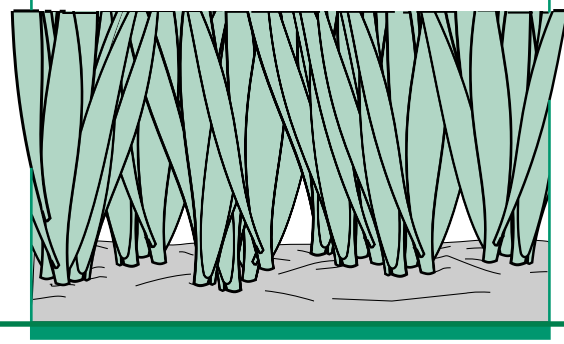
FERTILIZING KANSAS LAWNS

Turfgrass



Almost everyone who wants a beautiful, healthy lawn knows that they must fertilize to achieve it. But many lawn enthusiasts don’t know how to fertilize properly, and making mistakes in fertilization can lead to problems. This publication explains the concepts involved in fertilization. It will also guide the development of a well-planned fertilization program tailored to a particular lawn situation. Such a program takes into account the soil’s fertility level, grass species, expectations for the lawn’s appearance, the amount of traffic the lawn receives, and the amount of effort a homeowner is willing to expend.

Fertilization is extremely important, but regular mowing and proper watering are just as necessary for a healthy, attractive lawn. Together, mowing, watering and fertilizing form the core practices of a good lawn management program. For information on how to mow and water properly, see the K-State Research and Extension publications *Mowing Your Lawn*, MF-1155, and *Watering Your Lawn*, MF-2059.

Fertilizer Nutrients

Just as humans require certain vitamins and minerals to remain healthy, turfgrasses certain nutrients for healthy growth and development. These nutrients are classified as macronutrients, needed in relatively large quantities, or micronutrients, needed in smaller quantities. Most of them are already present in adequate quantities in the air, water or soil and do not have to be added in fertilizers. Some nutrients must be added periodically. Nitrogen, phosphorus and potassium are the macronutrients that have to be added most often. Iron is the micronutrient requiring most frequent addition.

Nitrogen (N) is the nutrient needed in the greatest quantities by turfgrass. It is essential for healthy growth, color and density. Vigorously growing lawns use more N than is available in the soil, so it must be replenished on a regular basis. Because of this high N requirement, lawn fertilization programs are built around this nutrient. Excessive or untimely N applications, however, can lead to a shallow-rooted turfgrass stand that is more susceptible to diseases and has poor tolerance to environmental stresses like cold, heat and drought.

Phosphorus (P), expressed as percent phosphate (P_2O_5) in fertilizer, is needed for energy-requiring processes such as growth of new roots and shoots. It is especially important for new lawns and is frequently deficient in soils surrounding new homes. For established turfgrass, however, it is often present in the soil in adequate quantities. Phosphorus fertilization should always be based on soil test results. Heavy, routine P fertilization can lead to excessive accumulation in the soil. This excess P may then interfere with plant uptake of iron and other micronutrients, possibly inducing deficiencies.

Potassium (K), expressed as percent potash (K_2O) in fertilizer, is essential for the overall health, stress-resistance and cold-hardiness of lawns. Many Kansas soils contain adequate K for turfgrass growth, but K may occasionally need to be added, especially on sandy soils. Like phosphorus, K fertilization should be based on soil-test results.

Iron (Fe) is required for chlorophyll synthesis. Consequently, a deficiency results in the turfgrass foliage becoming yellowish in color. Iron deficiencies are most common in high pH soils, excessively wet soils, or where phosphorus levels are too high.

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Soil Testing

Lawn soils vary widely in pH, P and K levels. It is extremely difficult to generalize about which nutrients are lacking and how much of each is needed. Soil testing is the only way to accurately determine the nutritional status of the soil. It is the starting place in developing a sound fertilization program. A soil test should be taken before the lawn is established, and every three to five years thereafter.

Soil samples can be submitted to the local K-State Research and Extension office. The office can also give instructions on how to take a soil sample and answer other questions about the soil-testing process. The routine soil test performed by K-State checks the levels of P, K and pH. This is usually sufficient, but additional testing may be suggested by the county agricultural agent. Because lawns routinely need N, soil tests are not usually helpful for determining turfgrass N requirements. Use the information in Tables 2 and 3 to schedule N applications.

Soil test results are normally accompanied by recommendations concerning pH adjustment and how much phosphate and potash to apply. The soil test only gauges the soil's nutritional status; it does not detect the presence of insects, diseases, thatch, compaction, pesticide residues or other problems. If the lawn does not respond to proper fertilization, watering and mowing, it may have other problems that need correction. If you cannot diagnose the problem, call the local K-State Research and Extension office.

Understanding Fertilizers

The Analysis

By law, a container of fertilizer must have a label, sometimes printed in small type, describing the percentage of each nutrient in the fertilizer. In addition to the label, a series of three numbers, separated by dashes, usually will be printed prominently on the bag (Figure 1). The three numbers represent the percentages (by weight) of nitrogen, phosphate and potash, respectively, contained in the fertilizer. This percentage breakdown is called the "analysis" of the fertilizer. For example, a fertilizer with an analysis of 24-4-6 contains 24 percent nitrogen,4 percent phosphate, and 6 percent potash. Stating it another way, 100 pounds of this fertilizer would contain 24 pounds of N, 6 pounds of phosphate, and 6 pounds of potash. Sometimes the percentages of other nutrients, such as sulfur or iron, will also be printed prominently on the bag.

Complete Fertilizers and Turfgrass Formulations

Some fertilizers contain a single nutrient (e.g., urea, with an analysis of 46-0-0, contains only N), while others contain a combination of two or more nutrients. A fertilizer supplying N, P and K is called a "complete" fertilizer. This term can be misleading because some lawns will require additional nutrients. Conversely, depending on the soil's nutritional status, only N may be required.

"Turfgrass formulations" are fertilizers that contain mostly N, with less P and K. The ratio of N:P:K can vary somewhat, but they usually have N concentrations at least three times greater than P, and at least one and one-half times greater than K. For example, a 20-5-10 fertilizer would be considered a turfgrass formulation, while a 10-10-10 fertilizer would not. Unless your soil test indicates P and K levels are high, or if you haven't yet tested your soil, use a turfgrass formulation. Again, you should have your soil tested to determine the proper amounts of phosphate and potash to apply. If the soil test indicates a severe deficiency of P or K, the county agricultural agent may recommend a specific fertilizer formulated to supply greater amounts of these nutrients. Normally, correcting the deficiency will require only one or two applications of the special P or K source.

Nitrogen Sources

After an appropriate analysis has been determined, the most important fertilizer selection consideration is whether it contains quickly-available N, slowly-available N, or a mixture of the two. The N-availability rate is determined by the nitrogen source, so it is helpful to have a basic understanding of the different types. Nitrogen sources can be broadly classified as either "water-soluble" or "water-insoluble."

The water-soluble types provide quickly available N with a relatively short-term response (usually about four to six weeks). These are the least expensive and most widely used N sources. Examples include ammonium nitrate, ammonium sulfate, and urea. These products are most commonly used as components of specialty fertilizers, including many turfgrass formulations, although ammonium sulfate and urea are occasionally sold "as is." Because of their high water-solubility, they may leach if applications are followed by heavy rainfall or over-irrigation. And because they are essentially salts, misapplications can burn the foliage. Besides cost, the advantage of this group is that nitrogen "release" (i.e., availability to the plant) is very predictable and requires water only in the root zone to dissolve the material.

Water-insoluble types contain slowly available N. The initial response is slower than water-soluble types, but the effect is longer lasting. Examples include urea-formaldehyde products (a.k.a. methylene ureas) and sulfur- or polymer-coated ureas. Like the water-soluble N sources, these products are typically used as components of turfgrass formulations and other fertilizers. Because of their low water-solubility, they are not prone to leaching and are not likely to cause foliar burn (even if misapplied). But, they are more expensive per unit of N. A disadvantage of the urea-formaldehyde products is that N release is somewhat unpredictable.

It is dependent upon the activity of microbes in the soil to change the N into a form the grass can absorb. Microbes are most active in warm, reasonably moist soils, so the bulk of N release will occur under those conditions. These materials have a high “temperature dependence,” and consequently, are not effective for early-spring or late-fall applications.

Natural organic fertilizers are a subgroup of the water-insoluble types. The N in these fertilizers is derived from plants or animals. Fertilizers in this group deserve special mention because they contain only slowly-available N. In fact, they are often the only N sources available to the homeowner that do. They typically have a low percentage of N, so more fertilizer must be applied to obtain a given amount of nitrogen. Examples of the natural organics include Milorganite (activated sewage sludge), processed poultry waste, fish meal, soybean meal and blood meal*. These fertilizers have characteristics similar to the urea-formaldehyde products. They have a low foliar burn potential, are highly temperature dependent, and are expensive per unit of nitrogen.

***Note:** Blood meal is an exception in that it has a rapid nitrogen-availability rate. Table 1 summarizes the characteristics of some different nitrogen sources.

Fertilizers With a Mixture of Quickly and Slowly Available Nitrogen

Some fertilizers sold in the retail market contain a mixture of quickly and slowly available N. Such products combine the advantages and offset the disadvantages of both types and can be very effective turfgrass fertilizers. However, despite wording on the bag that may claim the product “contains slowly available N,” these mixed products often consist predominantly of quickly available N. To truly incorporate the advantages of slowly available N, mixed products should supply at least one-fourth of the N from slowly available sources. The only way to accurately determine the percentage of N coming from slowly available N sources is to carefully inspect the label. Words or phrases like “ammoniacal nitrogen,” “urea nitrogen” or “water-soluble nitrogen” indicate quickly available N. “Water-insoluble nitrogen” (W.I.N.) or “slow-release” indicate slowly available N.

Figure 1 shows a sample fertilizer label. In the example, 6 percent of the fertilizer is W.I.N. Since the total N (from all sources) amounts to 24 percent of the fertilizer, this product contains one-fourth slowly available N:

$$(6\% \text{ W.I.N.} \div 24\% \text{ total N}) \times 100 = 25\%, \text{ or one-fourth.}$$

Retail outlets also frequently offer fertilizer formulations containing weed, insect and / or disease controls. These products are convenient because two applications can be combined into one, but the appropriate time to apply specific weed or pest controls may not coincide with the proper time for fertilizing. The most horticulturally sound lawn program will often

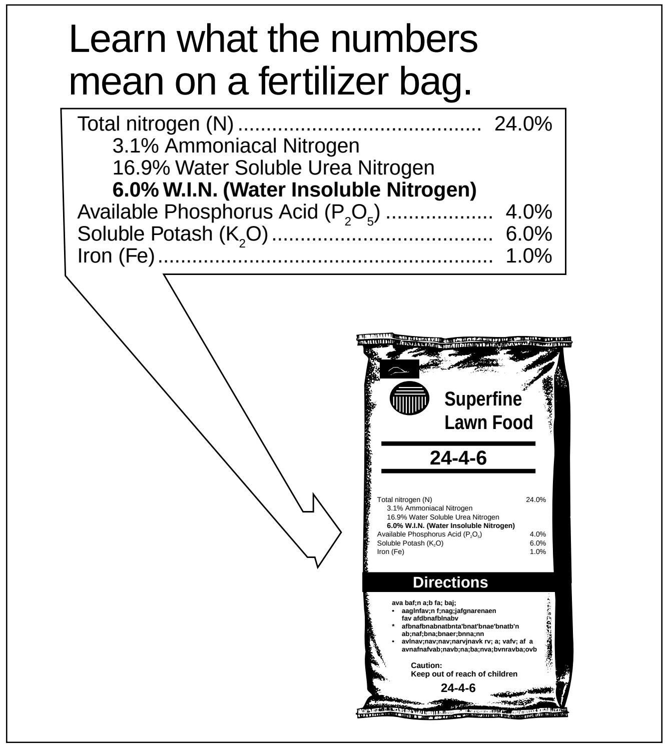

Figure 1. Fertilizer bag

Table 1. Characteristics of Common Nitrogen Sources				
	Approximate Percent N	N-Availability Rate	Temperature Dependence*	Leaching / Foliar Burn Potential
ammonium nitrate	33	fast	minimal	high
ammonium sulfate	21	fast	minimal	high
urea	46	fast	minimal	moderate-high
sulfur-coated urea	32	slow	low	low
ureaformaldehyde	38	slow	high	low
Milorganite	6	slow	high	low
blood meal	12	fast	low	low

*N sources with a high temperature dependence should not be used for early spring or late fall applications.

necessitate separate fertilizer and pesticide applications. Apply fertilizer- and pesticide-combination formulas only when you are sure the particular pesticide is needed, and the time is also right for fertilizing the grass.

Fertilizer Scheduling

Determining the Total Annual Nitrogen Requirement

Two things determine how much nitrogen your lawn will need: your turfgrass species and the quality level you expect of your lawn. All Kansas lawn species can survive on relatively low levels of N, but some species require higher levels to look their best. Other species, namely zoysiagrass and buffalograss, perform their best at lower N levels. In general, however, a high-quality lawn requires more N. It also requires more frequent mowing and more careful attention to the turf's water needs. Less N is required if you are not highly concerned with good color and density, but simply want the grass to provide cover and erosion control. Decide what type of quality you expect from your lawn, then use Table 2 to determine the total annual N requirement for your species. This total will generally be applied in several smaller applications during the season.

A word of caution: Do not exceed the recommended N amount for your particular species. Too much N may be worse for your lawn than too little. Overfertilized lawns often become thatchy. They tend to have poor root systems because the plants consume most of their resources for excessively lush shoot growth. Consequently, such lawns are more susceptible to many diseases and environmental stresses like heat and drought.

Returning Clippings Can Save You Money

Clippings are an especially good source of N, but they also contain other nutrients like P and K. Returning clippings to the lawn recycles these nutrients. Regularly returning clippings may reduce your lawn's total annual N requirement by up to 25 percent, and can reduce, or even eliminate, the need for supplemental P and K fertilization. Mulching mowers work well, but side-discharge mowers can also be used to return the clippings. Just leave the bag off. And follow the *one-third rule* always mow the grass frequently enough so that no more than one-third of the height is removed.

Determining When to Fertilize

The total annual nitrogen requirement is generally applied in doses of 1 pound of N per 1,000 square feet. Occasionally, as little as one half pound, or as much as 1½ pounds may be applied at one time. Applying the N in 1-pound doses supplies the lawn with a reasonable amount of N when it will be most beneficial.

In general, turfgrasses should be fertilized when they are actively growing. So cool-season grasses, such as Kentucky bluegrass, tall fescue, and perennial ryegrass, should be fertilized primarily in the fall and late spring. Warm-season grasses, bermudagrass, buffalograss and zoysiagrass, should be fertilized in late spring and / or summer.

For cool-season lawns, most of the fertilizer should be applied in the fall. Fescue, bluegrass and ryegrass benefit most from fall-applied nitrogen applications. September is the most important time. N applied during September helps thicken the stand, and encourages development of a healthy root system. A November application (at about the time of the final mowing of the season) helps the turf build food reserves. This enables the lawn to green up earlier in the spring, without encouraging the excessive shoot growth that often accompanies early spring N applications.

This emphasis on fall fertilization may seem strange, especially since some garden centers and stores vigorously promote their fertilizer products in the spring. But cool-season lawns characteristically experience a flush of shoot growth sometime in mid-spring. Applying N before this flush is over can cause the grass to grow too fast. The shoot growth exhausts the plant's food stocks, and leaves it with little in reserve for the stressful summer ahead. So it is best to wait until the flush of shoot growth is over, normally early in May, before making spring-applications of N. Ideally, a slowly available N source would be used for the May application. This encourages moderate, controlled growth as the hot summer weather approaches. If a late June or early July application is deemed neces-

Table 2. Total Annual Nitrogen Requirement (lb. N/1000 sq.ft.)*

Turfgrass Species	Quality Expectation		
	Low	Medium	High
Kentucky Bluegrass	1½	3	4–5
Tall Fescue	1	2	3–4
Perennial Ryegrass	2	3	4–5
Bermudagrass	2	3	4
Zoysiagrass	0–1	1–1½	2
Buffalograss	0	1–2	

*Do not apply more than 1 lb. of N in any one application. Refer to Table 4 for application schedules.

Table 3. Fertilization Schedule Based on Total Annual Nitrogen Applied

Cool-Season Grasses—Kentucky Bluegrass, Tall Fescue, and Perennial Ryegrass

Total Annual N (lb. / 1,000 sq.ft.)	lb. N / 1,000 sq.ft.			
	September[1]	November[2]	May[3]	Mid-June to early July[4]
1	1			
2	1	1		
3	1	1	1	
4	1	1½	1	½
5	1½	1½	1	1

Warm-Season Grasses—Bermudagrass, Zoysiagrass, and Buffalograss

Total Annual N (lb. / 1,000 sq. ft.)	lb. N / 1,000 sq.ft.			
	May[5]	June[5]	July[5]	Early to mid-August[5]
1		1		
2	1		1	
3	1	1		1
4	1	1	1	1

[1] A fertilizer containing both quickly and slowly available nitrogen is preferred for this application, but quickly available nitrogen is acceptable.
[2] Use quickly available nitrogen.
[3] Use a fertilizer containing at least one-fourth of the nitrogen as slowly available nitrogen (a fertilizer containing only slowly available nitrogen is preferred).
[4] If color and growth are acceptable, skip this application. If the application is needed, use only slowly available nitrogen.
[5] Quickly available nitrogen is acceptable for warm-season grasses during the summer, but slowly available nitrogen (or a mixture of the two types) may be used if preferred.

sary, use a slow-release N source and keep rates on the low side (see Table 3). Excessive N during the summer can lead to disease problems for cool-season grasses.

Warm-Season Grasses

Fertilize warm-season grasses in the late spring and / or summer. This is just the opposite of cool-season grasses. Fertilizing warm-season grasses too early encourages growth of cool-season weeds. For most of Kansas wait until at least May 15 to fertilize. For north-central and northwest Kansas wait until May 30 or later. On the other hand, late summer N applications to warm-season grasses can increase their susceptibility to winter-kill. So, do not apply nitrogen after August 15. Unlike cool-season grasses, warm-season grasses can tolerate quickly available N in the summer but slowly available N can be used if preferred.

After determining your lawn's total annual nitrogen requirement, use Table 3 to determine when to apply each dose. The footnotes in the table give tips on whether to use quickly available or slowly available N sources.

Applying Fertilizer

Is Liquid or Dry Fertilizer Best?

The grass doesn't care whether nutrients come from a liquid or a dry formulation, but dry materials are easier for the average homeowner to apply. Professional lawn care companies can do a good job applying liquids because they have the proper equipment. Homeowners, on the other hand, generally have to apply liquids with hand-held or hose-attached sprayers. These types of sprayers make it difficult to apply the fertilizer evenly, and considerable time is required to apply adequate amounts of nitrogen.

How to Get the Right Amount on Your Yard

Saying that you want to apply "1 pound of actual N per 1,000 square feet" is one thing, actually doing it is another. Many retailers will loan you a spreader and tell you what setting to use for the various fertilizers they sell. But blindly following such instructions can lead to errors in application. The primary reason for these errors is that the fertilizer rate applied by

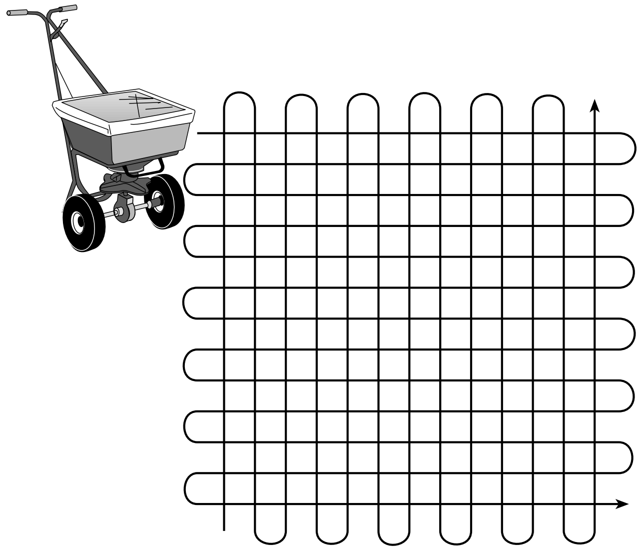

Figure 2. Apply a half-rate of fertilizer in two directions to give the full-rate. This practice minimizes errors caused by skips and overlaps. Be sure to shut off spreader when stopping and turning.

a spreader is greatly influenced by the walking speed of the operator. Some people walk quickly, others saunter along slowly. Changing your walking speed can change the application rate of a spreader by as much as 100 percent. So if you borrow a spreader from a retailer, ask to speak with the person who did the calibrating. Ask them when they last calibrated the spreader—if more than a year has lapsed, the spreader should be recalibrated. Have them show you how fast they walked, and walk alongside them so you can get a feel for the speed. If the calibrator is not available to give you this information, do not rely on the prescribed settings.

When using a drop spreader, be sure to overlap your wheel marks sufficiently on consecutive passes because the hopper is slightly narrower than the distance between the wheels. With broadcast spreaders, consecutive passes should be just far enough apart so there is slight overlap in the fertilizer pattern. No matter which type of spreader you use, the effects of skips and overlaps can be minimized by making two trips over the lawn in perpendicular directions, applying half of your desired rate in each direction.

Note: Avoid scattering fertilizer granules in the street, on sidewalks or driveways. If granules do reach these surfaces, sweep up and reuse them. Granules left to wash down storm drains eventually end up in surface waters. Taking extra care during fertilizer application will help protect the environment.

Calibrating a Spreader

Calibrating a spreader is a straightforward task, but it does require time and patience. Here are the steps:

1. Calculate how much fertilizer to apply to obtain a given amount of actual N. For example, if your fertilizer has an analysis of 20-5-10 (i.e., it is 20 percent N, by weight), and you want to apply 1 pound of actual N per 1,000 square feet, you will need five pounds of fertilizer per 1,000 square feet (1 lb. actual N ÷ 0.20 = 5 lb. fertilizer).
2. Measure the spreader's width of application. This is simple on a drop-type, simply measure the width of the spreader bin. Broadcast-types require help. To calibrate, walk at normal speed and have a helper watch the pattern from in front. Measure the width of "throw" with a tape measure.
3. To start, choose an intermediate setting and run the spreader a known distance across a clean concrete surface. A "collection pan" could be constructed so that the fertilizer drops into it rather than onto the floor. Gather the fertilizer and weigh the amount. Calculate how much fertilizer would have been applied if you had covered 1,000 square feet. For example, if your spreader applies fertilizer in a two-foot wide swath, you ran it for 50 feet (i.e., you covered 100 square feet), and you applied 0.75 pound of fertilizer. Set up a proportion as follows:

   0.75 lb. fertilizer / 100 sq.ft. =
   X lb. fertilizer / 1,000 sq.ft.

   X = 7.5 lb. fertilizer / 1,000 sq.ft.

4. Readjust the spreader and repeat Step 3 until the desired rate is obtained.

It is always best to calibrate the spreader to apply half your desired rate, and then go over the lawn twice in perpendicular directions. This practice minimizes application errors such as skips or overlapping passes.

An Alternative Calibration Method

There is an alternative approach for lawns that are not too large. This method requires more trips across the lawn, but saves you the work of calibrating the spreader in advance.

1. Measure the area of your lawn. Either measure the lot size and subtract the area of the driveway, sidewalks and other non-turf areas, or measure the actual lawn areas. This can be tricky if they are irregular shapes.
2. Weigh the amount of fertilizer required, and pour it into the spreader. For example, if the lawn is 5,000 square feet and requires five pounds fertilizer / 1,000 square feet, apply 25 pounds of fertilizer:
   [(5 lb. ÷ 1,000 sq.ft.) × 5,000 sq.ft.] = 25 lb.
3. Set the spreader on a low setting and keep going over the lawn (varying your direction) until the fertilizer is gone.

When using this method, avoid the temptation to set the spreader on a higher setting. The low setting, combined with several trips across the lawn, helps ensure uniform application of the fertilizer.

Spills

Always fill your spreader on pavement, never on the lawn. Filling the spreader on the lawn is one of the surest ways to spill fertilizer, which can result in unsightly and long-lasting burns. If you do spill fertilizer on the lawn, thoroughly vacuum the excess fertilizer. If vacuuming is impossible, scoop up as much of the material as you can. Then flood the area with water.

Adjusting the Soil pH With Sulfur and Lime

Soil pH is a measure of the acidity or alkalinity. A pH of 7.0 is neutral, less than 7.0 is acid, and greater than 7.0 is alkaline. The pH is important because it affects the availability of iron and other nutrients. Optimum turfgrass growth usually occurs at a pH between 6.0 and 7.0.

Sulfur is used to lower the pH of alkaline soils, whereas lime is used to raise the pH of acid soils. If they are needed, it is best to incorporate these materials into the soil before planting. In any case, DO NOT apply lime or sulfur unless a soil test indicates that one or the other is actually needed. Indiscriminate use of these materials may only worsen existing problems.

The process of changing the soil pH of an established lawn can be a slow, painstaking process. With established lawns, lime or sulfur cannot be thoroughly mixed into the soil without destroying the existing stand. The best you can do is apply them in conjunction with core-aeration. And because these materials can burn the turf, only limited quantities can be used at any one time. Compounding the problem, most soils with a high percentage of silt and clay resist changes in pH through a process called buffering. Because of these difficulties, adding lime or sulfur to an established lawn if the pH is between 5.5 and 7.5 is not recommended. But fertilizers with relatively high acidifying potentials, such as ammonium sulfate, can be used on slightly alkaline soils in an attempt to gradually lower the pH.

For details on adjusting the soil pH with sulfur or lime, see the K-State Research and Extension publication *A Guide to Turfgrass Nutrient Recommendations Based on K-State Soil Test Results,* MF 2311, available electronically at: http://www.oznet.ksu.edu.

Correcting Iron Chlorosis

When the soil pH is 7.2 or higher, iron chlorosis (yellowing) is common. Bluegrass and zoysiagrass lawns are the most likely to suffer from iron chlorosis, while tall fescue is somewhat more resistant. Iron tends to form insoluble complexes in alkaline soils, and turfgrass roots are unable to absorb iron in the insoluble form. Any condition that restricts or inhibits turfgrass rooting can also induce an iron deficiency. Culprits include excessive watering, compaction, excessive nitrogen levels, disease or insect injury. Iron chlorosis is often misdiagnosed as a nitrogen deficiency. Iron chlorosis normally occurs in a random, patchy pattern, whereas nitrogen chlorosis appears as a more uniform yellowing of the turfgrass stand. Applying nitrogen to an iron-deficient turf will only make the problem worse.

A foliar application of iron sulfate or chelated iron to an iron-deficient turf will result in green-up within 24 to 48 hours, but the effect may only last a few weeks. In fact, this is the best way to confirm a suspected iron deficiency. Soil tests for iron are not very reliable. Do not make a foliar application of iron if rain is imminent, and do not irrigate for at least three to four hours after the application. This will allow the turfgrass foliage the chance to absorb the iron.

A longer-lasting response might be obtained with soil applications of chelated iron. If the soil pH is greater than 7.2, many chelated products are not effective. The only truly long-term solution to iron chlorosis is to acidify the soil.

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Brand names appearing in this publication are for product identification purposes only. No endorsement is intended, nor is criticism implied of similar products not mentioned.

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