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Green Thoughts

Conversations and ideas about growing at the Spring Gardens

In the last issue, innocently enough, I published the results of a soil test carried out by Penn State Extension Service. The test was based on combined soil samples from six locations in my 10' x 20' plot. Among the variables Penn State reported was the collective pH of the plot, which was 7.5. That seemed a little bit high, but keep that number in mind. Meanwhile, I planted a row of spinach seeds in my plot. At one end of the row (east side) the seeds had a germination rate of about 85%. At the other end (west end) I had virtually no germination. Was it a fluke? I tried again and got the same results. There are a lot of possible reasons for this disparity. Perhaps some type of critter had a fondness for germinating spinach seeds, but why just there? Could it be that water was pooling at the west end and drowning the poor seeds? But it wasn't muddy over there. Perhaps something was inhibiting those seeds. The soil didn't look any different, although what visible difference would I expect to see? Perhaps there was some kind of pH anomaly at that spot.

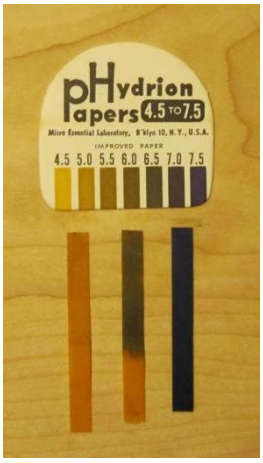
pH *pH*

Measuring Soil pH

It is not hard to measure pH. I have a roll of pH paper about ¼ inch wide and ten feet long. The paper turns different colors for different pHs and the roll comes with a chart showing the pH/color link. I took about 2 teaspoons of soil from that western end and put the soil in a cup. I added tap water to the cup and stirred the contents. I waited for the particles of the soil to settle. I then tore off a two inch long strip from my pH roll and dipped one end of the paper into the liquidy part of the solution. The pH was about 5.0, which is very low, meaning it was very acidic. Aha, suspicions confirmed! I then measured soil at the eastern end of the row and it wasn't much higher, about 5.5 but perhaps that makes a difference.

I got curious and measured the pH at various spots scattered around my plot at locations similar to the ones from where I had sampled for Penn State. All six of the locations had pHs between 5.0 and 6.0, much lower than Penn State's pH 7.5. I was now in a dilemma. I was facing cognitive dissonance. Should I believe my own amateur measurements or Penn State's professional one? My first assumption was that the pH paper had gone bad. So I tested the accuracy of the paper by comparing pH measurement of my soil to: 1) soil which I added some agricultural lime (mostly calcium carbonate); and, 2) a solution of water and baking soda (sodium bicarbonate), the classic elixir you take when you want to neutralize the acid of acid indigestion. As you can see (photo on next page) the color of the paper (left strip) of the untreated soil is tan, the color of the paper (right strip) dipped in the baking soda solution is dark

blue/green, and the color of the paper (center strip) dipped into soil with added lime stone is somewhat in between. So the pH paper seems fine and has different color when the pH is different. Unfortunately, I now have doubts about Penn State's measurement. It's like a kid learning the truth about Santa Claus. By the way, if you want to test your own plot I am happy to provide you with a strip of test paper.



What is pH?

There are other things to talk about but while we are on the subject, let's talk about pH and its biological importance. As you probably know, pH is a measure of hydrogen ion concentration. Pure liquid water basically comes in two forms: 1) as water molecules; and, 2) dissociated as hydrogen ions and hydroxyl ions. They are related in a simple equation which you may remember from high school chemistry:

$$H_2O \Leftrightarrow H^+ + OH^-$$

As chemists would say, the equation is shifted far to the left. That is, if you started counting the relative frequency of water molecules vs hydrogen ions, for every one hydrogen ion (H^+) you would have to count about 555 million H_2O molecules. The concentration (# ions/volume) of hydrogen ions in pure water is 10^{-7} molar (or, 0.0000001 molar). And since that is a tiny number, we talk about hydrogen ion concentration in terms of "pH" with the following logarithmic definition

$$pH = -\log_{10} [H^+]$$

where $[H^+]$ is concentration of hydrogen ions

The pH of pure water is 7. If a watery solution has a pH of 6, i.e. in the acid range, it has 10 times as many hydrogen ions per volume as pure water. And if the pH is 5, it has 100 times the concentration of hydrogen ions as pure water. Despite their relatively low concentration hydrogen ions are very active biologically. In human tissues pH is maintained within narrow limits. For instance, our blood is kept at a pH of around 7.4 and our body goes to great lengths to maintain that pH. If it drops below 7.0 or nears 8.0 we are in big trouble. Our stomach on the other hand has a pH of about 1.2. So it has about a million times higher hydrogen ion concentration than our blood.

What about soil? Most crops do best at neutral pH, around 7.0, but as we know some plants favor acidic soils, around 6.0 – blueberries, hollies, rhododendrons, while some spices do best in alkaline (higher than pH 7.0) soils.

Finally, how do we raise soil pH that is too low? One way is to use limestone. It is not a cure-all but it does work. Limestone that you get in a garden store contains carbonate usually in the form of calcium carbonate which dissociates into calcium ions and carbonate ions.

$$CaCO_3 \Leftrightarrow Ca^{2+} + CO_3^{2-}$$

carbonate ions can then associate with hydrogen ions and remove some of them

from the soil to produce plain water thereby raising the pH:

$$2H^+ + CO_3^{2-} \rightarrow CO_2 + H_2O$$

So what is the take home-lesson for me? I'll try planting spinach seeds in that west area again but first treat with limestone to raise the pH. If spinach seeds grow there then I solved the problem. If not, it is something else. Over-all that west area isn't a dead zone. Nearby strawberry plants seem fine. We'll go from there. …

Wintering over: Spinach, broccoli and artichokes

In the last issue I mentioned that some hardy plants, like spinach, can winter over and we can eat them in early spring. Sure enough, spinach planted in early fall 2016 did well this winter (see photo below taken 9 April

2017). In early April we started eating tasty dark green spinach. Broccoli survived too but it got fooled by warm weather in mid-February and was a little too unguarded in its growth. When the temperature plummeted down to 19° F and didn't get above freezing for 2 days, the leaves and shoots suffered. But as you can see in the lower photo the broccoli came back and we are eating away. Another real surprise were artichokes which we planted in spring 2016 and harvested in very early summer. The plants survived into fall and in anticipation of winter we covered them with salt hay. This spring they are doing well and producing new foliage. We'll report in later issues if they produce fruit. Why not?

Tilling Soil or Not?

Greg K. wrote in and asked if he should turn over the soil in his plot in the spring or just weed and disturb the soil as little as possible. Fellow gardeners, is there a straightforward answer or does it depend on the types of weeds in the plot and how porous the soil is? In addition to muscle ache, what are the deleterious effects of turning over the soil? If you know, please write in and enlighten us.

Please send your ideas, thoughts, suggestions and observations to:

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that address can also be used for getting on the mailing list for Green Thoughts, or getting off.

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