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Agricultural Extension Service
The University of Tennessee
PB1038

# Fertilization & Management


# of Home Lawns

# Table of Contents

# Fertilization & Management of Home Lawns

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## Introduction

Fertilization and liming practices based upon a soil test help ensure the most cost efficient and environmentally sound development and maintenance of lawns. A soil test is especially critical when soils test low in pH, phosphorus or potassium. A properly fertilized and limed lawn is usually greener, more vigorous, less weedy and more attractive than a poorly fertilized lawn or one suffering from the effects of low soil pH (soil pH is a measure of the soil's acid content).

The primary nutrients (nitrogen, phosphorus and potassium) must be added to most lawns, since soils in Tennessee seldom furnish adequate supplies. The secondary and micronutrients essential for lawngrasses generally occur in sufficient amounts in Tennessee soils and do not usually need to be applied.

Amounts of phosphorus and potassium to use when establishing and maintaining lawns are best determined by soil testing. Plant-available nitrogen usually does not remain in the soil for an extended time and must be applied more frequently than phosphorus or potassium. Therefore, the amount of nitrogen to use for healthy lawns is usually based upon measurement and/or visual observation of lawn quality at various rates of applied nitrogen. Environmental impact and water quality are increasingly important considerations when making appropriate fertilizer recommendations.

Limestone is recommended when establishing a lawn on soil having a pH less than 6.1. Limestone is also required for maintaining healthy lawns. Normal weathering of soils and fertilization lower soil pH over time.The amount of limestone to use should be determined by a soil test.

# The Primary Plant Nutrients

## Nitrogen

The nutrient required in greatest amounts by lawngrasses is nitrogen.  Nitrogen is very mobile in the soil, making it subject to leaching and other types of losses. It is difficult to substantially increase soil reserves of nitrogen. As a result, nitrogen is the nutrient most likely to be deficient in lawns.

Nitrogen promotes rapid plant growth, encourages a dense lawn and produces a dark green color. However, if the lawn is fertilized just for color, there is a tendency to apply more nitrogen than needed. Too much nitrogen tends to reduce the lawn's tolerance to temperature extremes, traffic, drought and diseases. Also, too much quickly available nitrogen during warm, dry conditions may produce foliage burn.

Lawns deficient in nitrogen appear yellowish to light green, grow slowly and are less dense. This results in increased weed growth and greater susceptibility to some diseases (rust, dollarspot).

## Phosphorus

Phosphorus is important for establishing and maintaining a healthy, vigorous lawn. It is especially needed by young lawngrasses for the development of a strong and fibrous root system. Recommended amounts of phosphorus should be incorporated into the soil prior to lawn establishment. Incorporation allows uniform distribution throughout the lawngrass rootzone. If soils test low, more phosphorus will be needed than if soils test medium or high. However, once the lawn is established, only modest amounts should be required.

Unlike nitrogen, phosphorus is very immobile in most soils and does not leach readily. The lawngrass response to phosphorus is not nearly as obvious as is the increase in growth and green color from the application of nitrogen. Lawns deficient in phosphorus may have a reddish-purple or a very dark green color. Grass blades are characteristically very thin and growth is extremely poor.

## Potassium

Potassium is used by lawngrasses in amounts second only to nitrogen. Potassium increases grasses' resistance to diseases and improves the hardiness of lawns to temperature and moisture stresses. If soils test low, more potassium will be needed than if soils test medium or high.

If adequate amounts of potassium are applied when the lawn is established, only small amounts should be required for maintenance. If grass clippings are removed, potassium will be depleted from the soil at a much faster rate than if clippings are allowed to remain on the lawn. Decomposing grass clippings serve to recycle potassium. Lawns deficient in potassium may exhibit a browning of the tips and/or margins of the grass blades. There may be a yellowing of the grass blades, with the mid-veins remaining green.

# Soil Testing

Soil testing is the most reliable and environmentally sound method available for determining amounts of lime and fertilizers to apply. Therefore, develop your lawn fertilization program on the basis of soil test results. Many homeowners depend on visual analysis of lawn color or quality for evaluating fertilization needs. This is usually not totally reliable. For example, neither amounts of nutrients already present in the soil nor soil pH can be determined by observation. Nutrient imbalances are likely unless recommended amounts of nitrogen, phosphorus and potassium are applied. The presence of moss or bare spots does not necessarily indicate a nutrient or pH problem and should not be used as the basis for lawn fertilization. Trouble spots in the lawn indicate a need for soil testing to objectively rule out the possibility of a nutrient deficiency.

## When and How to Sample

When **establishing** lawns, soils should be sampled prior to seeding, sprigging or sodding to allow incorporation of lime, phosphorus and potassium into the lawngrass rooting zone (Figure 1).

For **maintenance** fertilization, soils may be sampled anytime during the year. However, lawns should be dry enough to spade and samples should be collected early enough to allow testing before spring (March 15) or fall (September 1) fertilization.

Soil samples should be collected at random from 8 to 10 locations throughout the lawn (Figure 2). Sample soils to a depth of 6 inches for establishment or maintenance fertilization (Figure 3).

Place samples in a clean bucket or other suitable container and mix well. From this, remove approximately one cup of the mixed soil and place in a properly labeled soil sample box and mail to The University of Tennessee Soil Testing Laboratory in Nashville. Soil testing boxes and information sheets are available at your local Agricultural Extension Service office. See the **Soil Testing Information Sheet** (F394) for appropriate mailing instructions. This sheet (F394) should be filled out in detail and mailed **separately** to the laboratory. If areas of the lawn need special attention (eroded spots, fills, dead areas, etc.), they should be sampled separately, following the same procedure as above. For more detailed information regarding soil testing, please refer to Extension PB 1061, "**Soil Testing**."

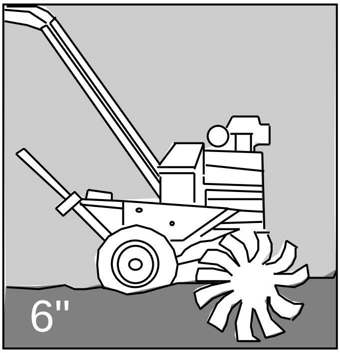



*Figure 1. Lime and fertilizer should be tilled into the top 6 inches of soil prior to establishing lawngrasses.*

## How Often to Soil Test Lawns

Soils should be tested prior to establishment or renovation of lawns and every three to five years for determining maintenance applications of lime and fertilizer. Soils should be tested more frequently if grass clippings are removed from the mowed area or any time a nutrient imbalance is suspected. Soil test every year when soil tests low in P or K.

# Choosing the Fertilizer Source

## What's in the Fertilizer Bag

There are two basic types of lawn fertilizers: **complete** or **mixed** and **incomplete** or **straight** materials. **Complete** fertilizers are those that contain each of the three primary nutrients: nitrogen, phosphorus and potassium. Amounts of each nutrient present determine the **grade** or guaranteed analysis and are shown on the fertilizer bag as 10-10-10, 6-

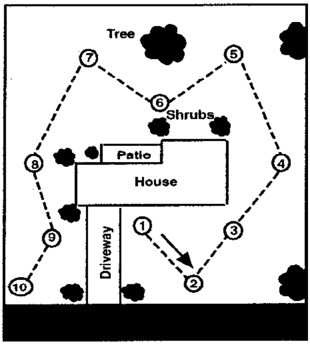



*Figure 2. Random locations for collecting soil samples from the lawn.*

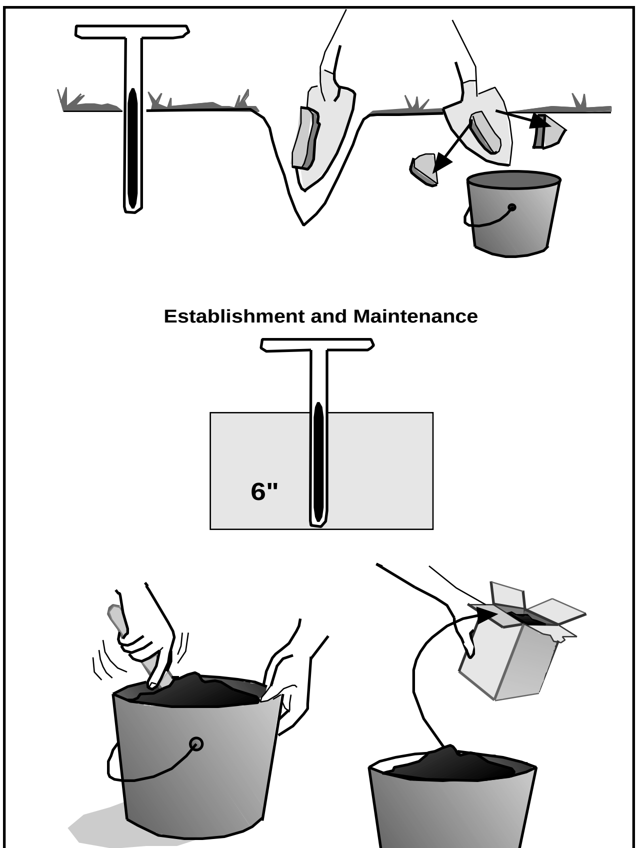



*Figure 3. Collecting, mixing, and packaging soil samples.*

12-12, 12-6-6, etc.(Figure 4). The first of the three numbers always refers to the percent of available nitrogen (N); the second the percent of available phosphate ($P_2O_5$); and the third the percent of available potash ($K_2O$). For example, 100 pounds of a complete 6-12-12 fertilizer contains six pounds of N, 12 pounds of $P_2O_5$ and 12 pounds of $K_2O$. Phosphorus and potassium in commercial fertilizers are expressed as phosphate ($P_2O_5$) and potash ($K_2O$), respectively.

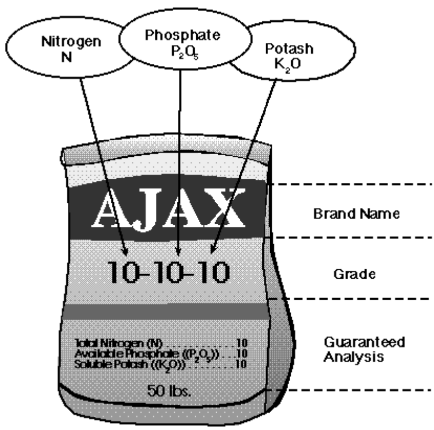



*Figure 4. A bag of complete fertilizer.*

Fertilizer **ratio** refers to the ratio of nutrient percentages for a given fertilizer grade. A 6-12-12 fertilizer has a $N\text{-}P_2O_5\text{-}K_2O$ ratio of 1-2-2. The grades 12-6-6 and 16-8-8 have ratios of 2-1-1. Fertilizers with a 1-2-2 ratio are best suited for establishment or renovation of lawngrasses, especially when soils test low in phosphorus or potassium. Fertilizers with a 2-1-1, 4-1-2 or 3-1-2 ratio provide N, P and K in quantities closer to actual plant needs and are best suited for maintenance applications.

An **incomplete** fertilizer is one that contains only one or two of the primary nutrient elements. If only one nutrient is present, the fertilizer is referred to as a **straight** material. An example is ammonium nitrate, which is a 34.5-0-0 grade of fertilizer and supplies 34.5 pounds of available nitrogen per 100 pounds of material.

Once soil test phosphorus and potassium levels reach “very high,” lawngrass growth may be controlled with straight nitrogen fertilizers (Table 1). Continue regular soil testing, as lime will still be needed to counter the acid-forming effects of nitrogen fertilizers.

# Nitrogen Sources

There are several considerations when selecting a nitrogen source (Table 1). The source you choose will depend upon your needs and personal preference. Favorable results can be obtained with any of the sources if properly applied and managed.

Nitrogen fertilizers are available in **quick-release** forms, **slow-release** forms and a mixture of the two. **Quick-release** sources readily dissolve in water and are immediately available for plant use. The interval between their application and a visual response in the lawn is relatively short — from three to five days. **Slow-release** sources dissolve less rapidly, breaking down over a period of a few days to several months.

The characteristics of quick- and slow-release nitrogen sources are summarized in Table 2. **Quick-release** nitrogen sources are usually less expensive than the slow-release materials. They may be more desirable for early spring fertilization of cool-season lawngrasses, since they usually produce a more favorable response under cooler temperatures than slow-release sources. Quick-release sources are suitable for either dry or liquid applications.

**Slow-release** nitrogen provides uniform feeding of the lawngrass and eliminates the short periods of excessive growth often associated with quick-release nitrogen sources. Nitrogen in slow-release form may be applied at heavier rates in a single application without danger of fertilizer injury or burn.

## Table 1. Examples of Fertilizers for Lawn Establishment and Maintenance

| Type | Percent Nitrogen | Ratio | Pounds of Fertilizer To Supply One Pound Nitrogen |
|---|---|---|---|
| **Straight Nitrogen Fertilizers** | | | |
| | **Quick Release Nitrogen** | | |
| Ammonium Nitrate | 34.5 | 1-0-0 | 3 |
| Urea | 46 | 1-0-0 | 2 |
| Ammonium Sulfate | 21 | 1-0-0 | 5 |
| | **Slow Release Nitrogen** | | |
| Processed Sewage Sludge (Milorganite) | 6 | may vary | 17 |
| Ureaformaldehyde Products (Uranite, Vertanite, Nitroform, etc.) | 38 | 1-0-0 | 2.5 |
| IBDU (Par-Ex) | 31 | 1-0-0 | 3 |
| Sulfur Coated Urea | 32-40 | 1-0-0 | 3 |
| **Complete Fertilizers[1,2]** | | | |
| 12-6-6 | 12 | 2-1-1 | 8.5 |
| 16-8-8 | 16 | 2-1-1 | 6.5 |
| 20-10-10 | 20 | 2-1-1 | 5 |
| 15-5-5 | 15 | 3-1-1 | 6.5 |
| 24-8-8 | 24 | 3-1-1 | 4 |
| 12-4-8 | 12 | 3-1-2 | 8.5 |
| 16-4-8 | 16 | 4-1-2 | 6.5 |
| 24-4-8 | 24 | 6-1-2 | 4 |
| 27-3-3 | 27 | 9-1-1 | 4 |
| 15-15-15 | 15 | 1-1-1 | 6.5 |
| 10-10-10 | 10 | 1-1-1 | 10 |
| 19-19-19 | 19 | 1-1-1 | 5.5 |
| 6-12-12 | 6 | 1-2-2 | 17 |
| 10-20-20 | 10 | 1-2-2 | 10 |

[1] May or may not contain slow release nitrogen. Check product label for nitrogen sources contained in the fertilizer.

[2] Fertilizers selected should be sufficiently high in phosphate and potash to maintain soil test levels. Soils testing low in phosphorus and potassium will require grades with lower nitrogen to phosphate and potash ratios than medium or high-testing soils.

## Phosphorus and Potassium Sources

The requirements of lawngrasses for phosphorus and potassium are usually met by applying one of the complete fertilizers (Table 1). If phosphorus alone is required, **triple superphosphate** (0-46-0) may be used. If only potassium is needed, **muriate** of potash (0-0-60) is the most common source. These high-analysis straight phosphorus and potassium sources may be the most economical when establishing and renovating large areas, when soils test low in phosphorus or potassium.

## Table 2. Comparison of Quick and Slow-Release Nitrogen Sources

| Characteristic | Quick-Release | Slow-Release |
|---|---|---|
| Response Time | Quick | Slow |
| Danger of Foliar Burn | High | Low |
| Residual N | Low | High |
| Leaching Potential | Moderate | Low |
| Cost per pound of N | Low | Moderate |
| Application Frequency | Frequently at low rate | Infrequently at higher rate |

## Fertilizer-Pesticide Combinations

Fertilizers containing pesticides are popular because insecticides and herbicides may be applied along with the fertilizer. Nevertheless, both fertilizer and pesticide requirements must be understood to use such materials wisely and effectively. For instance, a broadleaf herbicide may be needed in the summer when cool-season grasses do not need to be fertilized, or the fertilizer should be applied at a time undesirable for herbicide application. Also, a fertilizer containing a pre-emergence herbicide must be applied in the spring and not in the fall to control crabgrass. Fertilizer combinations containing herbicides may injure or kill shrubs and trees if more than label-recommended rates of the pesticide are applied to the grass underneath them. Calibration and application must be precise, so those extra trips with the spreader around trees and shrubs should be avoided.

Another problem is the concentration of ingredients. It is difficult to adjust the rate of application for different uses. Application rates must be based on manufacturer's label recommendations for the insecticide or herbicide and not on amount of fertilizer needed. Throughout the year, additional fertilizer may be needed to supplement fertilizers containing fertilizer/pesticide combinations. Do not use fertilizer/herbicide combinations for fertilizing trees or shrubs.

# Fertilizer Recommendations

As a good environmental steward, you should base the amount of fertilizers applied to lawns on **soil test** information. Table 3 lists the fertilizer recommendations for cool- and warm-season lawns to be established on soils testing low in phosphorus or potassium. Less phosphorus and potassium would be needed when soils test medium or high. When soils test very high in phosphorus and potassium, only nitrogen-containing fertilizers are needed for establishment. Maintenance recommendation for cool- and warm-season lawngrasses are listed in Tables 4 and 5. Phosphorus and potassium maintenance fertilizer recommendations depend on soil test results.

Your soil test report will list specific amounts of fertilizer to apply on the basis of soil test levels. For example, when your soil tests low in P and/or K, 25 pounds of 6-12-12 per 1000 sq. ft. is recommended for establishment of a cool-season lawn (Table 3). If 6-12-12 is not available, you can substitute another fertilizer having a 1-2-2 ratio. In Table 6, it is shown that 12.5 pounds of 12-24-24 or 15.0 pounds of 10-20-20 will provide the N, $P_2O_5$ and $K_2O$ contained in the 25 pounds of 6-12-12. Using a fertilizer with a 1-1-1 ratio such as 10 pounds of 15-15-15 listed in Table 6 would supply the nitrogen but not the phosphorus or potassium requirement for lawngrass establishment on low-testing soils. Additional phosphorus and potassium would have to be supplied from straight or incomplete fertilizers.

As an example, 25 pounds of 6-12-12 supplies 0.06 X 25 = 1.5 pounds of nitrogen and 0.12 X 25 = 3.0 pounds of $P_2O_5$ and 0.12 X 25 = 3.0 pounds of $K_2O$. Ten pounds of 15-15-15 also supplies 0.15 X 10 = 1.5 pounds of nitrogen, but only 0.15X 10 = 1.5 pounds of $P_2O_5$ and $K_2O$. An additional 1.5 pounds of $P_2O_5$ and $K_2O$ must be supplied from some other source. Triple superphosphate (0-46-0) could be used to supply the $P_2O_5$ (1.5 pounds $P_2O_5$ / 0.46 = 3.3 pounds of 0-46-0 to supply the 1.5 pounds of $P_2O_5$). Muriate of potash (0-0-60) is an example of a fertilizer source that could be used to supply the additional 1.5 pounds of $K_2O$.

Lime is needed when the soil pH falls below 6.1. The amount of lime needed to adjust the soil pH to an optimum range can best be determined by a soil test. Lawn grasses may not efficiently utilize fertilizers when soil pH is not in the optimum range.

## Table 3. Fertilization Guidelines for Establishing Lawngrasses on Soils Testing Low in Phosphorus or Potassium

| Grasses | Pounds of Fertilizer Per 1000 Square Feet |
|---|---|
| Cool Season (fescues, Kentucky bluegrass, ryegrass) | 25 lbs. of 6-12-12 or equivalent[1] |
| Warm Season (bermudagrass, Zoysia) | 25 lbs. of 6-12-12 or equivalent[1] If established before July 1, apply one lb. nitrogen[2] six weeks after seeding or sprigging, plugging or sodding. |

[1] See Table 6 for equivalent amounts as based on nitrogen requirement.
[2] Supply from straight nitrogen sources (Table 1).

**Additional Considerations:** High nitrogen fertilizers containing small amounts of phosphate and potash (Table 1) are not generally suited for lawn establishment on low-testing soils.

## Table 4. Suggested Lawn Fertilization Schedule for Maintaining Cool-Season Lawngrasses Based on Soil Test Results

| Application Dates | Nitrogen Application Rate per 1000 sq. ft. | Ideal fertilizer ratio to use when soil test levels of available $P_2O_5$ or $K_2O$ is: | |
|---|---|---|---|
| | | Low | Medium to High |
| March 15 | 0.5 | 1-0-0 | 1-0-0 |
| April 15 | 0.5 | 1-0-0 | 1-0-0 |
| September 1 | 1.0 | 2-1-1 | 2-1-1 |
| October 15 | 1.0 | 2-1-1 | 1-0-0 |
| November 15 | 1.0 | 1-0-0 | 1-0-0 |
| Total Yearly Application (lbs. of nutrient per 1000 sq. ft.) | 4.0 N | 1.0 $P_2O_5$ 1.0 $K_2O$ | 0.50 $P_2O_5$ 0.50 $K_2O$ |

**Additional Considerations:**
When phosphorus or potassium tests in the very high range, further applications of the nutrient testing very high should be omitted. When both phosphorus and potassium tests in the very high range, only nitrogen is needed. Continue regular soil testing to determine lime requirement.

## Table 5. Suggested Lawn Fertilization Schedule for Maintaining Warm-season Lawngrasses Based on Soil Test Results

| Application Dates | Nitrogen Application Rate per 1000 sq. ft. | Ideal fertilizer ratio to use when soil test levels of available $P_2O_5$ or $K_2O$ is: | |
|---|---|---|---|
| | | Low | Medium to High |
| April 15 | 1.0 | 2-1-1 | 4-1-1 |
| June 1 | 1.0 | 1-0-0 | 1-0-0 |
| July 15 | 1.0 | 1-0-0 | 1-0-0 |
| September 1 | 1.0 | 2-1-1 | 4-1-1 |
| Total Yearly Application (lbs. of nutrient per 1000 sq. ft.) | 4.0 | 1.0 $P_2O_5$<br>1.0 $K_2O$ | 0.50 $P_2O_5$<br>0.50 $K_2O$ |

**Additional Considerations:**
When phosphorus or potassium tests in the very high range, further applications of the nutrient testing very high should be omitted. When both phosphorus and potassium tests in the very high range, only nitrogen is needed. Continue regular soil testing to determine lime requirement.

## Table 6. Substitution of Equivalent Amounts of Fertilizer

**Pounds of Various Fertilizers to Supply Equivalent Amounts of Nitrogen**

| **For a 6-12-12 Recommendation of** | 15-15-15 | 10-10-10 | 12-24-24 | 10-20-20 | 46-0-0[1] | 34.5-0-0[1] |
|---|---|---|---|---|---|---|
| 10 pounds | 4.0 | 6.0 | 5.0 | 6.0 | 1.3 | 1.7 |
| 15 pounds | 6.0 | 9.0 | 7.5 | 9.0 | 2.0 | 2.6 |
| 20 pounds | 8.0 | 12.0 | 10.0 | 12.0 | 2.6 | 3.5 |
| 25 pounds | 10.0 | 15.0 | 12.5 | 15.0 | 3.3 | 4.3 |

**Pounds of Various Fertilizers to Supply Equivalent Amounts of Phosphorus**

| **For a 6-12-12 Recommendation of** | 0-25-0[2] | 0-33-0[2] | 0-20-0[2] | 0-46-0[2] |
|---|---|---|---|---|
| 10 pounds | 4.8 | 3.6 | 5.7 | 2.6 |
| 15 pounds | 7.2 | 5.5 | 8.6 | 3.9 |
| 20 pounds | 9.6 | 7.3 | 11.4 | 5.2 |
| 25 pounds | 12.0 | 9.0 | 14.0 | 6.5 |

**Pounds of Various Fertilizers to Supply Equivalent Amounts of Potassium**

| **For a 6-12-12 Recommendation of** | 0-0-22[3] | 0-0-50[3] | 0-0-60[3] |
|---|---|---|---|
| 10 pounds | 5.5 | 2.4 | 2.0 |
| 15 pounds | 8.2 | 3.6 | 3.0 |
| 20 pounds | 10.9 | 4.8 | 4.0 |
| 25 pounds | 13.6 | 6.0 | 5.0 |

[1] When using straight nitrogen materials, phosphorus and potassium needs must be supplied from straight phosphorus and potassium materials.
[2] Only supplies phosphorus needs
[3] Only supplies potassium needs

# Applying the Fertilizer

Several factors influence the timing, frequency and rate of lime and fertilizer applications. These factors include the lawngrass species, characteristics of the fertilizer material, soil phosphorus, potassium and pH levels and type of soil.

## General Guidelines

A. The rate of application of quickly-available, water-soluble N-sources, such as ammonium nitrate or urea, should not exceed one pound of nitrogen per 1,000 square feet in a single applica tion. For example, three pounds of ammonium nitrate per 1,000 square feet with a guaranteed analysis of 34-0-0 will supply about one pound of nitrogen (3 pounds of fertilizer material X 0.34 pounds of nitrogen per pound of fertilizer material = 1.02 pounds of nitrogen) per 1,000 square feet. Higher rates may cause foliar burn or may accelerate leaf growth at the expense of root growth. Excessive nitrogen applications may reduce the lawngrasses' tolerance of high and low temperatures, drought, disease and also accelerate the need for additional lime. Slowly-available nitrogen sources can be applied less frequently and at higher rates due to their relatively low burn potential and extended nitrogen release pattern (Table 2). If most (greater than 50 percent) of the N in the fertilizer is water-insoluble, then fertilizer may be applied less frequently and the application rate may be from 1 1/2 to 2 pounds of nitrogen per 1000 square feet in one application.

B. Fertilizers are best applied as solid materials that are dry and flowable, not wet and lumpy.

C. Applications should be made when the lawngrass is dry.

D. Nitrogen-containing fertilizers should not be applied to cool-season grasses between June 1 and September 1 or during periods of drought because the plants are usually making little, if any, growth. Fertilizing during this time will stimulate crabgrass and other weeds. Conversely, nitrogen fertilizer applied in early spring or late fall to warm-season lawngrasses invites weeds and reduces hardiness.

E. When establishing a lawn, incorporate both lime and fertilizer into the top 4 to 6 inches of soil prior to seeding, sprigging, plugging or sodding.

F. If possible, apply maintenance lime and fertilizer just prior to rain or irrigate immediately after application.

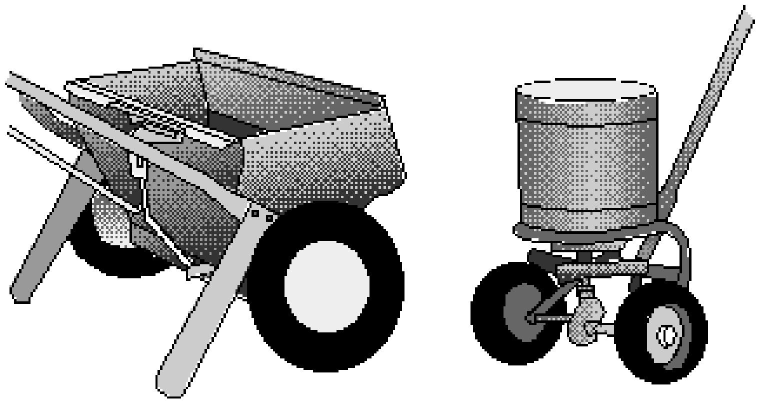


*Figure 5. Fertilizer spreaders can be pushed by hand or pulled behind riding lawn mowers or lawn tractors.*

G. Apply solid fertilizers with either a **gravity flow** or **centrifugal** spreader where possible (Figure 5). Applying fertilizer by hand is a less desirable but acceptable method.

H. There may be greater potential for foliage burn when fertilizers are applied in a liquid form. Liquid or water-soluble fertilizer materials may be applied with a hose-end sprayer or pressurized sprayer (Figure 6). To minimize potential for foliage burn and/or problems with fertilizer/pesticide combinations, apply only in amounts suggested by the manufacturer's label directions.

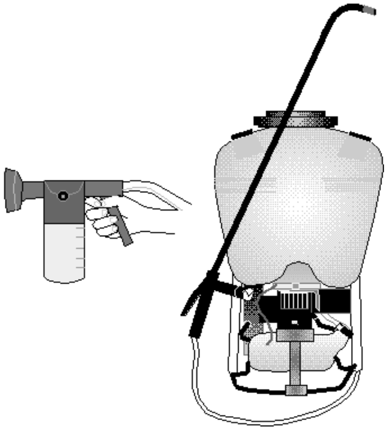


*Figure 6. Examples of hose-end sprayer and pressurized sprayer used to apply fertilizer materials.*

I. Follow a system or pattern when applying materials to avoid overlaps and skips (Figure 7). When using a centrifugal spreader or applying by hand, a more uniform distribution may be obtained by dividing the fertilizer into two equal portions and making two applications. Apply one portion over the entire area in one direction and the second portion over the same area in a crosswise direction (Figure 8).

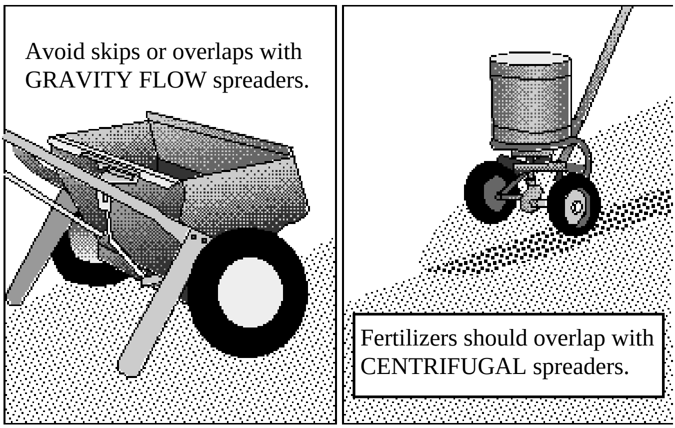



*Figure 7. Fertilizer application patterns for two types of spreaders.*

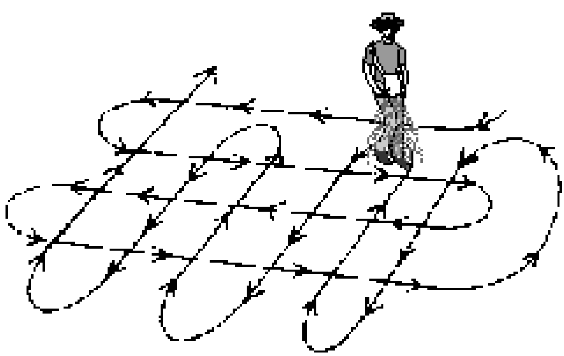


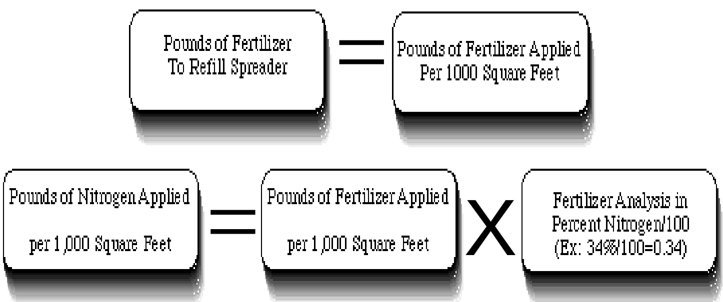
*Figure 8. Crosswise pattern of fertilizer application when using a centrifugal spreader or applying by hand.*

## Calibrating the Spreader for Solid Materials

Spreaders should be properly calibrated and maintained in good operating condition. The best way to check the calibration is to determine the amount of fertilizer applied to 1,000 square feet of lawn. To do this, fill the spreader to a given level with fertilizer and operate over the 1,000 square feet. Refill the spreader to the original level, accurately weighing the amount of fertilizer required.

For example, a 3-foot wide gravity flow (drop type) spreader pushed 333 feet covers 1,000 square feet. A centrifugal (rotary) spreader with a spread width of 5 feet would need to be operated a distance of 200 feet to cover 1,000 square feet of area. Additional information on the calibration of spreaders is available in the Extension factsheet “**Calibrating Fertilizer Spreaders for Lawn and Gardens**”(SP 268G).

Most name brand spreaders will have instruction or settings for applying different rates of fertilizers. However, these settings should be checked periodically for accuracy.




## Calibrating for the Application of Liquid Materials

To calculate N, $P_2O_5$ and $K_2O$ content of a liquid fertilizer, it is necessary to know both the grade and weight per gallon.

For example, if a material with a grade of 11-37-0 weighs 12 pounds per gallon, then each gallon will contain 0.11 x 12 = 1.3 pounds of nitrogen (N) and 0.37 x 12 = 4.4 pounds of phosphorus ($P_2O_5$).

Hose-end sprayers are widely available for applying liquid and water-soluble fertilizers (Figure 6). Calibration of many hose-end sprayers is rather difficult because of uncontrollable variations in pressure and amounts of material siphoned into the mixing tube or chamber. Applying fertilizers using a hose-end sprayer is best accomplished by dividing the area to be fertilized into sections of no more than 100 to 500 square feet. Calculate the total amount of fertilizer material to be applied within the selected unit area. Divide this total amount into at least three separate applications, attempting to cover the selected area as uniformly as possible with each application. Applications of fertilizer materials containing insecticides or herbicides with a hose-end sprayer are **not** advised. Pesticides must be applied with more precision at an appropriate rate.

Fertilizer materials containing insecticides or herbicides must be applied only in situations that are in accordance with label directions and **never** in amounts greater than recommended by the manufacturer's label. When application rates of fertilizer materials in liquid form are limited by amounts of recommended insecticides or herbicides, additional solid fertilizer will be needed to supplement the liquid application.

Unlike hose end-sprayers, pressurized sprayers can provide fairly consistent volumes of spray at low pressure. A simple calibration procedure is shown below:

1. Fill tank full or to marked level with water.
2. Spray an area of 1,000 square feet (100 feet by 10 feet).
3. Measure the amount of water needed to refill the tank to the same level as in step 1.
4. Mix the proper amount of liquid fertilizer material per 1,000 square feet of lawn area plus enough water to equal the volume that you measured in step 3, or dissolve the proper amount of water-soluble fertilizer material and fill to this same volume.

**Note:** To avoid foliage burn and/or problems with fertilizer pesticide combinations, **apply only in the amount of water and at rates recommended by the manufacturer's label**. Amount of water needed to cover a given area can be changed by varying walking/driving speed, pressure or type of nozzle. See Extension PB 1276, "**A Guide to Proper Sprayer Calibration**" for detailed information on calibration of pressurized sprayers.

# Liming the Lawn

Most soils in Tennessee become acid (sour) unless lime is applied. Leaching, the application of nitrogen fertilizers and the removal of grass clippings all contribute to increasing acid levels or reducing the pH of lawn soils. As acid levels increase, some plant nutrients become less available (Figure 9), microorganism activity is slowed and the environment for plant roots becomes unfavorable. As a result, lawns become less hardy and weeds become more prevalent as grasses are gradually thinned.

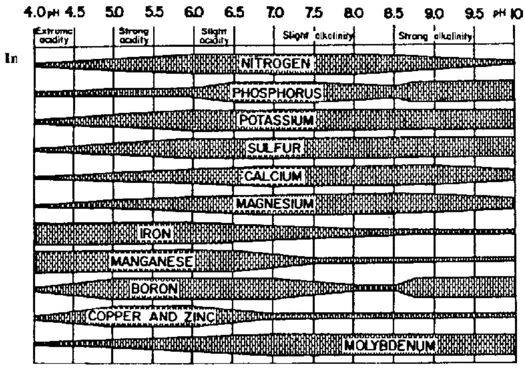



*Figure 9. Relative nutrient availability at varying soil ph values.*

## Amounts to Apply

The amount of lime to apply will depend upon soil pH, which is a measure of the amount of acid present. If the pH is above 6.0, acid content is low and lime is not recommended. However, as soil pH decreases below 6.0, acid levels rapidly increase and lime is needed.

The most reliable way to determine the need for lime is with a **soil test**. The pH of the soil is accurately measured and the amount of lime to use is recommended accordingly.

## Making the Application

For establishing a lawn, the total amount of recommended lime should be applied and tilled into the soil prior to seeding. When making maintenance applications, the amount recommended per 1000 sq. ft. should be divided into 50-pound increments and applied at six-month intervals. For example, if 150 pounds of lime are recommended for maintenance, apply 50 pounds per 1,000 square feet initially, 50 pounds after six months and 50 pounds one year after the initial application.

Lime applications can be made any time during the year, although late fall is preferred. Lime is best applied with a **gravity flow** spreader in a pattern similar to that for fertilizers. **Centrifugal** spreaders are suitable only for the newer types of pelletized lime formulations.

## Lime Sources

The main source of lime for lawns is **agricultural** or **ground limestone**, available in either calcitic or dolomitic forms. Calcitic limestone contains mostly calcium carbonate, while dolomitic limestone contains calcium plus magnesium carbonates. Both forms are sold in bulk and in bags. The most common form of bagged limestone is dolomitic and is available at most lawn and garden centers.

**Hydrated lime** (builders' lime or calcium hydroxide) can be used as a liming material, but is caustic and difficult to spread. It can irritate the skin and cause foliage burn unless carefully handled and applied. Hydrated lime should be applied to lawns when the foliage is dry and temperatures are relatively cool. Amounts to apply should be 3/4 of the amount of agricultural limestone recommended. However, no more than 25 pounds per 1,000 square feet should be used per application to established lawns. Hydrated lime is most commonly available at building supply dealers.

Lime particles that are compressed to form larger granules or pellets are referred to as **pelletized lime**. The purpose of the pellets is to make application easier. However, if the lime pellets do not readily slake or break down when in contact with rain or irrigation, their effectiveness in raising soil pH may be significantly reduced.

# Management Guidelines

A healthy, vigorous lawn resists insects, disease and weeds, the major pests of lawngrasses. By fertilizing properly, mowing often at a suitable cutting height, irrigating thoroughly and infrequently and managing thatch, you can help preserve the quality of your lawn.

## Mowing

Mowing is a fundamental lawn care procedure. The appearance of your lawn is affected by the height, frequency and pattern of mowing.

**Height:** The height at which you maintain your lawn affects leaf and root growth, rooting depth and the activity of above-ground (stolons) and below-ground (rhizomes) stems. Scalping your lawn or mowing too close to the soil surface often exposes bare soil and invites weed seed germination and weed invasion. Lawngrasses maintained below their recommended cutting height range are often weak, weedy and shallow-rooted. Lawns cut at a height above their optimum cutting height range are often puffy, soft and disease-prone. Recommended cutting height ranges for lawngrasses are presented in Table 7.

Mowing your lawn closely, within the recommended cutting height range, stimulates growth of aerial shoots, decreases the growth of roots and rhizomes and limits the amount of energy stored by lawngrasses. This often results in a beautiful, thick lawn less tolerant of environmental stresses. Higher cutting heights, within the recommended cutting height range, yield a coarser-textured, less dense lawn with greater root and rhizome growth.

Raise the cutting height within the recommended cutting height range before periods of stress. For example, increasing the cutting height of warm-season lawngrasses in early fall may help insulate the lawn from extreme low temperatures during cold winter months. Similarly, increasing the cutting height of cool-season lawngrasses in late-spring often promotes root growth before hot, dry periods of summer. Deeply rooted lawngrasses are more tolerant of high temperatures and drought.

## Table 7. Recommended Cutting Heights for Lawngrasses

| Lawngrass Species | Cutting Height (Inches) |
|---|---|
| **Warm-season** | |
| Common bermudagrass | 3/4 to 1 1/2 |
| Hybrid bermudagrass | 1/2 to 1 |
| Centipedegrass | 1 to 2 |
| Zoysia | 1/2 to 1 |
| **Cool-season** | |
| Fine fescues | 1 1/2 to 2 1/2 |
| Kentucky bluegrass | 1 1/2 to 2 1/2 |
| Perennial ryegrass | 1 1/2 to 2 1/2 |
| Tall fescue | 2 to 3 |

**Frequency:** The recommended frequency of mowing is determined by the vertical growth rate of lawngrasses and not by a set date. Ideally, no more than one-third of the shoot (above-ground) tissue should be removed while mowing. For example, a tall fescue lawn maintained at a height of 2 inches should be cut when it reaches a height of 3 inches. Hybrid bermudagrass maintained at a 1 inch cutting height should be cut when plants reach a height of 1 1/2 inches.

**Pattern:** Try to alternate the direction of mowing. By changing the mowing pattern each time you mow, you encourage lawngrasses to grow upright and distribute wear and soil compaction.

**Clipping Cycling:** Actively growing lawngrasses contain the 16 nutrients essential for survival and reproduction. By allowing leaf clippings to drop, rather than collecting them, bagging them and placing them at the curb, you are recycling nutrients and reducing the amount of landscape waste reaching your landfill. Generally, small leaf clippings lying on the soil surface decompose rapidly and do not contribute significantly to thatch. For more information regarding clipping cycling, please refer to Extension PB1455, "**Lawn Care To Reduce Landscape Waste**."

## Irrigation

Water is vitally important for your lawn's survival. An actively growing lawngrass usually contains more than 75 percent water by weight. An actively growing lawn generally requires from 1 to 1 1/2 inches (630 to 945 gallons per 1000 sq. ft.) of water each week.

In Tennessee, the total annual amount and distribution of precipitation is insufficient for maintaining consistent lawn quality. Color of leaves of warm-and cool-season lawngrasses may fade and plants may enter a dormant state in response to a lengthy drought. You can supplement natural precipitation by irrigating. Effective irrigation promotes deep rooting of lawngrasses when temperatures favor root growth and preserves the root system when environmental conditions limit growth.

Light, frequent irrigations most often result in a shallow lawngrass root system (Figure 10). Water deeply and infrequently, thoroughly moistening the soil to a depth of 4 to 6 inches. Do not irrigate again until the first symptoms of drought stress appear. Drought-stressed lawns are often bluish-green in color. Lawngrass plants may have rolled leaves. Footprinting is an indication that a lawn is in need of water. Lawngrasses low in water do not bounce back quickly when walked on. If footprints remain or disappear slowly, it may be time to irrigate. If necessary, use a soil probe to help you determine the amount of water available to your lawn.

Traditionally, mid-day irrigation is preferred to minimize disease problems. Water droplets remaining on leaves for an extended period of time may promote disease activity. By watering the lawn during early morning (i.e. from 5 to 7 a.m.), you can limit the amount of time that water droplets remain on the leaves and reduce the amount of water loss due to evaporation.

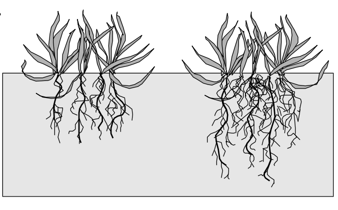



*Figure 10. Light, frequent irrigations most often result in shallow lawngrass root system.*

# Thatch Management

Generally, lawngrasses constantly develop new leaves, stems and roots. When old plants and plant parts die, they decompose, forming humus. Thatch, a layer of living and dead lawngrass parts located on the soil surface, accumulates when plant materials are contributed at a rate exceeding the rate of decay. A thin layer of thatch is very desirable. Thatch insulates the soil from extreme high and low temperatures, conserves water by reducing evaporation from the soil surface and cushions the lawngrass crowns (growing points) from wear injury resulting from foot traffic. Too much of this tightly entwined layer of living and decomposing plant materials may cause severe problems.

Excessive thatch can restrict the movement of air, water and nutrients into soil. Lawngrasses rooted in thatch may be prone to high and low temperature stresses. Many insect pests and fungal pathogens thrive in thatch. Dethatching is recommended when Kentucky bluegrass develops 1/3 inch of thatch and 1/2 inch of thatch accumulates in bermudagrass, centipedegrass, Zoysia, fescues and perennial ryegrass. To determine the width of the thatch layer in your lawn, remove several pie-shaped wedges of soil and grass and measure the width of the zone of organic matter (Figure 11).

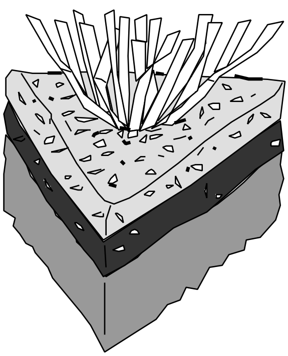



*Figure 11. To determine the width of the thatch layer in your lawn, remove several pie-shaped wedges of soil and grass and measure the width of the zone of organic matter.*

**Dethatching**: Hand raking is seldom vigorous enough to remove large amounts of thatch. Power rakes and vertical mowers are designed for thatch removal. These machines have blades, knives or tines mounted on a horizontal reel or shaft. The blades, knives or tines revolve in a plane that is vertical to the ground and penetrate the thatch layer, lifting and depositing a portion of thatch on the lawn surface (Figure 12). Tine or rake-type dethatching machines remove thatch with little damage to the lawn. However, they are not generally recommended for use on Zoysia (flexible tines scratch the lawn surface but may not penetrate the thatch layer or lift thatch). A lawn vacuum or rake may be used to remove the loosened organic matter after dethatching.

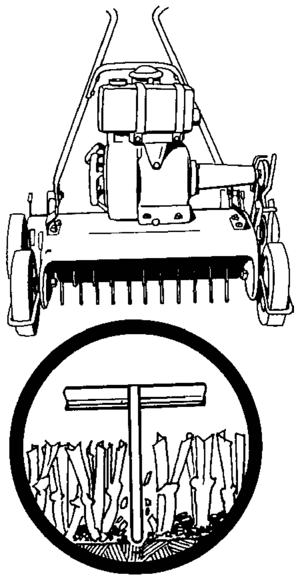


*Figure 12. Power rakes and vertical mowers are designed for thatch removal. These machines have blades, knives or tines mounted on a horizontal reel or shaft which revolve in a plane that is vertical to the ground.*

Early fall is preferred for removing thatch from cool season lawngrasses. Bermudagrass, centipedegrass and Zoysia may be dethatched while dormant in late winter or following spring recovery. In severe situations, when mechanical dethatching also dislodges most of the lawngrass plants, light thatch removal may be necessary each year.

The recovery of your lawn following dethatching depends on the level of soil fertility, the method and degree of dethatching, the lawngrass growth rate and the amount of thatch layer present.

**Core Aeration:** Core aeration promotes water, nutrient and air movement into the soil, and relieves soil compaction. Mechanical core aerification equipment punches through thatch into the soil and removes small soil cores, depositing them on the lawn surface (Figure 13). After cores have air-dried, you can use a rotary mower or drag mat to incorporate them into the lawn. The soil mixed with thatch contains microorganisms which feed on thatch and speed its decay.

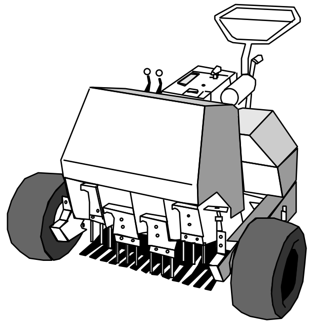


*Figure 13. Mechanical core aerification equipment punches through thatch into the soil and removes small soil cores, depositing them on the lawn surface.*

Vertical mowers, power rakes, core aerifiers and lawn vacuums may be rented at many lawn and garden equipment dealerships or rental agencies, nurseries and garden supply centers.

# Judicious Use of Fertilizers and Environmental Quality

## Soil Testing, A Best Management Practice

With increasing awareness and concern for our environment, soil testing and the application of lime and fertilizers only in accordance with objectively identified needs play an increasingly important role toward assuring a healthy environment for everyone. Plant nutrients that are being utilized for plant growth and development are a part of the solution, **not** a part of the problem.

An additional benefit of applying nutrients only on the basis of soil testing include monetary savings realized when lime and/or fertilizer is not needed because of high or very high levels already present in the soil. Identification of lime and/or fertilizer needs by soil testing also saves the homeowner money by reducing the potential for lawn failure because of inadequate fertility.

## Precautionary Statement

To protect people and the environment, pesticides should be used safely. This is everyone's responsibility, especially the user. Read and follow label directions carefully before you buy, mix, apply, store, or dispose of a pesticide. According to laws regulating pesticides, they must be used only as directed by the label.

## Disclaimer Statement

Any pesticides recommended in this publication were registered for the prescribed uses when printed. Pesticide registrations are continuously being reviewed. Should registration of a recommended pesticide be canceled, it would no longer be recommended by The University of Tennessee.

Use of trade or brand names in this publication is for clarity and information; it does not imply approval of the product to the exclusion of others which may be of similar, suitable composition, nor does it guarantee or warrant the standard of the product.

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