Preventing Pollution Problems from Lawn and Garden Fertilizers

C. J. Rosen and B. P. Horgan

Fertilizers are used by homeowners to maintain and improve landscape beauty and quality. Increased use of home lawn and garden fertilizers, however, has caused concern about pollution of lakes and groundwaters.

The two fertilizer nutrients primarily involved, nitrogen and phosphorus, are needed by all plants for healthy growth. Although an individual lawn or garden seems small, the total area of lawns and gardens in urban environments can be significant. Runoff and drainage waters carrying these nutrients may move over hard-surfaced streets where there is no soil to act as a filter. The potential result is an increase in pollution problems.

Proper fertilizer use can enhance plant growth without polluting the environment. Yet, misuse of fertilizer may not only harm the environment, but may result in injury to landscape plants.

In an effort to reduce phosphorus runoff to surface waters, the Minnesota state legislature passed laws in 2002 and 2004 that restrict phosphorus fertilizer use on lawns. Details of the law are described below.

Phosphorus and runoff concerns

Phosphorus is one of the macronutrients essential for plant growth. This nutrient can also be a primary cause for lake enrichment leading to growth of algae and weeds (a process called eutrophication). Sometimes phosphorus in lawn and garden fertilizers is implicated as the source of pollution, but this is not always an accurate assessment of the problem. Although misuse or misapplication can pollute lakes, proper application following soil test recommendations does not pose a significant threat of lake pollution and may reduce pollution possibility.

The major sources of phosphorus in runoff are from lawn clippings and tree leaves left in the streets and gutters. Other sources of phosphorus may come from soil particles either blown into the lakes by wind erosion or carried in runoff over bare soil.

Inorganic phosphorus moves very little in soil. When applied and incorporated as a fertilizer, phosphorus is

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quickly bound by soil particles. Most of it is not immediately available to plants and doesn't leach (wash) through the soil into lakes or groundwaters. Although phosphorus is relatively immobile in soils, some runoff containing soil particles and dissolved phosphorus can still occur. Phosphorus taken up by plants is incorporated into organic compounds. If not mixed into the soil, organic phosphorus from plant residues such as lawn clippings and tree leaves is soluble and a potential pollution source.

A study of storm runoff into Minneapolis lakes, comparing areas fertilized with phosphorus-containing fertilizer and areas fertilized with phosphorus-free fertilizers, showed little or no difference in phosphorus content of storm runoff.[1] However, when street gutters were swept weekly and kept free of plant residue, the phosphorus level was 30 to 40 percent less than in areas where no sweeping occurred. This indicates that plant residues such as lawn clippings and leaves have considerable potential for pollution of lakes whether or not they were growing in fertilized soil.

Another source of phosphorus lake pollution is from the settling of phosphorus-containing soil particles moved by wind or water. These sources of pollution are difficult to identify and control. Living plants such as trees, shrubs, and native vegetation around the lake reduce soil erosion and help remove particles from the air and runoff.

Some Minnesota soils are naturally high in phosphorus. Other soils may be high in phosphorus because of buildup from previous fertilization practices. Additions of phosphorus-containing fertilizer to high phosphorus-containing soils are unnecessary. Some soils contain low levels of plant-available phosphorus and additional phosphorus is necessary to maintain healthy plant growth.

Because most lawns in Minnesota already test very high in phosphorus, the Minnesota legislature passed a statewide law that restricts the application of phosphorus fertilizer to established turf. Note, this law does not pertain to phosphorus use in gardens. A brief summary of the law is as follows. Lawn fertilizer use is restricted to 0% phosphate (P_2O_5) content. Exceptions include if a new lawn is being seeded or sodded and only during the first year of establishment or if a soil or tissue test shows a need for phosphorus. In those cases, lawn fertilizers with phosphorus can be used. More detail pertaining to the law can be found in Chapter 18C.60 of Minnesota Statues: www.revisor.leg.state.mn.us/stats/18C/.

Because of this law, soil testing becomes even more important for managing applications of phosphorus to turf. Refer to Tables 1, 2, and 3 for phosphorus recommendations for newly seeded or sodded turf, established turf, and gardens. For more information on phosphorus runoff, refer to the following website: www.mda.state.mn.us/appd/ace/phosphorusguide.pdf

Soil tests and phosphorus fertilizer applications

Tables 1, 2, and 3 give phosphorus fertilizer suggestions based on soil tests for lawns and gardens.

Table 1. Phosphorus recommendations for a new lawn or turfgrass area before seeding or sodding[a].

Phosphorus (P) soil test level		Amount of phosphate (P_2O_5) to apply[b]
Bray-P1	Olsen-P	
ppm		lb. P_2O_5/1000 sq. ft.
0-10	0-7	5
11-25	8-18	2
over 25	over 18	1

[a]Phosphate fertilizer should be incorporated (tilled in) 4 to 6 inches before seeding or sodding.
[b]Multiply by 44 to convert the rate from lb/1000 sq. ft. to lb/acre.

Table 2. Annual phosphorus recommendations for existing grass[a].

Phosphorus (P) soil test level		Amount of phosphate (P_2O_5) to apply[b]
Bray-P1	Olsen-P	
ppm		lb. P_2O_5/1000 sq. ft.
0-10	0-7	1.0
11-25	8-18	0.5
over 25	over 18	0.0

[a]Soil should be aerated with a coring machine before fertilizer is applied.
[b]Multiply by 44 to convert the rate from lb/1000 sq. ft. to lb/acre.

Table 3. Phosphorus recommendations for vegetable and flower gardens[a].

Phosphorus (P) soil test level		Amount of phosphate (P_2O_5) to apply
Bray-P1	Olsen-P	
ppm		lb. P_2O_5/100 sq. ft.
0-5	0-3	0.4
6-10	4-7	0.3
11-15	8-11	0.2
16-25	12-18	0.1
over 25	over 18	0.0

[a]Phosphate fertilizer should be incorporated (tilled in) 4 to 6 inches before planting.

[1]Shapiro, J., and H. Pfannkuck. 1973. Interim Report No. 9 Limnological Research Center, University of Minnesota.

A routine soil test is recommended to determine phosphorus soil levels. Information about soil pH, lime requirement, organic matter, and potassium levels is also provided in this test. Detailed instructions on how to take a proper soil sample and where to send it for analysis can be obtained from: http://soiltest.coafes.umn.edu. The soil test report will recommend whether phosphorus or other fertilizer nutrients are needed.

Note that two different soil tests are used to determine available soil phosphorus. The Bray-P1 test is used when the soil pH is 7.4 or less and the Olsen-P test is used when the soil pH is greater than 7.4. It is important to realize that interpretations for phosphorus fertilizer can change, depending on which test is used. In other words, the amount of extractable phosphorus using the Bray-P1 test is not equivalent to the amount of extractable phosphorus using the Olsen-P test.

Establishment of turf is usually quicker with adequate phosphorus in the root zone. Current law allows application of phosphorus fertilizer to turf during the establishment year.

For gardens and new lawns, incorporate phosphate fertilizer 4 to 6 inches into the soil before planting, seeding, or laying sod. For established lawns requiring phosphorus based on a soil test, the soil should be aerated with a coring machine before application of the fertilizer. Coring machines can usually be rented from hardware stores or rental agencies.

Nitrogen and leaching concerns

Of all the fertilizer nutrients, nitrogen generally produces the greatest growth response in plants; however, unlike phosphorus, it usually is not the limiting nutrient for algae growth in lakes. This is because many of the blue-green algae can use nitrogen gas from the air and do not depend on ionic sources dissolved in the water. Nitrogen is present in soils as nitrate ion, ammonium ion, and as a component of soil organic matter. In all but very wet or dry soils, the ammonium form is readily converted to the nitrate form. This nitrate form is completely soluble and not tightly held by soil particles. Therefore, nitrate can readily leach downward with percolating water and contaminate groundwater supplies. Water with over 10 parts per million nitrate-nitrogen can cause methemoglobinemia (inability to use oxygen) in infants. This is why health authorities are concerned about keeping nitrate out of drinking water supplies.

Most problems of Minnesota wells contaminated by nitrates have been traced to animal manure, septic tank sources, or fertilizer spills. However, over-application of nitrogen fertilizer can also contribute to nitrate pollution, especially on sandy, coarse textured soils. This is because the nitrates not used by the plants can leach through the soil when excessive rainfall occurs. Because of the mobility of nitrate in most soils, nitrogen soil tests are not used for making nitrogen fertilizer recommendations in eastern Minnesota. General nitrogen fertilizer guidelines for lawns and gardens are as follows:

New lawns—apply and incorporate 0.5 lb. N/1000 sq. ft. (0.5-1 inch into soil) before planting.

Existing lawns—apply 0.5-1.0 lb. N/1000 sq. ft. two to four times per year. *Leaving clippings on the lawn (if evenly distributed by the mower) can be equal to one fertilizer application per year.* A good rule is never to apply more than 1.0 lb. N/1000 sq. ft. in any one application.

Vegetable and flower gardens—apply 0.1-0.2 lb. N/100 sq. ft. An additional 0.15 lb. N/100 sq. ft. may be needed as a sidedress for sweet corn, tomatoes, and cole crops.

To reduce nitrogen loss on sandy soils, split applications at one half this rate and twice as often. Another option on sandy soils to reduce nitrogen loss is use of slow release nitrogen fertilizers or natural organic nitrogen sources. Applying suggested rates of nitrogen fertilizer will not lead to groundwater pollution problems.

Selecting a fertilizer

Fertilizers are sold in many grades. Complete fertilizers such as 10-10-10 or 5-10-10, contain all three primary nutrients. Single nutrient fertilizers contain only one, but they generally are a high analysis, economical source of that nutrient (e.g., 46-0-0, 0-46-0, 0-0-60). Single nutrient fertilizers are available through fertilizer coop dealers, but may not be available or can be very expensive at most garden centers.

Numbers on the fertilizer bag indicate the exact percentages of nutrients by weight. For example, a 100 lb. bag of 5-10-10 fertilizer contains 5 lbs. of nitrogen (N), 10 lbs. of phosphate (P_2O_5) and 10 lbs. of potash (K_2O). Most garden fertilizers are complete fertilizers. With the new phosphorus law, most lawn fertilizers contain just nitrogen and potash (e.g., 25-0-12, 25-0-3). These fertilizers are relatively high in nitrogen and often low in potassium. They are convenient to use, but it may be difficult to find one that exactly matches the ratio required in a fertilizer recommendation.

Since meeting the exact amount required for each nutrient will not be possible in all cases, it is most important to match the nitrogen required. Once the correct ratio of $N–P_2O_5–K_2O$ is selected, follow the instructions on the bag for the proper rate to apply. If soil test potassium is also low, then supplemental potassium fertilizer may be needed.

Continuous use of fertilizers high in phosphorus such as 10-10-10, 12-12-12, or 15-30-15 will result in buildup of phosphorus. Organic amendments such as composted manure contain phosphorus and may also contribute to buildup of soil phosphorus.

Guidelines for fertilizer application and landscape maintenance

1. Have your soil tested and follow soil test recommendations. Application of phosphorus fertilizer to established turf in Minnesota is regulated by state law. Unless a soil test indicates a need, phosphorus fertilizer cannot be applied to established turf.
2. Although phosphorus use on gardens is not restricted, a phosphorus-free fertilizer should be used on high phosphorus testing soils.
3. For further information on soil testing and calculating fertilizer rates, refer to BU-01731, *Soil Test Interpretations and Fertilizer Management for Lawns, Turf Gardens, and Landscape Plants.* Website: www.extension.umn.edu/distribution/horticulture/DG1731.html
4. Water your lawn after fertilizing, but do not allow water to run off into streets or lakes.
5. Any fertilizer spilled on roads or sidewalks should be promptly cleaned up.
6. Never apply fertilizer to frozen ground.
7. Clippings not left on the lawn, leaves, and other plant debris should be removed as soon as possible from street gutters, sidewalks, and driveways. This plant material can be composted, used in the garden as a mulch, or disposed of through appropriate community services.
8. When mowing lawns, do not direct clippings into the street or lake.
9. Aerate compacted or high thatch lawns to promote better water infiltration and reduce runoff potential.
10. For lakeshore owners, landscaping practices that would force runoff water to seep into the soil before entering the lake are suggested:
    a. Leave a "buffer zone"—a strip of unmanaged grasses or natural vegetation—to grow around the shoreline. This vegetation will help prevent soil erosion from the shoreland and will also remove and retain some of the nutrients that would otherwise enter the lake.
    b. Construct and maintain a modified "berm" along the shoreline. This is best described as a slight hump in the ground that would run near and parallel to the shoreline. This rise in the ground/lawn will serve as an obstacle to the rapid and direct nutrient-rich runoff into the lake.

Summary

Improper use of lawn and garden fertilizers may contribute to pollution of lakes and groundwaters. Avoiding over-application of fertilizer by following soil test guidelines as well as by practicing simple landscape maintenance techniques will help reduce potential pollution problems and protect natural resources.

Authors

C. J. Rosen
Extension Soil Scientist
Department of Soil, Water, and Climate

B. P. Horgan
Extension Turfgrass Specialist

www.extension.umn.edu

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