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College of Agriculture,
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Your Yard and Water Quality

Kentucky Master Gardener Manual Chapter 11

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In this chapter:

We generally view gardening as a wholesome activity that enhances our environment. But pesticides, fertilizers, and erosion from gardens and landscapes can contaminate lakes, streams, rivers, oceans, and groundwater. Since the quality of our water resources affects our quality of life, we must learn how gardening practices can contribute to water contamination and how to reduce the threat to water quality.

We have long been aware of contamination from *point* sources such as factories and municipal sewage systems. Recently, we have become more aware of the threat of *nonpoint* source contamination from many relatively small, widespread sources. Each source by itself may seem insignificant; however, when added together, they can pose a serious threat.

Hundreds of thousands of homes in Kentucky have gardens. Each garden may contribute a relatively small amount of runoff containing soil, chemicals, and fertilizers. This runoff flows into surface water such as lakes, rivers, and bays. On the other hand, nitrate (from fertilizers and manure) and some pesticides can leach through the soil and contaminate groundwater (Figure 1, next page).

Added up, these small amounts of contamination form a sizable problem. Only when individuals take responsibility and make wise choices can we control nonpoint source contamination.

Why Be Concerned?

Clean water is essential for human health, wildlife, recreation, and industry. Water contamination poses many threats. For example:

- Pesticides and nitrate can contaminate drinking water supplies. Nitrate levels as low as 10 parts per million (ppm) in drinking water can cause methemoglobinemia (blue-baby syndrome). While humans more than 6 months old are not seriously affected by nitrate in drinking water, cattle and sheep are. Sediments from erosion can destroy aquatic habitats for species that need clear, oxygen-rich water. Residues from lawn and garden fertilizers can overstimulate aquatic plant growth in shallow lakes and bays, making water unsuitable for fish and wildlife. Contamination of water by toxic chemicals can reduce fish and shellfish populations or make them unfit for human consumption. These problems concern not only those who fish for sport but also the commercial fishing industry and consumers.
- Contamination can make lakes, rivers, and beaches unsafe for swimming and other recreational activities.

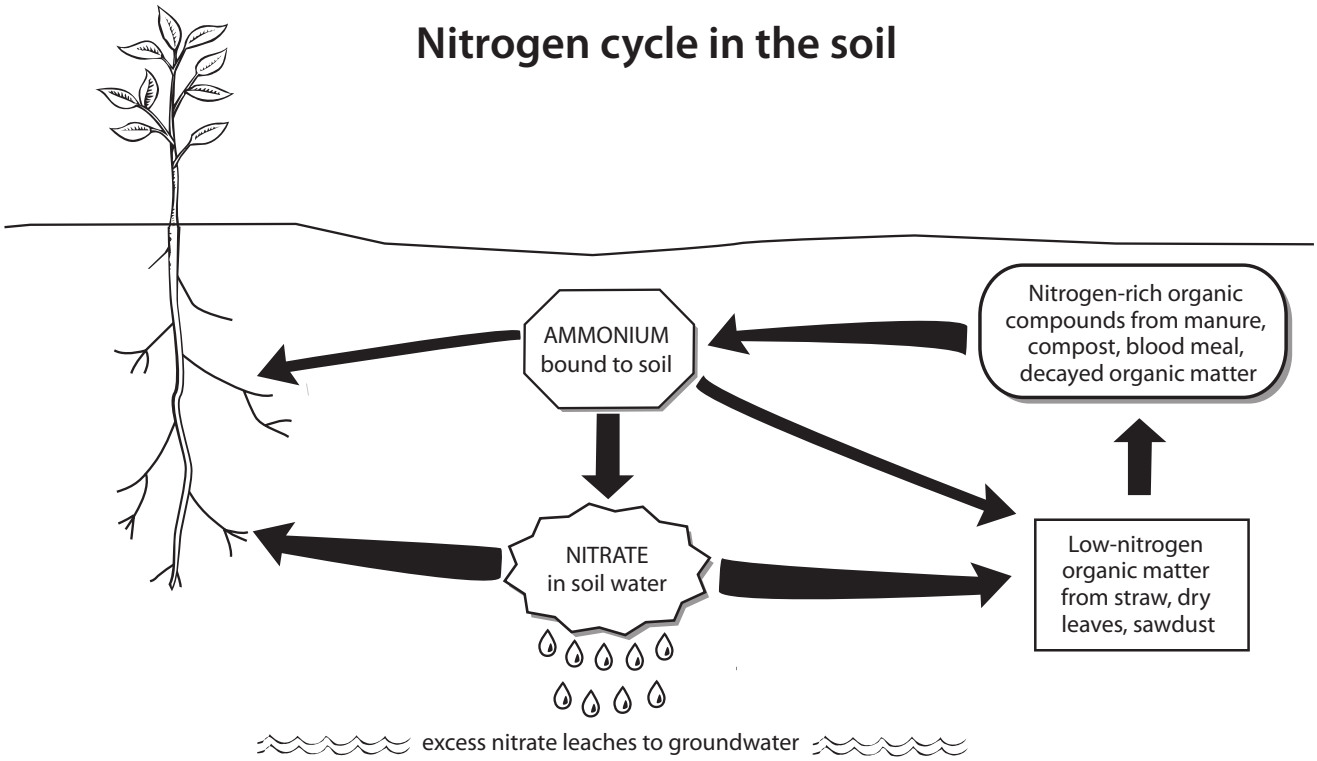

Figure 1. Nitrogen cycle in the soil. All of the arrows represent biological processes in the soil. These steps proceed more rapidly when the soil is warm and there is adequate moisture, but the soil is not saturated. Note that there are three possible fates of nitrate:
(a) Taken up by plants, if they are present
(b) Used by microbes to help break down coarse organic matter such as dry leaves
(c) Excess nitrate not used by plants or microbes can be carried to the groundwater by heavy rain or excess irrigation.
(Note: An alternate schematic of the nitrogen cycle is illustrated in Chapter 4, Soils and Fertilizers, AGR -204.)

Environmentally Sound Gardening

Gardens thrive with good water quality practices. The same simple, practical techniques that improve soil, beautify landscapes, reduce maintenance, and enhance plant health also can protect water quality.

For gardeners, the keys to protecting water quality include the following:

- Reducing the amount of potentially dangerous substances introduced to the environment
- Minimizing the amount of water that runs off the gardener's property

Landscape Design

An environmentally sound garden begins with proper planning and design. Properly selected plants and landscape features can reduce runoff and minimize pesticide and fertilizer use. Pavements allow much more runoff than a landscape of trees or grass (Table 1). On the other hand, maintaining a "perfect" lawn often involves more reliance on chemicals than do other types of landscapes.

Table 1. Estimated runoff from different surfaces.

Land cover	Runoff (%)
Dense forest	10
Light forest	15
Lawns	25
Gravel areas	80
Pavement and roofs	90

Source: King County, Washington, Surface Water Design Manual (January 1990).

What You Can Do

- Select plants adapted to the environmental conditions (sun, moisture, soil, and temperature) of your site to ensure healthy plants and reduced maintenance.
- Replace turf in inappropriate areas (e.g., dense shade; steep slopes; narrow, hard-to-irrigate areas; heavy-traffic areas with compacted soil) with plants, mulches, or paving materials that require less irrigation, fertilizer, and pesticides.
- Use porous paving materials (e.g., wood decking, modular pavers, porous asphalt, gravel, or wood chips) instead of impermeable concrete or asphalt.
- Allow roof runoff to spread over well-drained soil, where infiltration can occur.
- Build gravel trenches along paved walkways and driveways to catch runoff.
- Where runoff is a special problem, create gravel seepage pits or a series of infiltration beds over a gravel or tile drainage system. Consult an agriculture engineer to ensure proper design.

Soil and Fertility Management

Soil is the essential foundation of a garden. Proper soil and fertility management produces a healthier landscape and reduces the potential for water contamination from erosion, fertilizers, and pesticides.

Drainage refers to the ability of soil to transmit water through the surface and subsoil. Most landscape plants, fruit trees, and berry bushes require good soil drainage to a depth of at least 2 feet.

Drainage also affects the potential for water contamination. A coarse mineral soil, such as sand, drains rapidly but also allows dissolved chemicals to leach into the groundwater. Clay particles bind these chemicals and slow their movement through the soil, reducing the likelihood of groundwater contamination. But a dense clay soil drains slowly, thus increasing surface runoff.

Fertility refers to the presence of minerals necessary for plant life. Unfortunately, the fertility of garden soils often is less than ideal for plant growth. Gardeners usually compensate by adding fertilizers, either from synthetic or natural sources. Overapplication of any synthetic or natural nutrient source can result in excess nutrients being carried into lakes and streams or leaching into groundwater. Overfertilization also wastes money, damages plants, and can encourage weeds.

Rainfall and moving water can carry away soil particles, organic matter, plant nutrients, and soil contaminants. This water-soil-chemical runoff can cloud natural waters, stimulate unnatural and ecologically disastrous algal blooms, and contaminate fish. Therefore, it is essential to minimize erosion and runoff.

What You Can Do

There are several things you can do to reduce the likelihood of fertilizers contaminating groundwater and surface water. They include the following:

- Have your soil tested; testing will detect pH problems that affect nutrient availability to plants. Tests also reveal deficiencies of nutrients such as phosphorus, potassium, and calcium. Kentucky county Extension offices will submit soil samples for testing for a minimal fee and provide a recommendation once results are known. See Chapter 4 regarding information on how to take a soil test. Your county Extension office also can provide names of soil testing labs.
- Use only the amount of fertilizer recommended; more is not better.
- Fertilize according to what your plants actually need. Established trees and shrubs do not need annual applications if they are putting on adequate growth and their leaf color is healthy.
- Use slow-release fertilizers (organic or synthetic) when possible to reduce the loss of excess nitrogen into groundwater or surface water.

- If you use quick-release synthetic fertilizers, make several small applications over a period of time instead of a large amount all at once. Split applications reduce the potential for nitrogen leaching.
- Time fertilizer applications correctly. Trees and shrubs make best use of fertilizer just before or as new growth begins in the spring. Fertilize herbaceous perennials at the beginning of the growing season. Fertilize annuals when they are actively growing.

Conditioning can greatly enhance soil productivity. Incorporating organic matter, such as compost, ground bark, or sawdust, increases the soil's ability to store moisture and nutrients. In addition, organic matter can buffer the effects of pesticides in the soil and prevent rapid leaching of many chemicals into groundwater.

Organic matter helps both sandy and clayey soils. In sandy soils, it improves moisture retention and reduces leaching of fertilizers and pesticides. In heavy clay soils, it improves water infiltration.

There are several approaches to reducing erosion. For example:

- Slow down runoff. Try terracing slopes; creating grassy swales; or building earth, wood, or masonry diversions.
- Mulch bare soil. Use straw, grass clippings, wood chips, ground bark, or geotextiles (landscape fabrics).
- Plant vegetation that lends itself to erosion control. buttonbush, rough-leaf dogwood, silky dogwood, deciduous holly, and native grasses are a few examples.
- Protect existing vegetation where high water velocities are expected. E.g., use a concrete splash block at your rain gutter outlet, or place large, rough-edged stones at drainpipe outlets.
- Grow cover crops in your vegetable garden during winter to reduce erosion, trap nutrients, and add organic matter to the soil.

Using Garden Wastes

Like many things we do, gardening creates wastes: grass clippings, prunings, and leaves. Thrown into the garbage, yard wastes use up scarce landfill space. Landfills themselves can contaminate groundwater. Decaying vegetable matter thrown into a lake or stream can compete with marine animals for the limited oxygen supply. If processed in the garden, however, these wastes can be a valuable resource, contributing to healthy soil and plants.

What You Can Do

- Use leaves and grass clippings as a mulch. This practice reduces erosion, irrigation requirements, and weed problems.
- Run prunings and woody brush through a chipper and use the chips as mulch or to cover pathways.
- Compost leaves, needles, grass clippings, and annual weeds (before flowering) to create a valuable organic soil amendment.
- Cover compost piles with a tarp during the rainy season to help prevent leaching of nutrients.
- In case nutrients do leach from the compost piles, locate the piles away from bodies of water or places where runoff might occur.
- Compost herbicide-treated grass clippings for at least a year to eliminate potential herbicide problems. It's best to keep these clippings separate from other compost materials.
- Compost diseased plant materials, annual weeds that have flowered, or perennial weeds only if your compost pile is "hot."

Watering

The goals of environmentally sound irrigation are to maximize water infiltration and minimize runoff. Reduce the potential for runoff by reducing the need for supplemental irrigation. Use mulches to conserve moisture, and choose drought-resistant plants.

Overwatering can wash away soil, pesticides, and nutrients, which eventually find their way into surface water or groundwater. Overwatering occurs when water is applied faster than the ground can absorb it or when you let the water run too long. By watering efficiently, you will reduce your water bill while protecting water quality.

Hand watering, with either a hose or a watering can, generally is appropriate only for containers or small beds. Hand watering lawns and planting beds usually does no more than wet the soil surface since most people are unwilling to invest the time needed for thoroughly watering large beds and lawns..

Sprinklers can generate considerable runoff if they apply water too fast or throw water onto paved surfaces. Soaker hoses reduce runoff and evaporation losses because they apply water slowly. Trickle or drip irrigation is more efficient, reducing water use by 50 to 80 percent compared with overhead irrigation.

Do not water according to the calendar, since a plant's water requirement varies depending on weather, soil, species, age, and size. Never allow seedlings to dry out. Newly established plants need frequent watering until their root systems become well established. Established trees and shrubs usually do well if you soak them once or twice a month during dry periods. Many drought-resistant plants require little or no watering once they are established.

Watch for signs that indicate your lawn needs watering: gray-green grass, turf that does not spring back when walked on, and blades of grass rolled lengthwise. Lawns generally need irrigation at least once a week in dry summers to stay green. Alternatively, you can let your lawn go dormant; it will turn green again when fall rains begin.

Apply no more than ½ inch of water per hour, but adjust this amount according to soil type. Use small cans to measure the amount of water your sprinklers apply. Turn off the water at the first sign of soil saturation or runoff.

What You Can Do

- Select plants that need minimal water. Many native plants and other species adapted to dry summers and falls require little, if any, irrigation.
- Decrease the amount of lawn. Turf generally requires more irrigation than a landscape of established trees, shrubs, and groundcovers.
- Increase your lawn's drought tolerance through good cultural practices (soil preparation, aeration, fertilization, and mowing at proper frequency and height).
- Store runoff from your roof in a rain barrel. Mount a hose tap at the bottom so you can use the water in your landscape and garden.
- Divide your landscape into irrigation zones, grouping plants that use a lot of water in one zone and those that use less in another. Built-in irrigation systems should have separate circuits for lawns and planting beds.
- Avoid frequent, low-intensity irrigations. They tend to encourage shallow rooting and make plants more susceptible to drought.
- Apply water slowly (generally not more than ½ inch per hour).
- Adjust sprinkler patterns and output to avoid runoff and application of water to paved surfaces..
- Where possible, use soaker hoses or drip irrigation rather than sprinklers.
- If you must water by hand, sink perforated cans into the soil by each plant to apply water directly to the roots.
- Water when plants need it, not according to the calendar.
- Apply mulches to conserve soil moisture.

Nontoxic Pest Control Methods

Insects

- Keep your garden free of weeds and debris that provide a habitat for pests.
- Prune out insect-infested parts of plants and destroy the prunings.
- Cover susceptible crops with floating row covers or nylon screen to exclude certain pests.
- Use insect traps where appropriate. (Research indicates that light traps usually are ineffective.)
- Use a stream of water or a brush to dislodge insects.
- Hand pick insects from plants.
- Encourage beneficial insects by planting flowers that provide nectar and pollen.

Diseases

- Plant disease-resistant cultivars.
- Rotate annual plants (both flowers and vegetables).
- Allow adequate space between plants and prune for good air circulation.
- Time waterings so that foliage dries by nightfall.
- Prune off and destroy diseased plant parts. Do not add them to your compost pile unless you are hot composting.
- Improve soil drainage and aeration.

Slugs

- Place beer in containers to attract and kill slugs.
- Overturn clay pots or place flat boards next to plants to lure slugs. Check frequently and kill collected slugs.

Weeds

- Hand pull weeds or cultivate with a hoe where appropriate.
- Use mulches generously.
- Keep lawns healthy and dense to crowd out weeds.

Pest Management

A pest-free garden is expensive, impractical, and environmentally undesirable. Attempts to maintain a pest-free garden often result in heavy use of pesticides, which in turn increases the potential for water contamination.

Try to keep pest populations below the level at which they cause unacceptable damage. Allowing low levels of pests to survive helps maintain a population of their natural enemies.

The first step to effective pest management is to inspect your plants often so you can catch problems before they become serious. If you detect and deal with insect and disease problems early, you can reduce or eliminate the need for pesticides. The objective is to make your garden a healthy place for your plants and an inhospitable place for pests.

What You Can Do

- Plant pest-resistant species and varieties of plants. Check with local nurseries, landscapers, Extension agents, or other master gardeners to see whether resistance information is available for the plants you are considering.
- Rotate vegetables and annual flowers so that the same plant or plant family does not occupy the same space every year. For example, tomatoes, potatoes, and petunias are all in the nightshade (Solonaceae) family. Rotation can reduce insect infestations and the buildup of soilborne diseases.
- Keep your garden clean. Rocks, wood, and debris provide great hiding places for slugs and insects.
- Weed your garden. Weeds can harbor insects and diseases that attack your plants.

- Time plantings to avoid peak insect infestations. Often the most destructive phase of an insect's life is brief and predictable. Check with your Extension office to see whether this information is available for specific insect pests.
- Preserve naturally occurring beneficial organisms by minimizing your use of pesticides.
- Properly identify plant problems. If your problem is caused by a pest, proper identification is important in selecting the safest and most effective control strategy. Remember that most problems are cultural or environmental and do not respond to pesticide applications.
- Determine whether a problem really justifies treatment. Many pests cause only cosmetic damage and are not life-threatening to plants.
- Try the least toxic control strategies first. Cultural methods often are a good place to start.
- Record your observations and the results of your treatments for future reference.
- If you use pesticides, choose those that pose the least threat to water quality. Examples include pyrethrins, insecticidal soaps, horticultural oils, and *Bacillus thuringiensis (Bt).*
- If you decide to use pesticides, apply them when the pest is most susceptible, not according to a predetermined calendar schedule.
- If using insecticides, spot treat only those plants or plant parts affected. Compared to cover sprays, spot treatments can drastically reduce insecticide use (by more than 90 percent in some cases) and still achieve good control.
- Apply preventive fungicides only to plants likely to develop disease problems. Better yet, plant disease-resistant species or cultivars.
- If you use pesticides, carefully read the label for directions, use restrictions, and health and environmental precautions.

For More Information

See the UK Cooperative Extension Service publication *Living Along a Kentucky Stream* (IP-73) at http://www.ca.uky.edu/agc/pubs/ip/ip73/ip73.pdf. More information on this topic is available from the University of Kentucky Environmental & Natural Resource Issues web page at www.ca.uky.edu/enri and in *Principles of Home Landscape Fertilization* (ID-73) at http://www.ca.uky.edu/agc/pubs/id/id72/id72.pdf.

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