.

Adding potassium to the soil might not be enough if the soil doesn t have the right conditions in order for the plants to be able to get the nutrients from the soil. The characteristic that affects whether plants can get the nutrients they need from a soil is the pH. pH is a measure of the amount of acidity of the soil. A highly acid soil has a low pH, and 1 is the most acidic that a soil can be. The opposite of acidity is alkalinity. A highly alkaline soil has a high pH, and 14 is the most alkaline a soil can be. If a soil has a pH of 7 it is neither acidic nor alkaline, and it is considered to be neutral. Grass grows well when the pH ranges from 5.8 to 8.2. Soils that have a pH in this range have the conditions necessary for grass to get the nutrients it needs from the soil. Michigan soils usually have a pH in this range.

Test 6: Soil pH

Testing the pH of a soil requires that a some of the soil be added to water. I followed the procedure described below to test soil A98-25.

Procedure:

1. Weigh out 25 grams of soil in a paper cup.
2. Add 40 milliliters of pure water to the soil in the cup.
3. Stir the mixture with glass rod and let it stand for 30 minutes.
4. After 30 minutes, stir the mixture again, and then dip a pH test strip in the mixture so that it gets wet.
5. Remove the strip and compare its color (where it touched the soil-water mixture) to the colors on a pH chart (comes with the pH strips).

The color of the pH strip told me that the soil s pH was between 5 and 6.

This value is a little low for growing grass, meaning that the soil is a little too acidic. I used my soil reference guide to find out how to make a soil more alkaline. It recommends that a small amount of a chemical called lime (not the same as the fruit) be added to the soil. This will make the soil more alkaline and more suitable for growing grass well.