

Accuracy of a Soil Test

Introduction

I started farming my own crops when I was in the eleventh grade of high school. In the time between then and 1986 I had many soil tests taken. I believed everything on that sheet. In 1986 I joined with Dr. Dan Skow and we got International Ag Labs going. The first indication I had that my belief system may not have been right was when we started visiting laboratories and found that there were many different opinions. The very first surprise I recall was when we visited a land grant college lab and they showed us the different procedures.



When they got to organic matter, we were told they ranked it in three categories. These were high, medium and low. We asked how they tested them and were told “when we hold it in our hand and it is dark colored, it is high. If it is brownish or grey it is medium, and if it is yellow or very light colored, it is low.” At that time I didn’t know much about the testing procedures of soil, but I knew this wasn’t very scientific. I am now up to 2010 and the controversy still continues. **We will look at some the different procedures and I will share some of the opinions I have formed over the last twenty four years.**

Why testing procedures for soil aren't perfect

The first thing I am sure of is, man has not made a perfect testing procedure for soil. The first problem is the sampling procedure. It will never be totally accurate. It will depend on where the soil cores are pulled from. Uneven manure or fertilizer application in the past can effect the sample. There are various other things that can distort a sample. In my opinion a soil test is a guide and if we use it that way we will be alright. I always thought, in my prior years, that if the pH was 7.0 that was where it would stay. I didn’t realize that the pH can change daily and sometimes more often than that. The pH can even change in the bag as it is being sent to the laboratory. Also the time of year the samples are pulled have a direct effect on the levels.

In 1992 we hired two interns to collect samples at 120 different sights. A red flag was placed in a row of soybeans or corn. All samples were pulled within six inches of the flag. Samples were pulled every Monday throughout the growing season. The nutrient draw was very evident. When a crop was drawing heavily on any one nutrient, the nutrient level was very low. When there was very little draw on the same nutrient, this level may go to the top of the chart. This taught us the benefit of soil sampling during dormancy. When samples are taken during dormancy, we know what nutrient levels we have at the start. This is not to say we never sample when a crop is growing. I think it is very good to use a soil sample with a tissue sample. When this is done and a plant tissue shows a certain deficiency but the soil doesn’t, we need to know why this situation is happening. To me this is some very meaningful information.



Up until now I have not created a lot of controversy. This is about to change.

Different extract solutions used in soil testing

We will now write about the different extract solutions used to get the nutrients out of the sample in order to be tested. Over the years, I have been to many laboratories and asked a lot of questions about extract solutions. The answer changes with the opinions of who I am talking to. If this is the kind of answers I am getting, then I think it is up to me to form my own opinion. My opinion is what you will read in this newsletter.

Ag Labs is monitored for quality control

There is one more thing I want to make clear before we write about extract solutions. **International Ag Labs is a current member of the North American Proficiency Testing Program (NAPTP). This is a voluntary organization that monitors quality control.** They send us five samples of soil four times per year. These are tested and the results are sent back to them for quality assurance purposes. I want to assure you that our organic matter must have a number behind it or we are notified that we have failed. This is an excellent way to be sure that our methods are being done properly.

Mehlich-1, Mehlich-2 and Mehlich-3

The first extract solutions I will write about is a series of solutions called **Mehlich-1, Mehlich-2 and Mehlich-3**. The first two are not very popular because of some problems they have. The Mehlich-1 didn't work very well in alkaline soils. The Mehlich-2 was very corrosive to instruments. The Mehlich-3 is the most popular because it is not corrosive and will extract most of the main elements and trace minerals. Therefore multiple extractions are not necessary. The nutrients can be tested on an instrument called an inductively coupled plasma instrument (ICP). The ICP is a very fast instrument so you can test several thousand samples per day. Mehlich-3 is made up of a combination of components which include glacial acetic acid, ammonium nitrate, ammonium fluoride, nitric acid, and EDTA chelating agent. The research we have done will usually show higher numbers with a Mehlich-3 than any other test that is normally used. The great thing about Mehlich-3 is that it is very efficient for laboratories. My opinion of this is it was made for laboratories, not agriculture because of the speed that can be obtained during the testing procedure. This process is not used by International Ag Labs and there is no plan to use it in the future.

Bray-1

The next procedure we will examine is the **bray-1**. This extract is made up of reagent grade ammonium fluoride and hydrochloric acid or ammonium acetate. This extract is used to indicate the amount of phosphorous in the sample when the pH is below 7.4.

Olsen Extract

The **olsen extract** is made up of a combination of commercial grade sodium bicarbonate and sodium hydroxide. This test is used to indicate the phosphorous levels above 7.4 pH. I have never seen a good correlation between the two extract solutions when using the pH as a guide, especially when we get into the gray area around 7.4. I am sending along a sample of different soil tests which have a difference in pH. You draw your own conclusions.



Ammonium Acetate

The **ammonium acetate** is made up of a combination of glacial acetic acid and ammonium hydroxide. It is used to extract calcium, magnesium, potassium and sodium. These are called base nutrients. The soil test reports this in parts/million. The amount reported is usually ignored because most people read the base saturation percentage. The problem I see with base saturation is that it is a computed number. If you look on your soil test where it says base saturation, you will see the word (computed). Mother Nature is a grizzly bear and she sits wherever she cares to. I do not believe she is subject to a computer equation.

CEC Test

The same is true of the **CEC test** which is a number computed for soil texture. There is only one test that is reliable for CEC. That is the ribbon test. The best CEC test is to make a stiff mud ball in a pail. Then holding the ball in your hand, form a thin ribbon of soil and squeezing it out between your thumb and finger. The ribbon of soil should be between 1/8th to 1/4th inch thick. If the ribbon breaks off close to your hand, you have a low CEC. If the ribbon stays together until it is 6 inches long, you have a very high CEC. This test can be done on your farm. It is much more accurate than a number on a sheet even though it is not thought of as being very scientific.

We at IAL are certified to do the bray, olsen and ammonium acetate test with the computed base saturation test and CEC. All of these extracts from bray down to CEC, make up one soil sample. The sample sheets that accompany this letter have this test plus the morgan extract at the top of the sheet.

Morgan Extract Solution

The last extract solution we will analyze is called the **morgan extract solution**. This was developed by Dr. Morgan at University of Connecticut. The theory behind this was to develop an extract that would obtain the same amount of nutrients from the soil that a plant can get. The ingredients that make up the morgan extract are acetic acid with sodium acetate added only to adjust the pH of the solution to a standard pH. The morgan extract is what we at IAL depend on. The longer you use a process usually the more weaknesses you can find. We have found the exact opposite with the morgan extract. The longer we use it the more confidence we have in it. It just plain works!

Sample Soil Tests

I am sending with this letter some actual soil tests done with both the base saturation test and the morgan test done on the same sample. As I said earlier, we are members of the NAPTP. I had the opportunity to furnish the NAPTP soil for a test sample. This was sent to all the laboratory members and it came from my farm. This sample I labeled number 1. This sample I obviously know more about than any other sample because I know the story behind the sample. If you look at the phosphorus levels on the two tests you will see a glaring difference. The bray shows zero and the olsen shows seven parts/million. I know these are the correct answers because we have passed the NAPTP tests with these answers. If you look at the morgan it shows one hundred forty five lbs/acre of phosphorous. One test shows I am bankrupt and the other shows a good amount. Which is correct? The story behind this sample is this. The field is turned into a cattle yard every winter. We winter about eighty cows on fifty three acres each winter. This has been going on for the last fifteen years. All the feeding is done in the field, so the cattle spend most of their time in that field. The manure is plowed down in the spring. The field is planted to corn each year. If I didn't know all this background information, it would be confusing. I have to believe the morgan.



I am sending some other samples to compare. You can see there are some amazing differences. I will let you be the judge of these different samples. I wish I knew the story behind each of these samples like the one off my farm.

We are entering the fall season and it is time to think of getting your soil tested.

I realize many fields did not get tested last fall because of the late harvest. It will be doubly important to get samples pulled this fall. Those of you who have had extreme rain can have a dilution of nutrients. Your numbers can change dramatically from your last test. If you need information give us a call 507-235-6909, or all the information should be on the web at www.aglabs.com.

Thank you and God bless,

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