

Turfgrass, Part II

Part II of this two-part article follows up with information on secondary nutrients, micronutrients in turf, and fertilizer programs. Part I appeared in the January/February 2005 issue of GOVERNMENT ENGINEERING.

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Calcium, magnesium, and sulfur are considered secondary nutrients because in most cases they only occasionally need to be supplied to turf in the form of fertilizer. Applications of calcium and magnesium are usually only necessary when your soil pH is below optimum for turfgrass growth. By liming soil when your soil test indicates a need, you are supplying your turf with calcium or calcium- and magnesium-containing limestone. When your soil test indicates a need for calcium, but not magnesium, you can use a lime source containing only calcium carbonate. If the soil is low in magnesium, however, use dolomitic limestone since it contains both calcium carbonate and magnesium carbonate. (See Table 1.)

In the rare event that calcium is recommended for turf with an adequate pH, you can use gypsum as a source of calcium. Keep in mind that gypsum is not a liming source. Also, despite claims on some gypsum labels, it will not relieve soil compaction or break up clay soils in the northeast United States.

Sulfur is sometimes used to lower soil

pH where a high soil pH can cause turf problems. Sulfur is usually only necessary in western states where arid conditions lead to alkaline soils. In the northeastern United States, high pH values are rarely a problem and there is usually enough sulfur in soils to supply turf needs.

Micronutrients in Turf

The seven micronutrients (sometimes called trace elements) required by turfgrasses include iron, manganese, zinc, copper, molybdenum, boron, and chlorine. Micronutrients are needed by turfgrasses only in minute amounts and rarely need to be supplied to turfgrasses growing in mineral soils. However, when turfgrasses are grown in high-sand-content soils (golf course putting greens and some tees) or high-pH soils, micronutrient applications can be beneficial.

IRON. Iron is an important component of plant enzymes and proteins involved in respiration, nitrogen metabolism, and chlorophyll synthesis. In individual turfgrass plants iron deficiencies appear as chlorosis (yellowing) of

the youngest (upper) leaves. Turf deficiency symptoms show up as yellow mottling, rather than the uniform yellowing observed in nitrogen-deficient turf.

Most soils in the northeastern United States contain adequate levels of iron, and deficiencies are rare. In unusual cases where excessive liming has occurred or irrigation water contains high bicarbonate levels, the uptake and/or translocation of iron by turf may be reduced. This problem, sometimes referred to as lime-induced chlorosis, can be corrected by acidifying the soil and by supplying iron-containing fertilizers.

In the northeastern United States, iron fertilizer is applied by turfgrass managers to enhance turf color without stimulating excessive leaf growth. Iron applications can produce darker green turf even when levels are adequate in plant tissues before applications are made. By reducing the rate of nitrogen fertilizer and supplementing with small amounts of iron, a noticeable turf green-up can be achieved with fewer of the negative aspects associated with excessive nitrogen fertilization, such as frequent mowing and outbreaks of certain diseases.

The most common forms of iron fertilizer for turfgrasses are inorganic iron salts and organic iron chelates (chelated iron) (See Table 2.). An inorganic iron salt is a water-soluble form of iron that contains iron or iron and ammonium paired with sulfate (e.g., ferrous sulfate, ferric sulfate, or ferrous ammonium sulfate). Since turfgrasses can absorb iron from these products through foliage, the products are typically applied as foliar sprays. In soil applications, much of the

Table 1. Some Common Sources of Calcium, Magnesium, and Sulfur

| Sources | Approximate Nutrient Content* |
|---|-------------------------------|
| Calcium Carbonate (agricultural limestone) | 32% Calcium |
| Magnesium/Calcium Carbonate (dolomitic limestone) | 22% Calcium |
| Gypsum | 22% Calcium |
| Calcium Nitrate | 19% Calcium |
| Magnesium/Calcium Carbonate (dolomitic limestone) | 12% Magnesium |
| Epsom Salt (magnesium sulfate) | 10% Magnesium |
| Ammonium Sulfate | 24% Sulfur |
| Ferrous Sulfate | 19% Sulfur |
| Gypsum | 19% Sulfur |
| Potassium Sulfate | 18% Sulfur |
| Elemental Sulfur | 90% Sulfur |

*Actual percentages of nutrients may vary depending on purity and source of product.

Table 2. Some Common Fertilizer Sources of Iron

| Sources | Approximate Content* |
|--------------------------|----------------------|
| Iron | |
| Ferrous Sulfate | 19% |
| Ferric Sulfate | 23% |
| Ferrous Ammonium Sulfate | 14% |
| Iron Chelates | |
| NaFeDTPA | 10% |
| NaFeEDTA | 5-9% |

*Actual percentages of iron may vary depending on purity and source of product.

iron from inorganic sources is converted to insoluble iron hydroxides, iron phosphates, or iron carbonates—compounds that are unavailable to turfgrasses.

Chelated iron sources are usually more efficient at supplying plants with iron than inorganic iron salts. Recent studies have shown that about 2 lb of iron per acre from iron chelate provides the same color enhancement of Kentucky bluegrass as 4 lb iron per acre from inorganic iron sulfate. Since lower rates of chelated iron can be used to obtain a dark green turf, there is less chance of injuring turfgrass with an iron application.

Rates of iron fertilizer for lawn grasses can vary depending on the source, time of year, and number of applications. Generally, a rate of 2 lb of iron per acre from chelated iron is adequate for a noticeable turf green-up. Turf green-up from iron applications can last between several weeks and several months, depending on weather conditions following application. Applications during cool, wet periods (when turf is growing rapidly) enhance color for only two to three weeks, whereas applications during cool, dry periods (when growth of turf is slow) may last for several months.

Excessive amounts of iron can cause noticeable discoloration (a black-green color) in turfgrasses and, in some cases, may injure them. The degree of injury depends on the type of turf, the rate of iron, and the environmental and management conditions at the time of application. Some temporary blackening of Kentucky bluegrass foliage has been observed with as little as 4 lb of iron per acre, from both inorganic and chelated sources. Some dieback of Kentucky bluegrass foliage can occur with rates

higher than 15 lb iron per acre.

OTHER MICRONUTRIENTS. Unless your soil has a high pH (greater than 8.0) and the texture is extremely sandy, micronutrient fertilizer applications are probably not needed. In fact, micronutrients other than iron are rarely beneficial and are sometimes harmful when applied to turfgrasses. Boron, for example, is toxic to turfgrasses even when applied in small amounts. Indiscriminate use of copper can lead to deficiencies of iron in turfgrasses. If you are managing turf in high-sand-content soils, work with a reputable soil and tissue testing lab to determine if micronutrient supplements are needed. If they are, use high quality turfgrass fertilizers containing only the micronutrients that you need to correct the deficiency (See Table 3.)

Fertilizer Programs

No single turfgrass fertilizer program is ideal for all athletic fields, golf courses, and other turfs. The type and amount of fertilizer you use and the timing of your applications will depend on many factors, including grass species and cultivars, soil type, management practices, how the turf is used, and the users' expectations.

Turfgrass species differ in the amount of fertilizer, especially nitrogen fertilizer, that they require for best performance (See Table 4, next page.). Kentucky bluegrass and perennial ryegrass typically need 3 to 4 lb nitrogen per 1,000 sq ft per year, whereas the fine fescues respond best to about 2 to 3 lb nitrogen per 1,000 sq ft per year. If Kentucky bluegrass turf is fertilized only with 1 or 2 lb of nitrogen per 1,000 sq ft during the growing season, it will usually become light green or yellow, thin, and more susceptible to pest damage.

In contrast, if a fine fescue turf receives nitrogen in amounts required by Kentucky bluegrass (3 to 4 lb nitrogen per 1,000 sq ft per year), it can become more susceptible to drought, heat stress, and some diseases. Therefore, be sure to identify the species you are managing and to adjust your fertility program accordingly. With turf

Table 3. Some Common Fertilizer Sources of Micronutrients

| Sources | Approximate Nutrient Content* |
|---------------------------------------|-------------------------------|
| Manganese | |
| Manganese Sulfate and Manganese Oxide | 0.5-7.27% Manganese |
| Manganese EDTA | 0.05% Manganese |
| Zinc | |
| Zinc Sulfate and Zinc Oxide | 0.05-1.3% Zinc |
| Zinc EDTA | 0.05% Zinc |
| Copper | |
| Copper Oxide | 0.05-0.5% Copper |
| Copper EDTA | 0.05% Copper |
| Molybdenum | |
| Sodium Molybdate Molybdenum | 0.0005-0.026% |
| Boron | |
| Boric Acid | 0.02% Boron |
| Chlorine | |
| Potassium Chloride | <10% Chloride |

*Actual percentages of nutrients may vary depending on purity and source of product.

Table 4. Annual Nitrogen Requirements for Turfgrass Species used in the Northeastern U.S.

| Turfgrass Species | Amount of Nitrogen Required Each Growing Season* (lb/1,000 sq ft) |
|--|--|
| Kentucky Bluegrass | 3-4 |
| Rough Bluegrass | 3-4 |
| Perennial Ryegrass | 3-4 |
| Annual Ryegrass | 2-3 |
| Tall Fescue | 2-3 |
| Fine Fescues (creeping red, Chewings, hard, and sheep) | 2-3 |
| Creeping Bentgrass | 3-6 |

*Use rates in the high range for turf grown in infertile soils, when clippings are removed from the site, and in high traffic areas. Rates in the low range can be used for turf grown in inherently fertile soils and when clippings are returned to the turf.

containing mixtures of species, fertility programs are usually designed to favor the most desirable species.

Turfgrass cultivars can also vary in their nitrogen requirements. However, specific recommendations for individual cultivars are seldom made because nitrogen requirements have not been determined for most new cultivars. In addition, many managers have no way of knowing which cultivars are present in the turf.

Turfgrass fertilizer programs will vary with soil quality and type. Turfgrasses growing on sites where much of the topsoil has been removed or in sandy soils usually require more fertilizer than turf growing in good-quality topsoils. This is because of the lower amounts of nutrients found in poor-quality soils and the fact that nitrogen is more easily leached from sandy soils. Improving poor-quality soils with additions of organic amendments, such as good-quality compost, can improve soil structure, add nutrients, and enhance nutrient retention, thus reducing fertilizer needs.

Management practices such as mowing and irrigation can significantly influence the amount of fertilizer that turfgrasses will need. By returning grass clippings to turfgrass, nitrogen, phosphorus, and potassium fertilizer needs can be reduced by up to one-third. Lawns irrigated often during the summer months will use more fertilizer than those not irrigated.

How turf is used also dictates how much fertilizer is needed. For instance, turfgrasses growing in high traffic areas, such as athletic fields, require more fertilizer for better recovery from wear than low traffic areas. Roadside turf, used to

create a buffer between lanes on highways and to control erosion on banks, generally receives little or no fertilizer since aesthetics is not a primary goal and mowing must be kept to a minimum.

Ultimately, users will have differing expectations concerning the function and aesthetics of turfgrass areas. Thus, fertilizer programs will vary according to these expectations.

Application Frequency

The number of fertilizer applications you make during the growing season is just as important as the amount and type of fertilizer you use. To maintain high-quality turf, two or more fertilizer applications per year are generally required. If only two applications are made, higher rates of nitrogen (1.25 to 1.5 lb nitrogen per 1,000 sq ft per application) are usually necessary. In this case, fertilizers containing slow-release nitrogen sources are desirable since the nitrogen is released gradually over extended periods and turf burning is less likely.

In most cases, fertilizer programs involve more than two and as many as five applications per year. These programs allow more flexibility in application rate and nitrogen source than two-application programs since there is less time between applications. A four application per year program, for example, can involve rates less than 1 lb nitrogen per 1,000 sq ft per application. These lower rates allow the use of quick-release nitrogen sources.

Fertilizer Applications

The best times of year to fertilize cool-season turfgrasses are in late sum-

mer, late fall, and mid to late spring. Sometimes two spring applications may be desirable—one in early spring and another in late spring. Fertilizers applied to turf during periods of heat and drought in midsummer can stress plants and lead to injury.

The most important time of year to fertilize turfgrasses is late summer (early to mid September). Fertilizer is necessary at this time because it promotes recovery from drought and heat-related injury sustained during midsummer. Late summer to early fall is also the time of year that cool-season grasses begin to manufacture and store carbohydrates. Carbohydrates are used by turfgrasses for root and rhizome growth, disease and stress tolerance, and protection from winter injury. Nitrogen applied during late summer stimulates foliar growth, but not to the extent that occurs in spring. Thus, slightly higher rates of nitrogen (1.0 to 1.5 lb nitrogen per 1,000 sq ft) can be used for late summer application.

An application of fertilizer in late fall can serve as a replacement for an early spring application. Late fall, in this case, is the time that foliar growth slows or stops, but soils are not frozen.

The advantages of late fall fertilization over early spring fertilization are 1) nitrogen taken up by turf in late fall is used primarily for and by roots (before the soil freezes), 2) little, if any foliar growth occurs, and 3) carbohydrates are not exhausted as quickly when late fall fertilizer applications are made in place of early spring applications. If done correctly, late fall fertilization provides early and noticeable turf green-up in spring with less foliar growth. Excess growth is often associated with high rates of nitrogen applied in early spring.

The main disadvantage of late fall fertilization is that, in some situations, nitrogen leaching may occur. Consequently, this practice should not be performed on sandy soils with quick-release nitrogen fertilizers. Slow-release nitrogen sources, such as natural organics and IBDU, are ideal for late fall applications mostly because they are not as likely to leach as quick-release sources.

If late fall fertilizer applications are not made, a small amount of fertilizer

CHELATED MICRONUTRIENTS

Iron, zinc, manganese, and/or copper often occur in forms that are not taken up by plants. This problem is especially marked if the soil has a high pH (8.0 or above). One way of correcting this problem is to apply the nutrient as a chelate. Chelate comes from the Greek word “clawlike” and denotes a soluble and stable product formed when an organic compound called a chelating agent bonds to the nutrient. The chelating agent keeps the nutrient in solution and releases it at the root surface where it is absorbed into the plant. Chelated nutrients can also be absorbed through turf foliage.

The most common commercial chelating agents used in the turfgrass industry are EDTA (ethylenediaminetetraacetic acid) and DTPA (diethylenetriaminepentaacetic acid). EDTA chelates iron at a pH of less than 6.3; above a pH of 6.8 it reacts with calcium, rendering it ineffective. DTPA chelates iron up to a pH of 7.5; above 7.5, calcium interferes with solubility, making it ineffective.

Chelates have been shown to be superior sources of iron, zinc, manganese, and/or copper since lower rates of chelated micronutrients can achieve the same results as higher rates of inorganic sources. Because lower rates can be used, the potential for plant injury is reduced. However, the cost of chelated micronutrients may be considerably higher than that of inorganic sources.

may be desirable in early spring. Applying high rates of nitrogen to turf in early spring produces excessive foliar growth and forces plants to use up valu-

able food reserves needed for root growth and disease resistance. Thus, lower rates should be used. Typically, rates of 0.5 to 0.75 lb nitrogen per

1,000 sq ft does not supply enough nitrogen to carry the turf through the summer months, a late spring application is probably needed. A late spring application can be made in late May or early June; rates can vary from 0.75 lb to 1.5 lb nitrogen per 1,000 sq ft. A fertilizer containing some slow-release nitrogen is desirable at this time of year because it can supply limited amounts of nitrogen to turf in early to midsummer.

Potassium and Phosphorus

Recommendations from a soil test lab should specify the amounts of phosphorus and potassium (usually in lb phosphate and potash per 1,000 sq ft) your turf needs. The rate of phosphate applied in a single application should be similar to rates of nitrogen (0.5 to 1.5 lb per 1,000 sq ft) or slightly higher (2 lb phosphate per 1,000 sq ft), but it should not exceed 5 lb phosphate per 1,000 sq ft. Potassium is usually applied at rates of 0.5 to 2.0 lb potash per 1,000 sq ft. **GE**

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