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Practical Lawn Fertilization

J. MICHAEL HENRY, University of California Cooperative Extension Farm Advisor, Environmental Horticulture, Riverside County; **VICTOR A. GIBEAULT**, University of California Cooperative Extension Specialist, Environmental Horticulture, University of California, Riverside; **VINCENT F. LAZANEO**, University of California Cooperative Extension Farm Advisor, Environmental Horticulture, San Diego County

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Proper maintenance is the prerequisite to having an attractive lawn. One of the major requirements of proper maintenance is adequate fertilization to insure optimal growth and development of leaves, roots, and the other parts of the plant. A well-planned and executed maintenance program—which includes mowing, irrigation, and thatch and soil compaction control as well as fertilization—will produce good-looking, pleasingly green turfgrass that will quickly recover from wear, pest damage, or mechanical injury.

WHAT IS FERTILIZER?

A fertilizer is any material containing at least one of the essential elements for plant growth that is added to the soil for the purpose of supplementing the plant nutrient supply. The elements essential for plant growth are shown in table 1.

Most nutrients are normally available in plentiful amounts in soil, air, or water, but some are needed by turfgrass in greater amounts than the soil can supply. All lawns need nitrogen (N) fertilizer; in some areas, phosphorus (P), potassium (K), or sometimes iron (Fe) may also be required. Check with your local Cooperative Extension farm advisor or master gardener for possible nutrient deficiencies in your particular area.

WHEN DOES YOUR LAWN NEED FERTILIZER?

There are two methods to determine when and which fertilizer elements are needed. The most common method is to visually evaluate the appearance of a turfgrass stand.

A nitrogen-deficient lawn has poor color (yellow-green to yellow), slow or restricted growth, poor density with possible weed invasion (especially clovers), and an obvious reduction in grass clippings after mowing. Iron deficiency also results in yellowing of young turfgrass leaves, although there is no initial stunting of the growth. Phosphorus is the third most common nutrient deficiency. A phosphorus-deficient turfgrass stand has a dull, blue-green color, which progresses to individual leaf blades, giving them a purple color along their margins and then a reddish tint from leaf blade tip to base.

Visual evaluation of the lawn is often adequate for determining when to apply more fertilizer. Irrigation deficiency or pest or disease problems may also cause yellowing or reduced growth, but they cause more dead (brown) leaf blades, and symptoms are usually not as uniform throughout the grass stand as with nitrogen deficiency. If you are interested to learn the exact levels of soil nutrients, submit a representative soil sample to a commercial soil-testing laboratory. The sample should be at least 1 pint (0.5 l) and should be derived from several sampling locations in the lawn. Local University of California Cooperative Extension offices do not perform this service, but they may be able to suggest private labs that do agricultural or horticultural soil testing for a fee.

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Table 1. Essential turfgrass nutrients, in order of relative quantity

Nutrients needed in comparatively large amounts

Source	Nutrients
air and water	carbon (C)
	hydrogen (H)
	oxygen (O)
soil	nitrogen (N)*
	phosphorus (P)†
	potassium (K)‡
	calcium (Ca)
	magnesium (Mg)
	sulfur (S)‡

Nutrients needed in comparatively small amounts

Source	Nutrients
soil	iron (Fe)‡
	copper (Cu)
	zinc (Zn)
	manganese (Mn)
	molybdenum (Mo)
	boron (B)
	nickel (Ni)
	chlorine (Cl)

NOTES:
* Fertilization always needed.
† Fertilization probably needed at planting; less likely to be needed on established turf.
‡ Fertilization possibly needed.

WHAT KIND OF FERTILIZER SHOULD YOU USE?

Table 2 shows commercially available fertilizers that supply the commonly needed elements. The nutrient sources are listed on each fertilizer bag in an analysis statement that gives the percentage of each nutrient supplied by the product. For example, 16-8-8 is a turf fertilizer that contains 16 percent nitrogen, 8 percent phosphorus (P_2O_5) and 8 percent potassium (K_2O). A fertilizer containing nitrogen, phosphorus, and potassium is often referred to as a complete fertilizer (fig. 1). Nitrogen is the major element in a complete lawn-type fertilizer.

With all the different lawn fertilizers on the market, one might wonder how they are different, other than in percentages of nutrients. One of the main differences is the way in which products make their nitrogen available to grass roots. Fast-release or soluble nitrogen products are usually the least costly. They can provide a quick greening response for a relatively small amount of product applied. However, they can "burn" the lawn if improperly applied (fig. 2), and they also are soon used up, which means more frequent application will be needed.

Natural organic materials, including biosolids (sewage sludge), animal manures, compost, or other by-products, also contain plant nutrients. Although safer to use because they are not as apt to burn turf, they are generally bulky due to their low concentration of nutrients and are often more

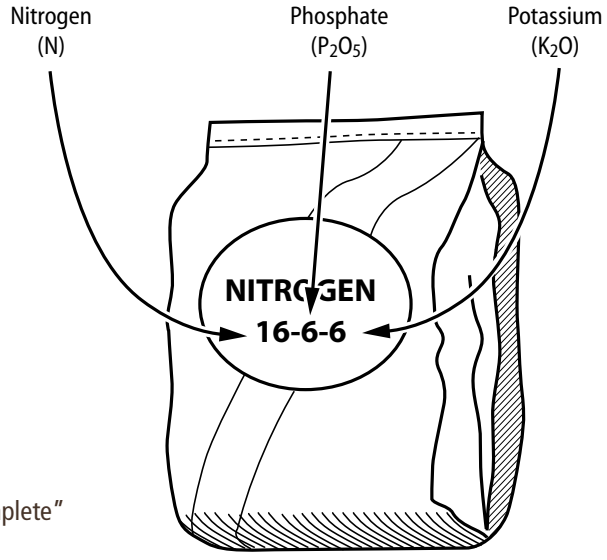


Figure 1. A sample label from a "complete" lawn fertilizer bag.

Table 2. Information on selected commercial fertilizers used on lawns

Fast Release soluble nitrogen (N) fertilizers	Analysis (% N-P-K)	Amount needed to apply 1 lb actual N/1,000 sq ft (lb, approx.)	Amount needed to apply 0.5 kg actual N/100 sq m (kg, approx.)	Relative cost/lb of actual N	Remarks
ammonium nitrate	33-0-0	3.0	1.5	low	Can burn. Contains immediately available nitrate. Used for winter nitrogen fertilization.
ammonium phosphate sulfate	16-20-0	6.0	3.0	low	Used mainly as a preplant fertilizer for soil incorporation.
ammonium sulfate	21-0-0	5.0	2.5	low	Acidic soil reaction. Can burn turf if over overapplied.
calcium nitrate	15.5-0-0	6.5	3.3	low	Quickly available. Can burn turf. Used for winter fertilizer.
urea	45-0-0	2.0	1.0	low	Converts quickly in soil to available ammonium nitrogen. Very high burn potential.
Natural organic materials and fertilizers	**% N**				
activated biosolids (sewage sludge)	4–7	20	10	high	Significant phosphorus and moderate nitrogen; some potassium present.
digested biosolids sludge)	1.5–3	40	20	high	Low nitrogen availability; some (sewage phosphorus present.
poultry manure	3–4	30	15	high	Good source of nitrogen, phosphorus. Odor may be rather strong.
steer manure	2	50	25	high	Low nitrogen, good source of phosphorus and potassium, but not a favored turf weed fertilizer. May introduce weed seeds and/or increase salinity.
Slow-release fertilizers	**% N**				
coated/soluble fertilizer	varies	varies*	varies*	high	Foot traffic and mowing equipment may crush coated fertilizer and destroy slow-release properties, especially on putting greens.
ESN (neutralized ionic elastomers)	varies	varies*	varies*	high	Coating is semipermeable, allowing release of dissolved ureas through membrane for up to 6 months.
IBDU (isobutyl-enediurea)	varies	varies*	varies*	high	Nitrogen released by slowly dissolving in soil water. Long-lasting response.
methylene-urea	varies	varies*	varies*	high	Similar to UF but quicker nitrogen release.
polymer-coated ureas	varies	varies*	varies*	high	More controlled release than SCU with addition of plastic to sulfur coat.
sulfur-coated urea	32–41	2.5–3.0	1.3–1.5	moderate	Release can be up to 16 weeks for some formulations.
UF (ureaform)	38	3.0	1.5	high	Nitrogen released by soil microorganisms. Poor winter release; faster summer release.

NOTE: * Follow manufacturer's recommendations for application rates.

Figure 2. Grass "burned" by spill of lawn fertilizer.

expensive than soluble fertilizers per pound of actual nitrogen content. Some of these natural materials may contain weed seeds or salts, and some may have unpleasant odors. Their advantage is that they release nutrients over an extended period of time.

Slow-release chemical fertilizers allow nitrogen to become available over longer periods of time than do soluble fertilizers, and they won't burn turf even when applied at comparatively high rates, such as 2 pounds of actual nitrogen per 1,000 square feet (1 kg per 100 sq m) and higher. Such products contain much higher concentrations of required plant nutrients than do the natural organics, eliminating the bulkiness associated with natural organic fertilizers. Slow-release chemical products can be applied less frequently than soluble fertilizers, but their release rate can vary depending on the product type, amount of water applied, temperature, and activity of soil microorganisms. They are often recommended for sandy soils and other situations where fertilizers are easily leached out of the turf root zone or into underground water supplies, reducing water quality for drinking and other beneficial uses.

HOW OFTEN AND WHEN SHOULD YOU FERTILIZE?

Creating a fertilizer program that is right for your lawn involves many factors. Turfgrass species, type of fertilizer, climate, soil, desired quality level, and budgetary considerations all play a role. The guidelines presented in table 3 give a basic fertilization schedule that should produce acceptable turf. More frequent fertilization would be required for specialty turfs such as playing fields and golf course putting greens; more would also be required in autumn to maintain the green color of warm-season grasses in mild-winter regions or anytime a greener, more lush lawn is desired.

Table 3. Turfgrass fertilization program showing when to apply equivalent of 1 lb actual N/1,000 sq ft (0.5 kg actual N/100 sq m)*

Turfgrass type	Months to apply fertilizer											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Southern California												
warm-season				X†	X				X	X		
cool-season			X		X					X	X†	
Central Valley, North and Central Coast												
warm-season					X†	X			X	X		
cool-season					X				X	X†		
Mountain Regions												
cool-season					X‡			X	X†			

NOTES:
* With slow-release products, follow the manufacturer's suggested rates of application.
† This is the best time to apply a complete fertilizer (containing N, P, and K), if necessary.
‡ After snow melts.

Generally, you should fertilize at the beginning of the optimal growing season(s) when the grass starts to grow vigorously and is free from heat or cold stress. To create a good turf fertilizer program, it is important to know the type of turfgrass being grown. The two main groups of turfgrasses, warm-season and cool-sea-

son grasses, have different growing periods in California; the proper times to fertilize each group are not the same.

Warm-season grasses make most of their growth in the warmest months and are often dormant (brown) in winter. Warm-season species include hybrid and common bermudagrass, zoysiagrass, St. Augustinegrass, buffalograss, seashore paspalum, and kikuyugrass. Warm-season grasses are best adapted to the Central Valley and Southern California, including the inland deserts. Fertilize when grass is green, but avoid excessive nitrogen in the summer when the grass is already growing fast. Many warm-season grasses developed for Southern California can be coaxed to stay green in the winter by regular nitrogen fertilizer applications into the late fall and winter, except where frosts and colder temperatures are common.

Cool-season grasses grow well in spring, fall, and in winter where the climate is moderate to mild. In areas having summer temperatures of 80ºF (26ºC) and higher, these grasses often come under heat stress, which results in reduced growth, increased disease potential, and poor appearance. Avoid nitrogen fertilizer applications in hot times of the year on cool-season grasses. Commonly used cool-season species include tall fescue, Kentucky bluegrass, perennial ryegrass, and red fescue. They are best adapted to coastal areas, Northern California (except the Central Valley), and mountainous regions of the state.

HOW MUCH FERTILIZER SHOULD YOU APPLY?

The amount of fertilizer to apply depends on the fertilizer product (% nitrogen and release rate), the square footage (area) of lawn, and the purpose the lawn serves (athletic field or low-traffic lawn).

At planting. Fertilize soil before planting seed, sod, plugs, or stolons. A general recommendation for a preplant fertilizer for most California soils is to apply 12 pounds of ammonium phosphate-sulfate (16-20-0) per 1,000 square feet (6 kg per 100 sq m), rototilled into the top 4 to 6 inches (10 to 15 cm) of soil.

Existing lawns. Most mature lawns benefit from about 4 pounds of actual nitrogen per 1,000 square feet (2 kg per 100 sq m) per year (see table 3). Recent University of California research on grasses suited to low nitrogen and water applications (e.g., zoysiagrass and buffalograss) found that they could perform adequately with only 2 pounds per 1,000 square feet (1 kg per 100 sq m) of actual nitrogen per year. Grass growing in light shade requires less fertilizer than grass growing in full sun. Turfgrasses under a grasscycling program need slightly less nitrogen; turfgrasses under heavy wear from foot traffic or sports require more nitrogen to encourage faster growth to repair damage.

Generally, a maximum of 1 pound of actual nitrogen per 1,000 square feet (0.5 kg per 100 sq m) should be applied at one time when using a soluble chemical fertilizer. Nitrogen is the major element, so it is the element that the application rate is based on. Also, nitrogen is the most soluble element and has the most potential for burning the grass if applied too heavily. Often, less than 1 pound of actual nitrogen can be applied, but ½ to 1 pound of actual nitrogen per 1,000 square feet (0.25 to 0.5 kg per 100 sq m) at a time is the usual recommendation. Slow-release fertilizers can be safely applied at higher rates. See the product label for specific recommendations on rates and frequency of application; the frequency can range from every 6 to 8 weeks to as long as every 6 months.

Calculating application rates. To find out how much of a particular fertilizer is needed to supply 1 pound of actual nitrogen, simply divide 100 by the first number of the analysis shown on the bag. This will give you the number of pounds of the

fertilizer you need to apply to 1,000 square feet of lawn area to supply 1 pound of actual nitrogen to the turf. For example, if the fertilizer analysis is 21-0-0, 100 ÷ 21 = 4.76 pounds of fertilizer needed to apply 1 pound of actual nitrogen. (A similar calculation is performed for metric measurements.) See table 2 for the results of this calculation for selected common fertilizers.

HOW SHOULD YOU APPLY THE FERTILIZER?

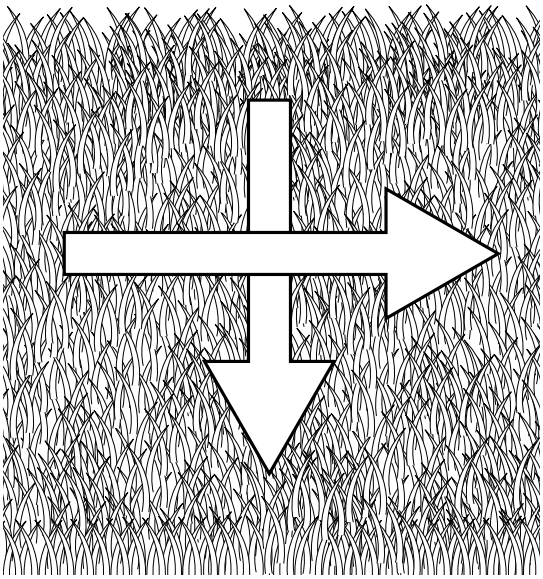
Fertilizing by hand can be effective, but the disadvantage to hand spreading is that it is easy to apply the fertilizer unevenly, burning some areas (see fig. 2) and failing to get fertilizer into others (fig. 3). Mechanical spreaders are much easier, safer, and more accurate for most turf managers and homeowners. Two general types of mechanical spreaders are available: the broadcast (cyclone or rotary) spreader and the drop spreader. Both can be equally effective. Correct use of the broadcast spreader avoids striping, a common problem with drop spreaders. In contrast, drop spreaders avoid overthrow of fertilizer onto streets or sidewalks. To achieve the most even distribution, especially with drop spreaders, spread half the fertilizer in one direction and the other half at right angles to the first (fig. 4).

Figure 3. Uneven application of nitrogen fertilizer gave poor results on this Kentucky bluegrass lawn.

Liquid fertilizers, sometimes used for lawn maintenance, can be applied with hose-end sprayers or other similar proportioning devices. Liquid fertilizers must be applied accurately and evenly, just as with dry fertilizers.

Fertilizer should be watered in immediately after application. Watering-in removes the fertilizer from the leaves, reducing the possibility of foliage burn, and it washes the soluble nutrients, such as the nitrate form of nitrogen, into the soil where they can be absorbed by the turf root system. This recommendation does not apply to some slow-release fertilizer materials, especially those containing broadleaf weed killers. If the fertilizer is a "weed and feed" type, follow the manufacturer's directions on application methods.

Figure 4. Apply one-half of the quantity to be used in each direction.



On the other hand, overirrigation after fertilizer application can cause water containing dissolved nutrients to run off, or it can leach the nitrogen below the turf root system, where it is unavailable to the grass.

Avoiding Water Pollution

The misapplication of lawn fertilizer can contribute to surface water pollution if the fertilizer is carried into storm drains. By dropping fertilizer onto sidewalks, driveways, streets, or bare soil, home gardeners and landscape workers can unknowingly contribute to this serious urban pollution problem. Restricting fertilizer to grass areas helps prevent nutrient runoff and channels movement of the dissolved fertilizers into the soil where they can be quickly taken up by turfgrass roots.

To prevent fertilizer pollution

- Apply fertilizer with care to turf areas.
- Sweep, blow, or wash fertilizer off concrete or asphalt areas (hardscape) and back onto lawns—not down storm drains.
- Soon after applying, water fertilizer into lawns in a controlled manner to prevent dissolved fertilizers from running off the lawn area into gutters and storm drains.

Most municipal storm drain systems empty into streams or large drain channels that feed into bays, lakes, rivers, or the ocean, where the fertilizer (mainly nitrogen and phosphorus) encourages growth of unwanted algae and problematic aquatic plants that slow water flows, create navigational hazards, and degrade the environment.

Rotary fertilizer spreaders are best used on large turf areas where they will not throw fertilizer beyond lawn areas onto hardscape and streets. Using drop spreaders along the edges of large turf areas and for small lawns greatly reduces overthrow and the need for additional labor to clean fertilizer from concrete surfaces.

Grasscycling

Grasscycling consists of letting clippings fall back onto the lawn instead of collecting them in a grass catcher or bag on the mower. The clippings dry and decompose, returning nitrogen and other nutrients to the soil, where they are reused by the grass and the soil microbes. Grasscycling can reduce a lawn's fertilizer needs by up to 20 percent. It also reduces green waste in landfills, saving room for less recyclable items.

Safety is a concern in grasscycling, because rotary mowers can discharge hard objects (rocks, wood, metal) at very high speeds, which can cause serious injury to the operator or bystanders or damage windows or property. The safest grasscycling is done with front-throw reel mowers or rotary mowers specifically designed to operate safely as mulching or grasscycling mowers (without grass catchers). Reel-type mowers that throw clippings back toward the operator can be used as well if the grass catcher is removed.

If the clippings pile up after mowing, the grass may have been too wet (from dew, rain, or irrigation) or too long when mowed. Follow the recommended cutting height for your grass species and match your mowing frequency to the growth of the grass to prevent excess clippings from accumulating on the lawn.

Fertilize lawns under grasscycling just enough to keep them growing and green in the growing season. In seasons when the grass is growing fast, don't fertilize until you see a need, indicated by yellowing of the leaves or slow growth. Then apply only half the recommended rate. This reduces the need for raising the cutting height or mowing more often.

QUESTIONS AND ANSWERS

Q. Will a lawn fertilizer that also kills weeds damage trees in a lawn area?

A. Most such products are safe as long as they do not contact tree foliage. Products containing dicamba may damage shrubs and trees if applied in their root zone. Check the label for use recommendations.

Q. Is green waste compost a good source of nitrogen for lawns?

A. Generally not. It is more useful as a preplant soil amendment, since most of the nitrogen is used up by bacteria in the composting process. Compost applied over existing turfgrass does supply other essential nutrients in small quantities. Equal parts green waste and manure or biosolids composted together can be used as turf fertilizers. Four applications per year of ¼ inch (6.5 mm) of this mixture can give adequate results if the compost contains around 1.5 percent nitrogen.

Q. Can I fertilize my lawn with wood ashes?

A. Wood ashes are very alkaline and high in soluble salts. They can increase soil alkalinity and salinity and may harm grass if applied too heavily. When wood ashes are used, apply them sparingly to dry grass and irrigate after application. Wood ashes are a good source of potassium and would be beneficial only where the soil was deficient in this element. They supply no nitrogen.

Q. Should I water before or after applying fertilizer?

A. Irrigate your lawn deeply a few days before you apply fertilizer. The grass blades should be dry if applying a dry fertilizer, especially soluble types. Follow the fertilizer application with a thorough irrigation to move fertilizer off the grass blades and down into the soil.

Q. Is fertilizing once a year adequate?

A. Fertilizing a lawn once a year is generally inadequate. However, if only one application is made, it should be in the fall on cool-season grasses and in late spring on warm-season grasses; a slow-release fertilizer would be more effective than a quick-release one.

Q. How can I tell if my fertilizer program is adequate?

A. Your fertilizer program is adequate if your lawn is green, is dense and uniform, and has a good overall appearance. Yellowing grass blades, weed invasion, and lack of growth may indicate a need for increased amounts or more frequent application of fertilizer, assuming that poor irrigation (excess or lack of water) is not the cause.

Q. Should sandy soil be fertilized differently from clay soil?

A. On sandy soils, apply the same amount of nitrogen per year as with clay soils but at lower rates and more frequently; or, use a slow-release form of nitrogen fertilizer to prevent the nutrients from leaching out of the root zone.

FOR MORE INFORMATION

You'll find more information on lawn care in the following ANR sources:

California Master Gardener Handbook, Publication 3382, 2002.

Lawn Aeration and Thatch Control, Publication 2586, 1973.

Lawn Diseases: Prevention and Management: Pest Notes for the Home Landscape, Publication 7497, 2002.

Lawn Watering Guide for California, Publication 8044, 2001.

Managing Lawns in Shade, Publication 7214, 1996.

Mowing Your Lawn and Grasscycling, Publication 8006, 1999.

Turfgrass Pests, Publication 4053, 1989.

Turfgrass Selection for the Home Landscape, Publication 8035, 2001.

UC Guide to Solving Garden and Landscape Problems (CD-ROM) Publication 3400, 2000.

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6701 San Pablo Avenue, 2nd Floor
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Telephone: (800) 994-8849 or (510) 642-2431
FAX: (510) 643-5470
E-mail inquiries: danrcs@ucdavis.edu

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