Fertilizing to protect surface water quality

Fertilizer product knowledge and familiarity with the site may help minimize or eliminate adverse impacts on water quality.

By Robert J. Mugaas, Michael L. Agnew and Nick E. Christians

■ Few soils have enough natural nitrogen (N) to maintain desired turfgrass quality and recuperative ability through the growing season.

Nitrogen shortages can lead to slow growth, yellow plants, thin turf and increased disease. However, excessively high N levels can lead to excessive shoot and leaf growth, reduced root growth, low plant carbohydrate reserves, increased susceptability to environmental stress and some diseases.

One of the first important considerations in using N fertilizers responsibly is to match the site conditions and the desired maintenance program with proper sources.

Nitrogen fertilizer sources—Inorganic fertilizers such as ammonium nitrate and ammonium sulfate are all water soluble or quick-release N sources. That is, N becomes available as soon as water is applied to the turf. Their response is predictable and results are fairly immediate. However, their burn potential is high and the effects are shorter-lived.

On sandy soils, high rates of these products combined with high irrigation or rainfall may result in higher N losses due to leaching (the movement of water or nutrients toward—and possibly beyond—the turfgrass rootzone). Once beyond the rootzone, nitrates can continue moving through the soil and may find their way into water sources.

Organic fertilizer products, natural or synthetic, are those containing carbon (C) in their chemical structure. Nitrogen from natural organic sources becomes available only after the product begins to break down due to soil microbial action. Compared to quick-release sources, these have a lower leaf burn potential and can be applied at slightly higher rates without damaging the turf.

Characteristics of common turfgrass N sources are given in Table 1.

Nitrogen fertilizer use—The amount of N required by a lawn or turfgrass area depends on the type of grass plants and management practices.

On highly leachable soils, sands and sandy loams, the N application rates recommended in Table 2 may result in excessive loss of nitrate-N due to leaching. Where soluble N sources are used on these soil types, reducing the N rates to 0.25 to 0.5 lb. N/1000 sq. ft. per application may minimize potential nitrate-N leaching. If frequent, lower N applications are not practical, slow-release N sources may be a better choice for these soils. This practice is adaptable to

TABLE 1

CHARACTERISTICS OF COMMON TURFGRASS N SOURCES

Fertilizer source	N content %	Leaching potential	Burn potential	Low temp. response	Residual effect
Inorganic					
Ammonium nitrate	33-34	High	High	Rapid	Short
Calcium nitrate	16	High	High	Rapid	Short
Ammonium sulfate	21	High	High	Rapid	Short
Organic - natural					
Activated sewage sludge	6	Very low	Very low	Very low	Long
Manures	3-10	Very low	Very low	Very low	Long
Other natural products	3-10	Very low	Very low	Very low	Long
Organic - natural					
Urea	45-46	Moderate	High	Rapid	Short
Urea solutions	12-14	Moderate	High	Rapid	Short
Sulfur coated urea	14-38	Low	Low	Moderate	Moderate
Resin coated urea	24-35	Low	Low	Moderate	Long
Isobutylidene diurea (IBDU)	30-31	Mod. low	Low	Moderate	Moderate
Methylene ureas and ureaformaldehyde*	38	Low	Low	Low	Mod. long to long

** Some products may contain urea in addition to the ureaformaldehyde component*

Source: The authors

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late-season N fertilization and may be especially true where sandy soils are close to surface or groundwater resources.

Watering practices that result in water movement beyond the rootzone may increase potential nitrate-N leaching. Frequent, daily irrigation during cool, moist periods can also increase leaching potential.

Irrigation practices that take into consideration the grass plant's needs during any weather cycle will be more effective. Adding enough water to compensate for that removed by plant uptake and evaporation will minimize potential N pollution problems from leaching. (Sloped areas may require more frequent but smaller amounts of water per application as they will be more vulnerable to runoff before ample water has infiltrated into the soil.)

Irrigation of 0.25 to 0.5 inches immediately after an application of a quick-release N source will help move the N into the surface soil where it can potentially be used by the grass plant. Also, it will be somewhat protected from runoff and possible volatilization back to the atmosphere.

Grass clippings should be returned to the lawn area to decompose and recycle nutrients back to the turf area. They should not be blown or raked into street gutters or onto sidewalks and driveways where they may be carried in runoff to surface water areas.

Nitrogen fertilizer product knowledge and familiarity with the site may help minimize or even eliminate potential adverse impacts on water quality.

General fertilization practices—Here are some general lawn fertilization practices which can help reduce potential water pollution:

- Be careful to never directly deposit or inadvertently apply fertilizer materials into lake areas. Never apply N fertilizers to frozen ground.
- Fill granular fertilizer spreaders on a hard surface where any spills can be easily cleaned up. Never wash off fertilizer spills into the street or other hard surface area where they can easily get into storm sewers and ultimately into surface water areas. Wash off granular fertilizer spreaders over turfed areas. Fill and clean liquid fertilizer applicators over turfed areas.
- Close the gate on the fertilizer spreader when crossing hard surface areas, or go back and sweep up the material and re-use it another time, or put it back into the spreader.
- Near shorelines, apply fertilizer around the perimeter of the property with a drop spreader to create a "buffer zone." The rest of the area further away from the shoreline can be fertilized with a rotary spreader. Since the perimeter has already been done with the drop spreader, it is not necessary to try to get close to the shore, potentially getting the fertilizer into the water. The same kinds of precautions should be taken when using liquid applications.
- Or, a buffer zone of unmanaged grasses or possibly natural vegetation could be left growing along shorelines. This can help prevent soil erosion and may also retain some of the nutrients that might otherwise run into the lake.
- Avoid getting fertilizer into natural drainage areas or pathways on a property. These may not necessarily be hard-surfaced areas, but can carry fertilizer directly into the surface water area before having the chance to infiltrate into the surrounding turf/soil area.

Improper turf fertilizer management and use may contribute to potential pollution of surface and ground water resources. However, combining appropriate landscape management practices with a modest lawn fertilizer program may further reduce surface water pollution.

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TABLE 2

ANNUAL NITROGEN REQUIREMENTS AND APPLICATION TIMING FOR LAWNS IN THE UPPER MIDWEST

	Nitrogen (N) to apply lbs. N/100 ft²	Timing of applications*
High maintenance lawn		
(Irrigation, clippings removed)	4	May - June, Aug., Sept., Oct. - Nov.
(Irrigation, clippings not removed)	3	May - June, Aug., Oct. - Nov.
Low maintenance lawn		
(No irrigation, clippings removed)	2	Aug., Oct. - Nov.
(No irrigation, clippings not removed)	1	September

** Assume 1 lb. N/100 ft² of a soluble, quick-release N source applied at each application.*

Note: Lower more frequent rates of a quick-release N fertilizer can be used on sandy to sandy loam soil. Slow-release N fertilizers could also be substituted for the quick-release types. Follow manufacturer's and/or extension suggestions for proper application rates.

Source: The authors

The function of turfgrass micronutrients

These small but mighty turf components control important plant functions. Deficiency symptoms are easy to spot.

■ Healthy plant growth depends on the proper amount and interaction of 16 chemical elements. Six of these elements are micronutrients: iron, manganese, zinc, copper, boron, and molybdenum.

Turfgrass can't replace micronutrients on its own, so it's up to the turf manager to be alert to the warning symptoms of deficiency.

- **Iron:** essential for the formation of chlorophyll.
- **Manganese:** absorption of CO_2.
- **Zinc:** improves reproduction capabilities, oxidation.
- **Copper:** activates some enzyme systems.
- **Boron:** for plant reproduction, protein synthesis, cell wall development.
- **Molybdenum:** essential for nitrogen fixation.

Dr. Dave Davidson of Cornell explains that there are three ways to diagnose nutrient deficiency:

Deficiency symptoms

Iron (Fe)
Symptoms: Intervenal yellowing in new tissues (chlorisis). Blades lose color; necrosis is minimal.
Treatment: 1-2 lbs./acre of iron sulfate; foliar sprays.

Manganese (Mn)
Symptoms: Yellowing or striping between veins along with stunting, curling or spotted leaves. Leaves are very limp.
Treatment: 1-2 lbs./acre of manganese sulfate.

Zinc (Zn)
Symptoms: Dark, thin leaves turning progressively white; yellowing and bronzing of stunted leaves; witches brooms, reduced growth.
Treatment: 0.4-0.8 lbs./acre of zinc sulfate.

Copper (Cu)
Symptoms: Bluish discoloration at the tips of youngest leaves.
Treatment: 0.3-0.5 lbs./acre copper sulfate.

Boron (B)
Symptoms: Growing points develop chlorotic streaks; leaves are stubby and rosette-like in appearance.
Treatment: 0.1-0.3 lbs./acre of boron.

Molybdenum (Mo)
Symptoms: Wilting, stumping and cupping of broad leaves.
Treatment: 0.1 lb./acre of molybdenum. Lime applications improve availability.

Source: "The Turf Managers' Handbook" by Daniel & Freeborg, 1989

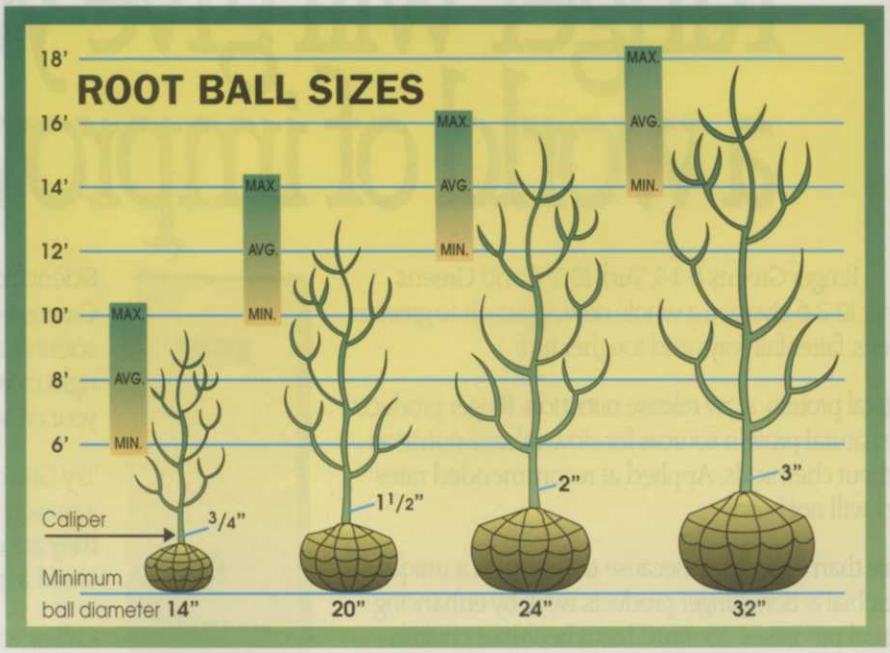
Proper size, proportions, of root balls

■ To reduce transplanting shock and assure that adequate feeding roots are moved with trees purchased from nurseries, the American Association of Nurserymen has established standards for height/diameter relationships and root ball sizes. General rule of thumb for approximating minimum root ball diameter is one foot for each one inch of caliper, according to the AAN.

Please note that caliper is tree trunk diameter, measured at six inches above the ground for trees with a diameter of four inches or less and 12 inches above the ground on larger planting stock. The diameter of larger trees, expressed as "diameter breast height" (DBH), is measured approximately 4-1/2 feet above ground level.

This chart, courtesy of "Tree City USA Bulletin" of the National Arbor Day Foundation, illustrates the AAN standards for most deciduous shade trees.

A more complete range of sizes may be found in "American Standard for Nursery Stock," available for $10. Send check or money order to: AAN, 1250 I St., NW, Suite 500, Washington, DC 20005.



1. Soil testing
2. Tissue testing
3. Plant symptoms

Of those three methods of detection, Davidson says observation of plant symptoms is most reliable.

"There's no really good calibration for soil testing," believes Davidson, "and most state labs are reluctant to make micronutrient recommendations based on soil tests. If private labs (make recommendations), I would question their data base."

Davidson says tissue analyses can be helpful, but they must be done regularly to determine a pattern of deficiency.

"Plant performance," advises Davidson, "will be your best source of information as to whether or not micro- or macronutrients are deficient."

Visual clues to micronutrient deficiency include:

- Lack of vigor; gradual slowing of growth rate.
- Poor response to nitrogen (especially important when you know there are no diseases or pests present).
- Turf adjacent to the affected area is healthy.
- Are symptoms occuring on young or old leaves? According to the "Turf Managers' Handbook," for example, iron deficiency will cause new tissue to develop intervenal yellowing.
- Is the symptom occurring intervenally, uniformly, or is it blotchy?
- Is the plant dying? Watch leaf tips and margins.

Factors influencing nutrient availability include:

—The soil (texture; minerology; fertility; amount of oxygen present).

—Management (fertilizers; pesticides; irrigation; water quality).

—The plant (species and variety; root function).

Davidson predicts the green industry will soon see more sophisticated "quick tests" for turf diagnosis.

The Micronutrient Danger Zone
(parts per million)

Iron : 120 ppm
Copper : 12 ppm
Manganese : 80 ppm
Boron : 8 ppm
Zinc : 50 ppm
Molybdenum : 2

Source: Dr. Dave Davidson, Cornell University