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Fertilizing Lawns

Essential Elements

All plants require certain chemical elements for proper growth and appearance. Of these at least 17 are known to be essential elements. Table 1 lists the 17 known elements and the sources from which plants obtain them. All essential elements except carbon, hydrogen and oxygen are obtained from the soil and absorbed by plant roots. If limited nutrients are available in the soil, lawn growth and quality may be limited. However, essential elements can be added to the soil through fertilizer applications.

Table 1. Essential Elements Required by Lawn Grasses (From Southern Lawns).

Macronutrients		Micronutrients
From Air/Water	From Soil	From Soil
Carbon	Nitrogen	Iron
Hydrogen	Phosphorus	Manganese
Oxygen	Calcium	Zinc
	Magnesium	Boron
	Potassium	Chlorine
	Sulfur	Copper
		Molybdenum
		Nickel

Lawns require the macronutrients nitrogen (N), phosphorus (P) and potassium (K) in the greatest quantities. Calcium, magnesium and sulfur are required less frequently and in smaller quantities.

Dolomitic limestone is the major source of both calcium and magnesium. So, in addition to reducing soil acidity, it acts as a supplement to the fertilizer.

The micronutrients iron, manganese, zinc, boron, copper, chlorine, molybdenum, and nickel are required in very minute quantities and less often than the macronutrients. Micronutrients are as essential as the macronutrients but are required in smaller amounts. Table 2 outlines those elements categorized as the primary, secondary and micronutrients.

Types of Fertilizers

Fertilizers are identified by analysis and/or brand name. Many common commercial fertilizers are known by their analysis such as 16–4–8, 10–10–10 or 15-0-15. The numbers indicate the percentage of each of these nutrients in that particular fertilizer. A 16–4–8 analysis, for example, contains 16% nitrogen, 4% available phosphate and 8% soluble potash. Thus, a 100-pound bag of 16–4–8 would contain 16 pounds of nitrogen, 4 pounds of phosphate, and 8 pounds of potash. These three constituents – nitrogen, phosphorus, and potassium – are called the primary plant nutrients, and if all three are present, then these fertilizer are considered complete fertilizers. Complete fertilizers like 16–4–8, 12–4–8, and 18-24-6 are commonly recommended for lawn fertilization. Incomplete fertilizers are missing one of the macronutrients, such as 15-0-15, 21-0-0, 34-0-0, 0-0-60, and 0-46-0, and these can be used when one or more nutrients are not needed, or a single nutrient needs to be supplemented.

Table 2. Listing of Primary, Secondary and Micronutrients.

Primary Nutrients	Secondary Nutrients	Micronutrients
Nitrogen	Calcium	Iron
Phosphorus	Magnesium	Manganese
Potassium	Sulfur	Zinc
		Boron
		Chlorine
		Copper
		Molybdenum
		Nickel

Besides the primary elements (N, P and K) the fertilizer may contain secondary plant nutrients, such as calcium, magnesium, sulfur, iron, manganese, zinc, copper, and molybdenum. Both primary and secondary elements, if present, are listed on the fertilizer label. The label also tells the materials from which the fertilizer has been made. This information appears beside the "derived from" statement. An example of a mixed fertilizer containing several different sources of nitrogen is shown in Table 3.

Table 3. Example of a Fertilizer Label (From *Southern Lawns*).

Lawn (Turf-Type) Fertilizer: 16-4-8	
Total Nitrogen	**16%**
8.50% Ammoniacal Nitrogen	
2.00% Nitrate Nitrogen	
0.90% Water Soluble Organic Nitrogen	
4.60% Water Insoluble Nitrogen	
Available Phosphoric Acid (P2O5)	4%
Soluble Potash (K2O)	8%

In addition to complete fertilizers, some materials are used almost exclusively to supply nitrogen to the lawn for rapid growth and dark green color. These materials include ammonium sulfate with urea (34% N), ammonium sulfate (21% N), calcium nitrate (15.5% N), IBDU (31% N), urea (45% N), and ureaform (38% N). Nitrogen fertilizers can be used as frequently as or more frequently than complete fertilizers, if needed.

For lawns, the best yearly fertilization program is based on soil analysis results and usually includes a combination of one or two applications of a complete fertilizer and several supplemental applications of a nitrogen fertilizer. The complete fertilizer supplies nitrogen, phosphorus, and potassium, while the nitrogen material supplies mainly nitrogen. **While nitrogen fertilization is based on the desired growth rate and type of turfgrass being grown, the phosphorus and potassium fertilization rate should be based on the analysis of a soil sample and the recommendations obtained from it.** For information on how to sample soils for testing, refer to HGIC 1652, *Soil Testing.*

Fertilizer Application

Most fertilizers are applied at a rate determined by the type and amount of nitrogen present in the material. Nitrogen is the nutrient most used by the grass, and often is the material that burns the lawn when applied at excessive rates.

The pounds of actual N in every fertilizer can be determined by dividing the percent N listed on the label into 100. For example, in applying soluble nitrogen from ammonium sulfate, divide 21% (the N content of ammonium sulfate) into 100 to find out the number of pounds of fertilizer that will supply 1 pound of N over 1000 square feet of turf. Since 100 divided by 21 equals 4.75, apply 4.75 pounds of ammonium sulfate per 1000 square feet of lawn to supply 1 pound of actual nitrogen. If applying N in a 16-4-8 fertilizer and the nitrogen in the product is all slow-release organic nitrogen, one could apply 2 pounds of actual nitrogen. The calculation is the same as the first sample. Divide 100 by 16 (16 is the percent N in the fertilizer). The answer is about six to apply 1 pound of actual N per 1000 square feet of turf, so 12 pounds of the 16-4-8 over 1000 square feet of turf would supply 2 pounds of nitrogen.

An alternative method of calculating this rate is to divide the amount of nitrogen desired per 1,000 square feet of lawn by the percentage of nitrogen contained by the fertilizer source being used. For example, as illustrated below, you wish to apply 1 pound of actual nitrogen per 1000 square feet of lawn using a 16-4-8 fertilizer source, divide 1 pound nitrogen desired per 1000 square feet of lawn by 0.16 (or 16% N from the 16-4-8 fertilizer).

Rate of nutrient wanted divided by % nutrient (N) in fertilizer:

$$\frac{1 \text{ lb N}/1000 \text{ ft}^2}{0.16} =$$

6.25 pounds of a 16-4-8 fertilizer per 1000 square feet of lawn. This will supply 1 pound of actual N per 1000 square feet of lawn.

Several fertilizer materials are listed in Table 4, and the rate of application for 1 pound of N is already calculated. For example, if using ammonium sulfate with urea (34-0-0) on the lawn, note that the table lists the rate of application at 3 pounds of material per 1000 square feet.

When a soil test of the lawn is not available, Table 5 can be used as a guide for lawn fertilization. Table 5 shows two lawn fertilization programs (low and high maintenance) for each type of lawn grass for two regions of South Carolina. Note that most programs use a combination of complete fertilizers and nitrogen fertilizers, applied during different months of the year. In the total yearly N column, the lower number would correspond to a low maintenance program and the high number would correspond to a high maintenance program.

Keep in mind that a turfgrass fertility program will be based on several factors including soil type, environmental conditions of the site, the turfgrass being grown, the desired management program and the quality desired of that turf. A generic turf fertility program may not fit every lawn situation in a general area.

To use Table 5, find the particular lawn grass and part of the state, and then apply the fertilizer indicated during the month(s) recommended. For rates of various materials, refer to Table 4. For example, to obtain a desirable centipedegrass lawn in Piedmont and Mountain areas of South Carolina, apply ½ to 1 lb of N/1000 sq. ft. in May and August. Supplemental iron (Fe) applications can be made in summer to provide green color without excessive lush grass growth.

Table 4. A Guide to Rate of Fertilizer Materials to Use on Lawns (From Southern Lawns).

Nitrogen Fertilizers	%N	Pounds needed to supply 1 pound actual nitrogen per 1000 sq ft
Rapid N Release (Inorganic)		
Nitrate of Soda	16.0	6
Nitrate of Potash	13.0	8
Calcium Nitrate	15.5	7
Ammonium sulfate with urea	34.0	3
Ammonium Sulfate	21.0	5
Mono-ammonium Phosphate	11-48-0	9
Diammonium Phosphate	18-46-0	5.5
Rapid N Release (Organic)		
Urea	45 - 47	2
Cyanamid	21	5
Slow N Release (Natural Organics)		
Sewage Sludge	6.0	16
Cottonseed Meal	7.0	15
Slow Release (Synthetics)		
Ureaform	38	2.5
Nitroform	38	2
IBDU	31	3
Sulfur coated urea	36	3
Polymer-/Plastic-/Resin-coated urea	varies	varies
Some common potassium and phosphorus fertilizers include: Muriate of Potash (60% K_2O) Sulfate of Potash (50% K_2O) Potassium Carbonate (64% K_2O) Potassium Nitrate (44% K_2O) Sulfate of Potash-Magnesia (22% K_2O) Superphosphate (20% P_2O_5) Triple Superphosphate (46% P_2O_5)		
CAUTION: Practically all inorganic fertilizers can burn grass foliage. These materials should watered from the turf foliage immediately after application.		

Organic vs. Inorganic Fertilizers

There is much confusion over whether to use organic or inorganic fertilizers on lawns. Both types have advantages and disadvantages; however, the type of fertilizer makes no difference to the grass. Grasses absorb nitrogen only as nitrate ($NO3^-$) or ammoniacal-nitrogen ($NH4^+$). Organic nitrogen is not used directly by the plant but must first be converted to one of these chemical forms by soil microorganisms before plants can use them.

The advantages and disadvantages of organic or chemical fertilizers relate to the consumer, not the lawn grass. Inorganic and organic nitrogen fertilizers have advantages and disadvantages as listed in Table 6. Some common organic fertilizers and their nitrogen contents are listed in Table 4. Select a nitrogen source after considering the pros and cons of the various forms.

Table 5. Lawn Fertilization Schedules for Various Turfgrasses & Geographical Areas of South Carolina.

Lawn Grass	J	F	M	A	M	J	J	A	S	O	N	D	Total Yearly N (lbs) per 1000 ft²
Piedmont and Mountain Areas of the South Carolina (See notes section below for a more detailed recommendation.)													
Bermudagrass	--	--	--	N?+K	C	N+K	N+K	C	--	--	--	--	3-5
Carpetgrass	--	--	--	--	C	--	--	C	--	--	--	--	1-2
Centipedegrass	--	--	--	Fe	C	--	Fe	C	--	--	--	--	1-2
St. Augustinegrass	--	--	--	Fe	C	N^++K	C	C	Fe	--	--	--	1-4
Tall Fescue/Ky Bluegrass	--	C	--	--	--	--	--	--	C	--	C	--	1-3
Zoysiagrass	--	--	--	N?+K	C	N+K	N+K	C	--	--	--	--	3-5
Coastal Plain and Sandhills Regions of South Carolina (See notes section below for a more detailed recommendation.)													
Bahiagrass	--	--	--	C	Fe	N	--	C	Fe	--	--	--	1-4
Bermudagrass	--	--	--	C	N+K	N+K	N+K	C	--	--	--	--	3-5
Carpetgrass	--	--	--	C	--	Fe	--	C	Fe	--	--	--	½-2
Centipedegrass	--	--	--	C	--	Fe	--	C	Fe	--	--	--	½-2
St. Augustinegrass	--	--	--	C	N^+ +K	N^++K	--	C	--	--	--	--	1-4
Zoysiagrass	--	--	--	C	N+K	N+K	N+K	C	--	--	--	--	3-5

C = Apply a complete fertilizer (e.g., 16-4-8 or 12-4-8) at 1.0 lb N/1000 square feet for high maintenance lawns or ½ lb N/1000 square feet for low maintenance lawns. An additional potassium application at 1 lb K/1000 square feet in late August through mid-September may increase turfgrass winter hardiness.

N = Water-soluble inorganic nitrogen source (e.g., ammonium sulfate or ammonium sulfate with urea) is applied at 1.0 lb N/1000 sq ft. for higher maintenance lawns and ½ lb N/1000 square feet for low maintenance lawns. The first N fertilizer application for the year should be made once the grass has greened up and growing in the spring. The addition of potassium when applying nitrogen will benefit most lawns especially in sandier soils.

K= when applying N fertilizer alone, an addition of potassium (K) may benefit the turf especially in sandier, well-drained soils during high rainfall years, as potassium tends to leach from sandy soils rather quickly. Potassium can be applied by itself such 0-0-60 or can be applied in an incomplete fertilizer with a 1-0-1 ratio such as 15-0-15. Additionally, some preemergence herbicides come mixed with 0-0-7 fertilizer.

Fe = apply iron to provide greener color without stimulating excessive grass growth. Ferrous sulfate (2 oz in 3-5 gal water per 1000 square feet) or a chelated iron source may be used when temperatures are 80 ºF and good soil moisture present. This will also be beneficial where the soil pH is high or alkaline.

N^+ = to reduce chinch bug problems, use a slow-release N source during the summer.

$N^{?}$ = monitor weather conditions and temperatures before applying your first N application in the cooler regions of South Carolina. Late winter/early spring cold temperatures could set your first fertilization later by several weeks.

Notes:
Total yearly nitrogen rates listed per 1000 square feet are suggested guidelines. Actual rates depend on the desire aesthetics and location. Those desiring optimum aesthetics may choose the higher rates. The higher rate range also may be needed for lawns located in sandy soils and/or those with longer growing seasons nearer the coast. Lawns being grown on heavier clay soils may perform fine with lower N rates especially in locations with short growing seasons.
Fertilizing centipedegrass in excess of 2 lbs N/1000 square feet per year is not normally recommended as this often results in the disease/winter-kill phenomena termed 'centipedegrass decline' due to excessive thatch. Also, once established, centipedegrass should not receive additional phosphorus fertilizer unless soil tests suggest otherwise.
Be aware that fertilizing turf using a high maintenance program will require more frequent mowing and could lead to an increase in insect and disease problems, especially during warm, wet periods. A disease and insect monitoring program will need to be instituted to monitor for problems.
For northern (cooler) portions of each geographical zone listed, fertilize dates may be 1 to 2 weeks later in spring and 1 to 2 weeks earlier in fall; for southern (warmer) regions of each geographical zone listed, fertilizer dates may be 1 to 2 weeks earlier in spring and 1 to 2 weeks later in the fall than listed.

Table 6. Advantages & Disadvantages of Inorganic & Organic Nitrogen Fertilizer Sources (From *Southern Lawns*).

	Advantages	Disadvantages
Inorganic Nitrogen Sources	Readily available N Low cost per unit N Easily controlled N levels Little problem of residual N May have greater efficiency	Leaches readily Danger of fertilizer burn High salinity potential Must be applied frequently at low rates Usually acid forming
Organic Nitrogen Sources	Slow release of N Less subject to leaching Small danger of grass burn Applied infrequently at high rates	May be expensive Not released readily in cold weather Slow response May contain weed seeds (especially manure)

Supplemental Iron Application

Many times turfgrasses, such as centipedegrass, bahiagrass, zoysiagrass and St. Augustinegrass, turn yellow during the spring due to a lack of iron or nitrogen. However, fertilization with nitrogen is not always desirable since this often encourages disease and insect problems. Many times the addition of iron (Fe) to these grasses provides the desirable dark green color, but does not stimulate excessive grass growth, which follows nitrogen fertilization. This is especially useful when growing turf in an alkaline soil (soil with a high pH), or when soil phosphorus levels are high.

Usually iron sulfate (2 ounces per 3 to 5 gallons of water per 1000 square feet) or a chelated iron source is used to provide this greening effect. The effect from supplemental iron application is only temporary (about 2 to 4 weeks); therefore, repeat applications are necessary for summer-long color. Do not apply iron when air temperatures are greater than 80 ^{o}F or onto wet grass, and water-in immediately after application to minimize turf burn.

Precautions

All fertilizers may burn lawn grasses if improperly applied. Never exceed the recommended rate, or the lawn may be damaged. Always apply fertilizers when temperatures are cooler and the grass leaves are dry and water thoroughly after application.

Excerpted with permission from *Southern Lawns*, Bert McCarty, Editor, Clemson University Public Service Publishing, 2003.

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