

Golf Course in Florida. As I suspected, he and his fellow superintendents in the south use a lot of soluble N. Tom informed me that Allied Chemical produces both regular and fine grades of ammonium sulfate for golf course use. Now all you have to do is find a fertilizer distributor that does or is willing to stock the Allied ammonium sulfate.

Q: I've heard colleagues talk about using "feed grade" urea. Not wanting to appear uninformed, I have been reluctant to ask. What is it anyway? Buffalo County

A: Feed grade urea, as the name implies, is manufactured as a feed additive. Animal researchers demonstrated years ago that adding the material to something like ensilage increases its nutritional value. To ensure uniform blending, the urea has to have a small particle size. It so happens that the feed grade urea particle size is very similar to that of a fine greens grade fertilizer. For example, a feed grade urea that I purchased locally has 85% of its particles in the size range of 0.5 to 1.0 mm, or the size of coarse sand particles. In contrast, a regular grade of urea purchased from a turf fertilizer vendor has nearly 75% of its particles larger than 2 mm. The obvious advantage of feed grade urea is that it produces no speckling in the closely mowed turf of greens and tees. If you do elect to apply granular feed grade urea, calibrate your spreader carefully. Because of its small particle size and the fact that it contains 45 or 46% N, I have to close my little drop spreader all the way down and still get an application rate of 0.8 lb N/M.

Q: How can I calculate from the pH of our very hard water how much acid to use to move the pH down in my spray tank? What should be the target pH for a spray tank? What kind of acid should I use? Where can I buy it? Waukesha County.

A: You can't calculate the amount of acid required based on the pH of the water. The water is hard because it contains high levels of dissolved calcium and magnesium carbonates. Carbon dioxide from air reacts with the water and carbonates to form bicarbonate in equilibrium with carbonic acid and carbonate ions. What this constitutes is a weak acid-weak base system in which the hydrogen ion concentration (measured as pH) represents only a small portion of the total amounts of acids and bases pre-

sent. The direct analogy is soil. The pH of soil represents only a miniscule portion of the acidity that must be neutralized in order to change its pH. If this were not the case and all we had to neutralize are the hydrogen ions actually in the soil solution, the amounts of liming material required would be in the range of pounds per acre rather than tons per acre. The other thing you have to be aware of is that the pH of hard water depends on the temperature of the water. The colder the water, the more CO₂ that dissolves in it. This shifts the equilibrium of the carbonic acid-bicarbonate system in favor of the carbonic acid. As the water warms up, CO₂ concentrations in the water decrease and the concentration of bicarbonate increases.

Therefore, cold water drawn directly from the well may have a pH of 7.5. Let that water stand until it reaches air temperature and the pH may be in the range of 8.5. If you don't believe this, take a bottle of your favorite brew from the refrigerator and measure its pH. Let the brew come to room temperature and measure the pH once again.

To determine how much acid you need to add to your water to drop the pH to the level that you want, you have to take a known volume of the water and determine how much acid of a known concentration is needed. Alternatively, you can send a water sample to a commercial lab and have it titrated for you. To save having to do some calculations yourself, be prepared to tell the lab what pH you want and the concentration (normality) of the acid you'll be using. I'd request a pH in the range of 6.0 to 7.0, which is what you want in your spray tank for the vast majority of the tank mixes you'll be preparing. As for the acid to use, I recommend what is known as technical or commercial grade sulfuric acid. This can be obtained from distributors of industrial chemicals.

Q: Do late season iron applications on turf have any effect on winter hardiness or survival? Green County

A: In responding to this question I'm assuming that you're referring to foliar application of Fe to the non-Fe deficient turf that we grow in Wisconsin. If iron were to influence winter hardiness and survival, the most likely mechanism would be increased production of so-called total non-structural carbohydrates (TNC). For this to happen as a result of iron application, the Fe would have to increase turfgrass chlorophyll content

and, in response, increase photosynthesis and carbohydrate production late in the season when shoot growth is slowed by low temperatures. The problem with this line of reasoning is that foliar Fe applications on non-deficient turf do not increase leaf chlorophyll content. Unless the turf is iron deficient, N supply, not Fe, is the controlling factor in chlorophyll production. What happens instead is that the foliar applied Fe forms a black coating the leaves, particularly on cut and damaged portions. This gives the appearance of a darker color. In a recent study of the effects of foliar iron on winter injury in bermudagrass, no greening response was noted, the leaves were observed to be "stained", and at rates above 1.5 oz Fe/M leaf levels of TNC actually declined. The authors surmised that the iron coatings may have actually blocked sunlight from reaching the leaf surface and reduced photosynthesis accordingly.

Q: Do you believe a fertility program can effectively or successfully move the bentgrass/Poa annua population ratios in a green or fairway one way or another? Ozaukee County

A: Let's start with the understanding that Poa is really a weak competitor with something like bentgrass. To move into bentgrass, it needs invasion gaps that greatly reduce or eliminate competition from the bentgrass. Thus, anything that creates invasion gaps is an invitation for Poa. On golf courses, these gaps are being created continuously in the form of ball marks, divots, patches of disease, traffic wear, aeration holes, earthworm casts, etc. This obviously limits what effect fertilization can have on Poa populations. Furthermore, any differences between bentgrass and Poa in terms of their nutrient requirements are slight to none. There is no truth to the idea that high P levels favor Poa over bentgrass. The two grasses do appear to differ in their tolerances to low soil pH. Applying sulfur to drop soil pH to around 5.5 has been found to adversely affect the Poa more than the bentgrass, but don't try this as a control measure unless you want to see some very sad looking bentgrass. All fertilization can accomplish is to impart to the bentgrass the capacity to recover quickly from any type of mechanical or disease injury that may occur. In most instances, this means keeping nitrogen levels up where the bentgrass has good color throughout the season and
(Continued on page 19)

(Continued from page 17)

applying late season N to ensure rapid spring recovery from winter injury and disease.

Q: Is K₂SO₄ really that much better as a source of K than KCl? Grant County

A: The issue of K₂SO₄ vs KCl boils down to concerns about foliar burn, soil salinity, and blacklayer formation. Soil salinity problems arise primarily from irrigation with low quality water high in soluble salts. Fortunately, we don't have this problem in Wisconsin. Thus, concerns about the relative contributions of the chloride and sulfate forms of potassium on salinity are misplaced. Sulfate, in and of itself, does not cause blacklayer. The culprit is impeded drainage that leads to development of anaerobic conditions within soil. Once these conditions develop, then microbial reduction of sulfate can occur, leading to formation of black metallic sulfides and phytotoxic hydrogen sulfide gas. In the absence of impeded drainage, blacklayer will not form and the source of potassium applied is of no consequence. This leaves us with

the issue of foliar burn. Three common sense practices will eliminate this potential problem; only apply the fertilizer to dry turfgrass, keep the rates below the recommended maximum of 2 lb K/M per application, and water the fertilizer in after application. If these practices are followed, there are no valid reasons for selecting K₂SO₄ over KCl as the material of choice for turf fertilization.

Q: My putting green soil tests consistently show low K levels despite ample K additions. Simply put, I'm not making any progress. Do Ca or Mg levels in these sandy greens (80/20) have anything to do with this? Oneida County

A: Yes, exchangeable Ca and Mg are involved, but there's more to it than that. In 80/20 mixes cation exchange capacity arises almost entirely in the organic matter. The negatively charged sites on the organic matter that attract cations have a strong preference for cations that can form chemical bonds through partial sharing of electrons. Potassium cannot do this, but Ca and Mg can. The result is that

Ca and Mg are more strongly held by the cation exchange sites and relatively large amounts of the potassium remains in the soil solution where it is subject to leaching loss. It is this feature of 80/20 mixes that prompts the recommendation that over the course of every season you apply as much K as you do N. Research has shown that in a typical 80/20 mix you cannot expect to hold the soil test K levels at much above 250 lb/A or 125 ppm. If you try for higher levels, the excess potassium leaches away. Recognition of this problem is what has prompted the recommendation that K be applied as many as four different times during the growing season. Alternatively, you can fertilize regularly with a fertilizer whose N:K ratio is near 1:1 or periodically apply a high K fertilizer. Decreasing the levels of Ca and Mg is not an answer to the problem. To decrease the amounts of Ca and Mg you would have to acidify the soil. When you do this the cation exchange capacity also decreases. Thus, the potential exists for reducing even further the amount of exchangeable K that can be held in the soil. ♣



Construction Services to the Golf Industry

Your source for Golf Course Construction, Reconstruction & Improvement.

*You have the Projects, Ideas & Needs. We have the Experience & Equipment to do the job **Right the First time.***

*Many Trucks
Equipped with
High Floatation
Tires to
Minimize
Damage to your
Golf Course*



- **Water Control Structures**
- **Pond Cleaning**
- **New Ponds**
- **Pond Lining**
- **Cart Paths**

- **New Construction**
- **Remodelling**
- **Irrigation**
- **Drainage**
- **Feature Shaping**
- **Trap Sand Replacement**



*Specialized
Equipment
suited to
Cleaning your
existing Golf
Course
Water
Features.*

CALL US TODAY!!

Lee Bruce

(608) 836-7041

Carl Dowse

Established 1953