Phosphorus Facts Myths and Legends for California Superintendents

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Of all the plant food nutrients that golf course superintendents have under their care, phosphorus is often one of the most overlooked for good quality turfgrass. Confusion about phosphorus use in the western United States is common, as soil phosphorus chemistry in alkaline soils is sometimes difficult to understand. For years, speculation about the need for phosphorus in turfgrass culture has spawned myths about how much to use and when to use it. To most, phosphorus is the most misunderstood of all the basic plant nutrients.

The Basics

Phosphorus is a negatively charged soil ion also known as an anion. It is very reactive and often tied up in the soil with calcium and other cations. The bond between calcium and phosphorus is very hard to break, especially in biologically weak soils and in soils of an alkaline nature carrying a pH of over 7.0. The result is a turfgrass plant left in a state of constant phosphorus deficiency.

Phosphorus stands first to regulate the breakdown of carbohydrates and energy transfer in cell division and multiplication. Seeds, flowers, and young shoots show a higher concentration of phosphorus than other plant tissue types. This is due to its role as an energy source in the enzyme and amino acid systems that are responsible for the primary plant function of photosynthesis. Without phosphorus, the very basic plant growth functions suffer due to lack of energy for cell division. Severe phosphorus deficiencies lead to plant stress, susceptibility to disease, insect attack, and weed infiltration. Regulation and restriction of phosphorus levels has become commonplace in the turfgrass industry, much to the harm of a solid system of plant growth which can be sustainable.

Myth 1: Phosphorus Application Encourages Poa Annua

In the early years of formal turfgrass research it was discovered that poa annua (poa) or annual bluegrass tissue had higher levels of phosphorus than other turfgrass types. Because the poa plant is a strong flower and seed producer, it makes good sense that poa tissue would show high levels of phosphorus. Some very early research on phosphorus suggested that when available to annual bluegrass, phosphorus was in ample supply.

In addition, during the same time as the quantification of phosphate in poa physiology, many golf courses were working very hard to rid themselves of annual bluegrass. One tool for this during those years was the use of arsenical herbicides. Under an application of a phosphate fertilizer, the anions of phosphate and arsenate doing battle could easily render the arsenicals useless.

A joining of these two lines of thinking and a little bit of the "grapevine telephone game" spawned the idea that using phosphorus would encourage poa. While it is certainly true that annual

bluegrass genetics and physiology lends itself to higher detectable levels of tissue phosphorus, the thought that phosphorus applications "encourage" poa has since been found to be baseless. In fact, many times when soil phosphorus levels are very low, poa is one of the few turfgrass types that continues to do well and show no signs of phosphorus deficiency. This is due to the storage of phosphorus in seeds, seedheads, and young plants.

Phosphorus Sources

Phosphorus is available to the turfgrass industry in many forms. To obtain soluble phosphorus, rock phosphates which are mined from the earth are acidified with either phosphoric acid or anhydrous ammonia to produce triple-super, single-super, diammonium (DAP), and monoammonium (MAP) phosphates. With the exception of MAP, these forms are very reactive and in soils with a pH over 7.0, they tend to tie up in the soil very quickly. Following application, this bond sometimes occurs in a matter of hours.

Application of rock forms of phosphorus are gaining in popularity. Soft rock phosphate, also known as colloidal rock phosphate, is made from phosphate mine tailings. It is also one of the only soil mineral sources that much like soil, can support plant life all by itself. Hard rock phosphate and dark rock phosphate are minerals directly from the mine source and are also used for soil applications. Dark rock and hard rock phosphate are both rich in carbon, a building block for biological soil strength. Both hard and soft rock phosphates are now being used as soil amendments. They help condition the soil and provide a slow release form of phosphorus that can constantly be made available to plants through biological activity and mild acidic reactions near the plant roots. Recent research and field work is beginning to show that when taking chemical tie up into account, the mineral forms of phosphorus are as readily available as the soluble forms.

Bone meal and blood meal are also found in many of todays meal-type granular organic fertilizers. As a by-product of animal rendering these sources are plentiful and outstanding soil biological activators. Although it is more difficult to extract phosphorus from these materials in higher pH soils, acidification renders a steady supply available to plants.

Phosphorus deficiencies in the plant can be typical in turfgrass, making foliar applications very beneficial. Liquid formulations containing phosphoric acid can also be combined with humic and fulvic acids for soil carbon enhancement. This keeps the phosphorus in a more stable form, which is less likely to be tied up and made unavailable to plants.

Myth 2: Phosphorus Testing is All the Same

Seven different testing methods are currently accepted for soil phosphorus testing, with each method designed for a specific soil situation. All too frequently, a P soil test procedure is applied to a soil for which a test was not designed. The interpretation of these tests varies considerably as the levels of phosphorus extracted do not correlate well between the individual testing methods. Care should be taken in comparing different phosphorus tests from different labs until the testing procedure and extraction methods are known. The Mehlich III extraction is becoming the most common method. However, combining this method with a test to determine total soil P helps complete the picture of easily extractable and total soil phosphorus.

Golf course superintendents must seek their own trials when establishing soil phosphorus application regimens. Even though the correct test methods are being used, those tests cannot predict and model the high degree of reactivity that phosphorus has in western soils. While not exactly high tech, a simple multi-rate trial will provide a visual indicator of the soil's need for phosphorus. It is not always nitrogen that makes for a green-up in turfgrass. Use of 1-0-1 NPK ratio fertilizers is changing to more long term use of "starter-type" analysis materials with NPK ratios of 1-2-2 and 1- 3-1.

Iron and manganese play key roles on phosphorus availability and vice-versa. If soils are weak in the levels of these two elements, phosphorus can be much more difficult to deal with. Soils with excessive iron can quickly tie up shy phosphorus and keep it from helping with its intended role in cell division.

A good trial with different rates of P can help a superintendent to quickly decipher what is needed. We don't really always want a big growth response when we fertilize, but we do want color impact. We look for root development in the early season and a lasting green indicating iron and phosphorus working with each other. That's the beauty of the rock phosphate sources to many supers as they provide an excellent slow-release function and biological enhancement.

Combined with the proper soil testing method and a basic understanding of the materials available, money spent on phosphate will go a long way. As soil fertility and fertilizer application cost and efficiency continue to be of primary concern to the golf course superintendent, the shunned and once-forgotten phosphorus will continue to enjoy new and more special consideration in the modern soil management program.