KISS approach to Soil Chemistry on Greens

I became motivated to write a little something about soil chemistry after I read Dr. McCarty's piece on "The Importance of pH Management in Soils" in the May – June issue of the Carolinas Green. It really hit home with me since I spent the better part of my agronomic life dealing with pH problems in the soil that were influenced by alkali water. This alkalinity was due to water constituents that were made up of sodium, bicarbonates, carbonates, TDS, etc. that created soil chemistry problems. These soil chemistry problems were never fixed in the soil; they were just constantly being remediated to adjust for what the water was doing to the soil. If I learned one important thing over time from dealing with the bad water, you never get ahead on soil chemistry. You are constantly trying to maintain and prevent the water from destroying everything you are trying to do agronomically. Thank goodness most superintendents don't have to deal with bad water. But that doesn't mean that you still don't have other things that influence soil chemistry as well as plant health that require thought, remediation, and constant attention. This is where one should be aware of why and how your soil chemistry may change agronomically over time even if you have good irrigation water.

Let’s start with fertilizer. Most fertilizer sources are acid, except for Potassium Nitrate, Calcium Nitrate and organic fertilizers that are derived from poultry manure. Products that are slightly acidifying are urea and ammonium nitrate. While a product like DAP (Diammoium Phosphate) is moderately acidic, ammonium sulfate and MAP (Mono-ammonium Phosphate) are extremely acid. These are just a few examples of how fertilizers can play an important role in changing soil chemistry as well as pH. When you are analyzing your soil samples as it relates to soil chemistry, consider the type of fertilizer source that best suits the conditions, whether it is granular or soluble. Even if it is a refined product that is a brand name, pay attention to the makeup of the product. Every brand product has different nutritional constituents. So read and understand what is in them before applying them to your turf/soil. Let’s say you have a high pH. Ammonium Sulfate and MAP may be good products to consider as a part of your nutritional arsenal. Both may help lower the pH of the soil and may free up some unavailable nutrients. If you are dealing with more acidic soils, one may find Potassium Nitrate and Calcium Nitrate as more favorable options. The last thing someone needs to do is apply an acid fertilizer like Ammonium Sulfate to a soil substrate where the soil chemistry is extremely acid. This would be like adding gasoline to an out-of-control fire. Basically, nutrition should be adjusted to compliment one's soil chemistry. So, pay attention to the type of fertilizer being used as it relates to soil chemistry and pH. If you have a moderately high pH that is slightly alkali, one might consider mixing MAP with Potassium Nitrate at a rate that may be compatible with complimenting the existing soil chemistry in conjunction with pH management.

The next most important thing is to contemplate the effects of rainwater on soil chemistry. Rainwater is typically acid for the most part. Its pH is usually around 5.0 to 5.5. However, it may be lower in some cases because of sulfur dioxide and nitrogen oxides in the atmosphere. This may cause the pH in rainwater to be even lower, i.e.,4.0 to 4.5 range as an aqueous solution. For example, "**Acid rain occurs when sulfur dioxide (SO_2) and nitrogen oxides (NO_X) are emitted into the atmosphere and transported by wind and air currents**. The SO_2 and NO_X react with water, oxygen, and other chemicals to form sulfuric and nitric acids. These then mix with water and other materials before falling to the ground." When this happens, it influences the soil chemistry in a positive and a negative way.

The positive effects are that acid rainwater can neutralize the carbonates on calcium and magnesium making these two macronutrients more available for plant uptake and in turn enhance soil flocculation. As a result, the soil substrate becomes more conducive to maintaining healthier plant growth and better permeability within the soil.

The negative effects are when calcium, magnesium and potassium become more available, this can facilitate leaching and reduce their presence in the soil. As this happens, too many hydrogen ions occupy the soil relative to calcium, magnesium, and potassium. As a result, an acidic environment will develop adversely affecting the sustainability of microbial activity in the soil and lead to more disease pressure and reduced plant health and a compacted soil. In addition to excessive hydrogens, sodium may become more prevalent due to the lack of calcium. Also, it is a known fact that available calcium is an essential food source for microbes. If it is not present in the right amounts, an anaerobic condition may develop. Remember, calcium, magnesium, and potassium all react off each other in a synergistic manner to support and maintain a good soil chemistry, proper C.E.C. and a solid pH. This is what keeps the soil alive and healthy in ways that benefit and enhance plant growth. Without the proper balance of these cations in the soil, plant sustainability and good soil structure will become compromised and suspect at best.

Now that we have covered some key reasons for pH change in the soil, let's investigate why certain soil substrates react to pH change faster than other soil substrate types.

It all starts with buffering capacity of the soil. If someone is managing a heavy soil with a high C.E.C. (Cation Exchange Capacity), the soil will hold onto these base cations (calcium, magnesium, and potassium) longer than a soil with lower C.E.C. For example, Let's say you have an 80:20 mix and the greens perk rate of 16 inches per hour with a C.E.C. of 2. Under this scenario, the pH may change much quicker than greens with a lower perk rate, i.e., greens that perk at 6 inches per hour with C.E.C. of 6. Now that we understand how a pH can change on a different substrate, how fast does it take to rebuild the pH using lime? If the soil is heavy, it will take much longer where colloidal exchange sites are tighter, and the buffering capacity is greater. This makes it more difficult to replace hydrogen with the calcium, magnesium, and potassium in the proper amounts to adjust the ph. If a substrate is sandier in its makeup with a lower C.E.C., the exchange sites are far more conducive to cation remediation than a substrate that has a high C.E.C. So, if you have an excessively rainy season, pay attention to your soil pH and the type of fertilizer you might select to feed your turf. It may impact your soil in a big way depending on its physical makeup. As a rule of thumb, if the pH is in order, the base cations usually fall within a desirable range:

Calcium - 65-75 %

Magnesium - 10-15 %

Potassium - 3-6 %

Hydrogen - Less than 10 %

Sodium – Less than 1 %

However, don't be totally deceived by pH readings. If the sodium is high, i.e., 15-20 base saturation, pH value can misrepresent ideal pH values. Basically, high sodium can cause a high pH reading while other essential cations are low. So even if you check the pH, and it seems to be in line, check the soil chemistry before assuming everything is okay.

As a final note on soil testing, it has been my experience that low areas on greens can show two distortions: High sodium levels or high hydrogen levels. Both can create problems. So, consider spot soil testing isolated areas that are suspect to problems instead of testing the whole green. You might find these areas do not represent the same values as the whole green. I have seen low areas become very acidic due to an accumulation of acid rainwater and high sodium levels due to poor drainage.

Pay attention to your base saturation levels and do not let pH alone guide your decisions. And if you have isolated problem areas, soil test just those areas to make sure there is not an isolated problem. Sometimes sampling the whole green does not give an accurate account of what is going on in one area. As a closing note, nutrients are not available when the soil pH is too acidic or alkaline.

I hope this little bit of information helps you moving forward and gives you a better understanding of how soil chemistry may be impacted due to rainfall and fertilizer applications.

Low Ph of a green that is 4.5. In this case the calcium and magnesium as well as sodium is way out of line.