University of Kentucky
College of Agriculture, Food and Environment
Cooperative Extension Service

Water Quality and Nutrient Management at Home

Brad Lee, Suzette Walling, and Gregg Munshaw, Plant and Soil Sciences; and Rick Durham, Horticulture

Fertilizers and other lawn amendments benefit the residential landscape by providing or supplementing the essential nutrients for plant growth and maintenance. Commercial fertilizers are commonly formulated based on three major nutrients: nitrogen (N), phosphorus (P), and potassium (K). Each nutrient plays an important role in plant development; however, improper application of fertilizers and amendments may increase the risk of non–point source pollution of surface and ground waters.

Nutrients and Algae

In a balanced system, the major nutrients (N and P) contribute to soil health and plant growth. However, runoff of surplus nutrients (particularly P) to freshwater bodies can result in eutrophication, creating a nutrient rich water body for algae growth. This process can lead to hazardous or nuisance algal blooms (HNABs). These blooms may appear as a green scum on the water surface or as thick mats below the surface.

Large growths of algae (Figure 1) can decrease oxygen levels in water and limit light to plants that provide food and shelter for aquatic organisms, and may produce toxins that are harmful to aquatic and terrestrial organisms. Some of the toxins are known to cause skin irritation, rashes, or even more serious damage in humans and their pets.

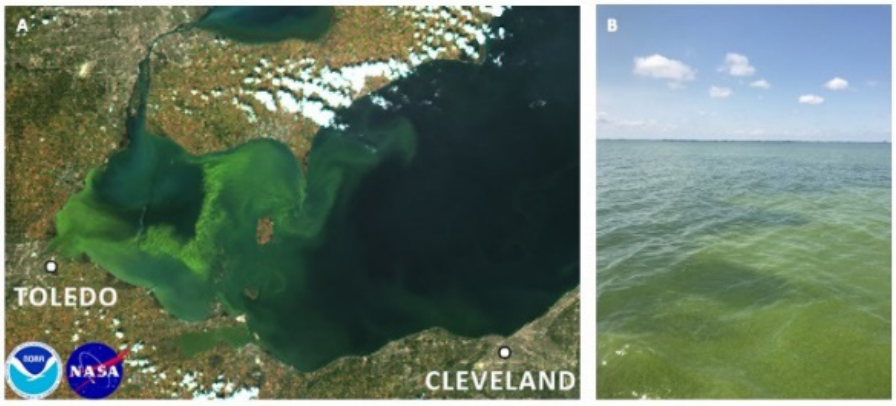

Figure 1. A. Satelite image of a toxic Lake Erie algal bloom which resulted in a "do not drink" advisory for Toledo's drinking water system in August 2014. B. Photo of algae bloom in Lake Erie from a boat, July 2017.

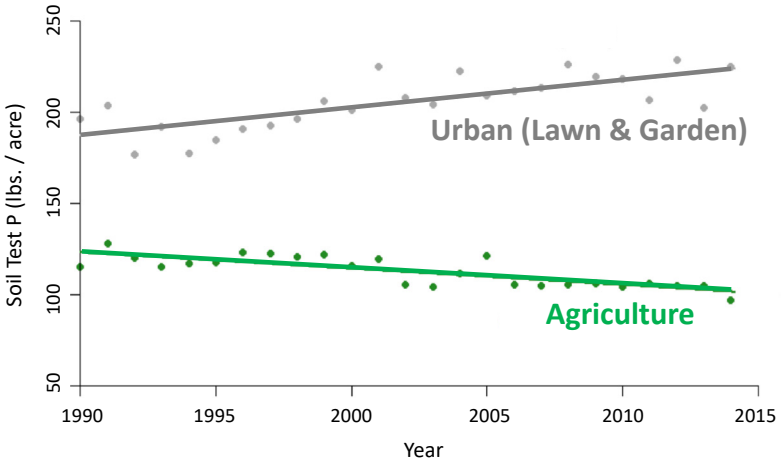

Figure 2. Average soil test P levels of approximately 1 million samples collected from urban and agricultural soils between 1990 and 2014.

Natural P in Kentucky

The amount of P in soils is strongly related to the naturally occurring amount in the soil's parent material. For example, the limestone parent material from which soils in the Bluegrass region form is naturally high in phosphate. However, there are other parts of the state, such as the western Pennyrile region, where the limestone parent materials and soils are naturally low in phosphate. Many Kentucky farmers are knowledgeable about the level of P in their soils and most apply only when fertilizer is needed or when fertilizer is affordable. However, in the urban areas of Kentucky, landowners are much less knowledgeable about soil nutrient levels and often apply P fertilizer without knowing how much their plants actually need. In addition, many homeowners over apply fertilizer because they do not know the amount of nutrients needed nor do they realize the concentration of nutrients within different fertilizer sources. This problem is compounded by marketing campaigns by fertilizer vendors suggesting that a

particular brand of fertilizer is required for a successful lawn or garden. Soil test results over the past 25 years show that most Kentucky urban soils already have more than enough P and no additional applications are required.

The agricultural sector has responded to government incentives and economic drivers to reduce P applications, resulting in soil P levels that have decreased over time. However, results from home and garden soil tests show the opposite trend, with soil P levels increasing over time (Figure 2). The high level of P in lawn and garden soils indicates that many of these soils are at a high risk for P becoming soluble, indicating a higher likelihood of P being transported downstream by runoff. *It is important that the urban sector reduce P applications to avoid increased risk to our lakes and streams.*

Urban Sources and Transport of Nutrients

We all contribute to nutrient pollution. As consumers, we contribute to industrial nutrient pollution through wastewater treatment, generation of electricity, driving cars, and consumption of agricultural goods, just to name a few activities. Nutrient pollution can also come from our yards in the form of fertilizers and other lawn amendments, waste from pets, poorly maintained septic systems, and yard waste (e.g., grass clippings). In urban environments, nutrients are carried directly to waterways by stormwater runoff. Recent research shows that nutrients from lawn fertilization and pet waste are the major contributors to N and P in urban areas, with P being the primary nutrient transported through stormwater runoff. We can pick up after our pets and keep the grass and leaves out of the storm sewer, but how should we manage our applications of fertilizer and other plant nutrient amendments responsibly?

What You Can Do at Home

The goal is to optimize fertilizer application–in other words, to promote healthy plants without applying excess. The key to good lawn care practices is to follow the Five Rs of nutrient management.

- **Right source.** Know what is in the fertilizer bag and match it to plant needs.
- **Right rate.** Supply the right amount of nutrients for plants.
- **Right time.** Apply when fertilizer will be most beneficial for plants.
- **Right place.** Apply fertilizers near plants.
- **Right price**. Don't pay for something you don't need.

Right Source

Fertilizers are plant nutrient supplements that are applied to soils. These soil amendments should only be applied to soils that cannot provide adequate nutrients for plant growth. Commercially prepared fertilizers have standardized labels to indicate the percent of the primary nutrients, which are always listed in this order: N, P (indicated on the label as P_2O_5), and K (indicated as K_2O). P and K are always expressed as oxides (P_2O_5 and K_2O), although neither P_2O_5 nor K_2O are present in fertilizers. Organic materials also supply some levels of these nutrients but will have more variable composition, depending on the source material (Table 1). It is important to know the needs of your plants and what you are applying to avoid excess. However, most urban landscapes will need regular N fertilization to remain healthy. Nitrogen, when properly applied, encourages growth of small trees and aids in the maintenance and appearance of large trees. Nitrogen also promotes thick, lush green lawns that can reduce weed populations by crowding them out. Unless a soil test indicates that P or K is required, only apply N.

Right Rate

For most landscape situations, two N applications (recommended application rate is 1 pound of actual N per 1,000 square feet) are adequate. Remember that the N rate on the bag is given as a percentage. A fertilizer bag labeled 44-0-0 will have 44 percent N, so you only need apply about 2¼ pounds of fertilizer to 1,000 square feet of lawn to apply a pound of N. To calculate how many pounds of a fertilizer you would need to supply a standard application, simply divide 100 by the N percent on the bag. For example, the fertilizer mentioned above contains 44 percent N. If we divide 100 by 44 we get 2.27. Applying 2.27 pounds of what's in the bag will supply the lawn with one pound of N.

Right Time

Fertilizing in the fall is the best time for cool-season lawns (fescue and bluegrass), trees, and shrubs. The applications should be split with the first application just as the trees are going dormant (leaves changing color) and the second application six weeks later. Splitting the two N applications six weeks apart will encourage greener turf in winter, less spring mowing, less heat stress, and fewer weeds and disease. Ideally, you want to apply fertilizer applications just prior to rain or run the sprinklers for a few minutes after application. This minimizes the chance that the nutrients will burn the plants.

Perennial flowers will benefit from a split application in spring with the first application in early April when plants are emerging and a second application six weeks later. Annual flowers and warm-season grasses (zoysiagrass, bermudagrass) should be fertilized at six-week intervals over the summer. Vegetable gardens should be fertilized at the time of planting, either spring or later summer.

Table 1. Various organic amendments, their analysis, and the amount required to fertilize a lawn with 1 pound of actual nitrogen per 1,000 square feet. Urea is included for comparison.

Fertilizer	Analysis (N-P-K)	Amount Needed for 1 lb Actual Nitrogen per 1000 sq. ft.
Cow Manure	0.5-0.3-0.5	200
Cottonseed Meal	3-1-1	33
Fish Pellets	7-7-2	14
Kelp Meal	2-1-3	50
Sewage Sludge	6-2-0	17
Urea	46-0-0	2.2

Right Place

Just as important as where to apply fertilizer is where not to apply it. If you are using a rotary fertilizer spreader, consider attaching a piece of cardboard or other device to the side of your spreader when applying near impervious surfaces, drains, or water sources to deflect fertilizer only toward the lawn and to protect these areas (Figure 3). Despite best efforts, occasionally fertilizer particles will fall on impervious surfaces. In these cases, the fertilizer particles should be blown or brushed back into the lawn.

For steep slopes, make sure the applied fertilizer falls on vegetated areas so it stays in place rather than rolling downhill. If you are applying fertilizer to established plants other than turf, it is best to apply fertilizer near the plants but not on the plant. Use water from a hose to wash fertilizer granules from plant leaf and stem surfaces, but not so much water that the fertilizer is washed away from the soil surface. Never apply fertilizers within 10 feet of surface waters.

Right Price

Fertilizers are often packaged with things that your lawn and landscape may not need. Further, advertisements on television show beautiful landscapes that were produced using various brands of fertilizers. While there are some benefits of specialty lawn fertilizers (reduced burn potential, small particle sizes, slow-release N), when it comes to the plant, the only thing that matters is that the required nutrients are available in the soil. If you are not soil testing, or if the soil test report states that no additional P or K is required, applying these specialty lawn fertilizers will not benefit the lawn or garden and often simply lead to water pollution. If Kentucky lawns do not require P or K, why would we pay for these nutrients? A comparison of fertilizer prices (per pound of N) is shown in Table 2.

Based on the prices in Table 2, urea is the least expensive N source. Other products may contain only N (similar to urea), but the N can be in both soluble and slow-release forms. These products reduce environmental impact and plant phytotoxicity by slowly releasing N over time. Slow-release N products cost more than urea, but the benefit may be worth the additional cost. Other products that contain P and/or K are more expensive and are only recommended when a soil test confirms P and K are needed.

Figure 3. Lawn fertilizer spreader with cardboard taped to one side to keep fertilizer off of impervious surfaces such as a driveway, street or sidewalk.

Testing Your Soil

A soil test is a chemical analysis of your soil. The basic test provides information on the plant available content of the major (P and K) and minor (calcium, magnesium, zinc) nutrients in your soil as well as the soil pH.

The process for collecting a soil sample for a soil test is simple. All you need are a shovel, garden trowel, or soil probe (available for loan at your County Cooperative Extension office), a clean and dry bucket, and a soil sample bag. Before collecting your soil sample, assess your landscape and identify the major areas you want to sample such as the lawn, flower beds, or garden. Work by area and collect samples from several random locations, keeping the soil from each area separate. Using your shovel/trowel, insert the blade

Table 2. Various fertilizer sources and prices per pound of nitrogen (2018 Lexington, Kentucky prices).

Fertilizer	Analysis (N-P-K)	Bag Size (pounds)	Price of Bag ($)	Price per Pound of Nitrogen ($)
Urea	46-0-0	50	36.94	1.58
10-10-10	10-10-10	40	11.90	2.98
Nature Safe	8-5-5	50	32.50	8.13
Miracle-Gro All Purpose Plant Food	24-8-16	4	8.99	9.36
Miracle-Gro Water Soluble Lawn Food	36-0-6	5	14.99	8.33
Scotts Turf Builder Lawn Food	32-0-4	14	15.99	3.57
Milorganite	5-4-0	36	12.99	7.22

about 4 to 5 inches deep. Move the blade back about an inch and again insert it into the soil. Remove the turf and plant debris at the top, and place the soil in the bucket. If the soil is wet and difficult to mix, allow it to air dry for a day or two. Once dry, mix the soil while breaking up large clods. Remove a large handful and place in the labeled soil test bag. Repeat this for each area, resulting in a soil sample bag representative of each major area of the landscape.

For more information on how to collect a soil test and other turfgrass management information, visit the University of Kentucky Turfgrass Science webpage: http://www.uky.edu/Ag/ukturf/lawns.html.

Remember

- **Right source**. Get a soil test and apply only what your lawn and garden need. (Usually Kentucky urban lawns and gardens do not need additional P or K.)
- **Right rate.** A majority of lawns need only two pounds of N per 1,000 square feet per year.
- **Right time**. For cool-season lawns (including trees and shrubs), apply split applications of N in the fall; warm-season grasses should have split applications of N in the summer.
- **Right place.** Fertilize only your lawn or garden; do not spread fertilizer on concrete or near a waterway.
- **Right price.** Price per pound of N can range widely. The least expensive source of N is currently urea (46-0-0).

For more information about your home and the environment, visit the University of Kentucky Environmental and Natural Resource Issues webpage at https://water.ca.uky.edu.

Issued 7-2019