



Source Water Protection Practices Bulletin

Managing Turfgrass and Garden Fertilizer Application to Prevent Contamination of Drinking Water

Fertilizers are made up of organic and inorganic materials that are added to soil to supply nutrients required for plant growth. If improperly managed, fertilizer elements, specifically phosphorus (P) and nitrogen (N), can run off into surface water or leach into ground water. This fact sheet focuses on the management of small-scale fertilizer applications to prevent contamination of drinking water sources (ground water and surface water used as public drinking water supplies); see the fact sheets on pesticide application and storm water for other preventative measures related to lawn and garden care.

FERTILIZER USE IN TURFGRASS AND GARDENS

The care of landscaped areas can contribute to the pollution of surface water and ground water. Heavily landscaped areas include residential yards, commercial lawns, golf courses, ball fields, and parks. The soils in many of these areas require frequent fertilization to maintain their turf grass. Because excess fertilizer use and poor application methods can cause fertilizer movement into sources of drinking water, the increased application of lawn and garden fertilizers in recent years has raised concern over the pollution of surface water and ground water.



The two main components of fertilizer that are of the greatest concern to source water quality are nitrogen and phosphorus. Nitrogen is used to promote green, leafy, vegetative growth in plants. Plants with nitrogen deficiency show stunted growth. Phosphorus promotes root growth, root branching, stem growth, flowering, fruiting, seed formation, and maturation.

A recent nonpoint source loading analysis from a New Jersey study indicated that ten percent of the nitrogen and four percent of the phosphorus applied annually in a 193-square-mile area of landscaped residential development ended up in surface waters as a result of over-application. Another study (South Jersey Resource Conservation and Development Council, Inc.) found that more than 50 percent of the nitrogen in fertilizer leaches from lawns when improperly applied. This kind of nutrient loss can be reduced by following the prevention measures given in this fact sheet.

WHY IS IT IMPORTANT TO MANAGE FERTILIZER USE NEAR THE SOURCES OF YOUR DRINKING WATER?

Improper or excessive use of fertilizer can lead to nitrate pollution of ground or surface water. Nitrogen fertilizer, whether organic or inorganic, is biologically transformed to nitrate that is highly soluble in water.

Use of nitrogen-containing fertilizers can contribute to nitrates in drinking water. Consumption of nitrates can cause methemoglobinemia (blue baby syndrome) in infants, which reduces the ability of the blood to carry oxygen. If left untreated, methemoglobinemia can be fatal for affected infants. Due to this health risk, EPA set a drinking water maximum contaminant level (MCL) of 10 milligrams per liter (mg/l) or parts per million (ppm) has been set for nitrate measured as nitrogen.

Phosphorus is the other element of concern in fertilizer. Under certain conditions phosphorus can be readily transported with the soil. In fact, 60 to 90 percent of phosphorus moves with the soil. Phosphorus is the major source of water quality impairments in lakes nationwide. Even though regulations that affect the taste and odor of water are not Federally enforceable under the Safe Drinking Water Act, municipalities often must treat their drinking water supplies for these aesthetic reasons.

AVAILABLE PREVENTION MEASURES TO ADDRESS TURFGRASS AND GARDEN APPLICATIONS OF FERTILIZER

This section discusses some of the most often used prevention measures, but is not an exhaustive list of all known measures. For information on additional prevention measures, see the documents referenced in the last section of this fact sheet. Please keep in mind that individual prevention measures may or may not be adequate to prevent contamination of source waters. Most likely, individual measures should be combined in an overall prevention approach that considers the nature of the potential source of contamination, the purpose, cost, operational, and maintenance requirements of the measures, the vulnerability of the source water, the public's acceptance of the measures, and the community's desired degree of risk reduction.

Ways to Eliminate Excess Fertilizer Use

Fertilizer applications should be based on *soil tests* to avoid the economic and environmental costs that can be incurred with excess fertilizer use. A soil test will show the levels of phosphorus and potassium present in the lawn; however, soil tests for nitrogen are rare. Nitrogen is highly mobile in the soil and tests generally provide little useful information relative to lawns. Most newly planted areas should be tested during initial planting and every one or two years following that. A minimum of three to four weeks after the last fertilization should pass before sampling. For sampling, 15 to 20 cores should be taken at about three to four inches in depth and mixed in a plastic container. Samples can be tested using readily available field kits or submitted to a private laboratory or extension office for testing and interpretation.

Selecting the appropriate fertilizer is the next crucial step after receiving soil testing results. Most homeowners use blended fertilizers that list percentages of nitrogen, phosphorus, and potassium in the fertilizer. For example, a 100-pound bag of 10-5-10 would contain ten pounds of nitrogen, five pounds of phosphorus, and ten pounds of potassium. The remainder of the bag contains micronutrients and filler materials that allow for an even application of nutrients. If the soil test shows phosphorus is high, then a fertilizer with a low percentage of phosphorus should be chosen (such as 20-0-10 or 24-3-8). Most lawns contain adequate phosphorus, and continuous use of fertilizers high in phosphorus can result in excessive buildups. These lawns are more likely to contribute high levels of phosphorus to surface water during storm runoff events. The use of organic nutrient sources, such as manure, can supply all or part of the

nitrogen, phosphorus, and potassium needs for turfgrass and gardens. However, organic fertilizers can also cause excessive nutrient loads if improperly applied.

Nitrogen should be applied as recommended for the type of grass being grown. It is often recommended that 1,000 square feet of lawn requires 0.5 pounds of nitrogen per month of active growth. A good rule is never to apply more than one pound of nitrogen fertilizer per 1,000 square feet of lawn in any one application. For vegetable and flower gardens only 0.1 to 0.2 pounds of nitrogen per 100 square feet should be applied per year, although corn, tomatoes, and cole crops may require more.

To help maintain a healthy lawn it is best to mow frequently at a height of 2.5 to 3 inches. ***Grass clippings should remain*** on the lawn to decompose and recycle nutrients back to the lawn. By leaving grass clippings on the lawn, nitrogen applications can be reduced by 30 to 40 percent.



Native plants



Mulching lawnmower

Wherever possible, ***low maintenance, native plants and grasses should be planted*** to minimize the use of fertilizer. Plants that are adapted to the local soils require less fertilization and watering (for example, xeriscaping is a landscaping method to minimize the use of water in dry climates). In fact, these practices can reduce required lawn maintenance up to 50 percent. Local planting suggestions may be obtained from State and county extension offices and Web sites.

Proper Fertilizer Application

The use of an ***appropriate form of nitrogen*** fertilizer can reduce the potential for leaching and runoff problems. Quick-release fertilizers should be used on heavy clay or compacted soils, because the longer a fertilizer granule remains intact, the greater the chances it will be washed away into surface water. On sandy soils, however, nitrogen can leach through the soil quickly. On these soils, slow-release nitrogen sources provide soluble nitrogen over a period of time so a large concentration of nitrogen is not made available for leaching. Fertilizer bags are generally labeled as a ratio of water-insoluble nitrogen (WIN) slow-release fraction, to water-soluble nitrogen (WSN) quick-release fraction. A large WIN/WSN ratio indicates a high percentage of slow-release nitrogen is contained in the product.

While the ***proper time of year to fertilize*** varies by location, applying a smaller amount of fertilizer at a higher frequency is often best. Eliminating excess nutrients in soil reduces the chances of polluting surface runoff and ground water. Ideally, fertilizer application should be timed to coincide as closely as possible to the period of maximum uptake and growth. The most active growth periods are spring and fall in cool climates and early and late summer in warm climates. Avoid fertilizer applications before heavy rains.

Core compacted soils before ***applying fertilizer to insure incorporation***. In all types of soil, it is always best to incorporate organic fertilizers into the lawn. When the phosphorus in organic fertilizer remains on top of the soil it has an increased chance of washing away during heavy

rains. Fertilizer should never be applied to frozen ground, and also should be limited on slopes and areas with high runoff or overland flow.

It is important to *irrigate* with $\frac{1}{4}$ to $\frac{1}{2}$ inch of water immediately after application of phosphorus or water-soluble nitrogen fertilizer. Afterwards, the key is to add only enough water to compensate for that removed by plant uptake and evaporation; this will minimize potential pollution problems from runoff and leaching. Over-watering can increase nitrogen loss five to 11 times the amount lost when proper watering strategies are used. Soaker hoses and trickle or drip irrigation systems are preferred alternatives to sprinkler systems. These systems deliver water at lower rates, which can conserve water, increase the volume infiltrated, and reduce surface runoff.



To ensure the proper amount of fertilizer is applied, *spreaders should be properly calibrated*. As spreaders get older, settings gradually change because of wear and tear. Regular cleaning and lubrication of the spreader will help it perform properly. Labels on fertilizer

bags often list the proper spreader settings for different types of spreaders. In general, drop spreaders are slower and more precise than rotary spreaders. Drop spreaders should be used near bodies of water because rotary spreaders can easily cast granules into the water bodies.

Buffer strips or filter strips can be created to slow runoff and help filter nitrogen and phosphorus from runoff. Buffers to runoff can be created simply by avoiding consistent mowing near water bodies. Additionally, natural deep-rooted vegetation can be planted to enhance nutrient filtering. Soil is held in place by the root systems of these plants. This decreases the velocity of runoff and helps prevent erosion near sources of surface water. The vegetation and soil strain and filter sediments, nutrients, and chemicals. For more information on buffer strips and filter strips see the fact sheet on storm water runoff.

Fertilizer Storage and Handling

Closely follow label directions when storing and handling fertilizer and when disposing empty containers. Stored dry fertilizer poses little threat to ground water as long as it is kept dry. Therefore, stored fertilizer should be kept covered to keep precipitation off. Keep bags on pallets to reduce the possibility of water damage.

Fill spreaders on hard or paved surfaces where spills can be cleaned up easily by sweeping or scooping up the spilled granules.

Additional Prevention Measures for Golf Courses

Golf course fairways, tees, and greens should be located where the seasonal water table is not excessively high. Fertilizer movement will be lowest on these sites.

State or local governments can produce guidelines for the design and maintenance of golf courses. These guidelines can require golf course developers and managers to submit plans for approval that show how they intend to lessen the impact of the site on the natural resources of the area. Plan requirements could include ground water and surface water monitoring, and design specifications, such as vegetative buffers or erosion controls.

FOR ADDITIONAL INFORMATION

These documents contain information on fertilizer use and best management practices. All sources are available for free on the Internet. See EPA's Guide to Source Water Information at www.epa.gov/safewater/protect/sources.html for a listing of resources on management measures. You can also contact your local Extension Service for more information.

Contact local government authorities in your area to see if there are ordinances in place to manage fertilizer use. Numerous examples of local source water protection-related ordinances for various potential contaminant sources can be found at:

<http://www.epa.gov/r5water/ordcom/>

<http://www.epa.gov/owow/nps/ordinance/>

<http://www.epa.gov/owow/nps/ordinance/links.htm>

The following documents provide more detailed information on prevention measures for fertilizer use in lawns and gardens.

Home*A*Syst - University of Wisconsin. Retrieved May 22, 2001 from the World Wide Web: <http://www.uwex.edu/homeasyst/>

North Carolina Cooperative Extension Service. *Water Quality and Professional Lawn Care (WQWM-155)*. (1995, September). Retrieved February 9, 2001 from the World Wide Web: <http://www.ces.ncsu.edu/TurfFiles/pubs/wqwm155.html>

Purdue University Extension Service. *Beneficial Lawn Care and Chemical Management*. (n.d.). Retrieved February 12, 2001 from the World Wide Web: <http://pasture.ecn.purdue.edu/~epados/lawn/src/title.htm>

South Jersey Resource Conservation and Development Council, Inc. *Non-Point Pollution Prevention – Homeowner*. (n.d.). Retrieved February 9, 2001 from the World Wide Web: <http://www.sjrkd.org/ce/erosion3.htm>

University of Idaho, College of Agriculture. *Fertilizer BMPs for Your Lawn*. (1994, April). Water Quality Update, volume 4, number 2. Retrieved February 9, 2001 from the World Wide Web: <http://www.uidaho.edu/wq/wqu/wqu42.html>

University of Maryland – Cooperative Extension. *Information Central – Greenhouse, Nursery, Landscape, & Turf*. Retrieved May 22, 2001 from the World Wide Web: <http://www.agnr.umd.edu/CES/greennursury.html>

University of Minnesota Extension Service. *Fertilizer – Phosphorus and Water Pollution (282)*. (1992). Retrieved February 12, 2001 from the World Wide Web: <http://www.extension.umn.edu/info-u/environment/BD282.html>

University of Minnesota Extension Service. *Preventing Pollution Problems from Lawn and Garden Fertilizers (FO-2923-GO)*. (1999). Retrieved February 12, 2001 from the World Wide Web: <http://www.extension.umn.edu/distribution/horticulture/DG2923.html>

University of Minnesota Extension Service. *Turfgrass Management for Protecting Surface Water Quality (BU-5726-GO)*. (1997). Retrieved February 12, 2001 from the World Wide Web: <http://www.extension.umn.edu/distribution/horticulture/DG5726.html>

University of Wisconsin – Extension. *Lawn and Garden Fertilizers (GWQ002)*. (1999). Retrieved January 23, 2001 from the World Wide Web: <http://www.clean-water.uwex.edu/pubs/stewards/index.html>

University of Wisconsin – Extension. *Step in the Right Direction with Proper Lawn Fertilizing*. (n.d.). Retrieved January 23, 2001 from the World Wide Web: <http://www.clean-water.uwex.edu/pubs/stewards/index.html>

University of Wisconsin – Extension. *Steps for Maintaining Healthy Lawns and Quality Waters*. (n.d.). Retrieved January 23, 2001 from the World Wide Web: <http://www.clean-water.uwex.edu/pubs/stewards/index.html>

The following documents are examples of local guidelines for the design and maintenance of golf courses:

Baltimore County Environmental Protection and Resource Management. *Environmental Guidelines for the Design and Maintenance of Golf Courses*. (n.d.). Retrieved May 17, 2001 from the World Wide Web: <http://www.epa.gov/owow/nps/ordinance/golf.htm>

Worcester County Department of Planning, Permits & Inspections. *Voluntary Guidelines Recommended for Golf Courses in Worcester County & the Delmarva Peninsula*. (n.d.). Retrieved May 18, 2001 from the World Wide Web: <http://www.dnr.state.md.us/bay/tribstrat/golf.html>

The following University of Florida website details their outreach program to reduce non-point source pollution, which includes proper nutrient management techniques: <http://hort.ufl.edu/fyn/>