CHAPTER 2

MINIMIZING PESTICIDE IMPACT

LEARNING OBJECTIVES

After completely studying this chapter, you should:

- Understand pesticide labeling.
- Understand the difference between point and non-point source pollution.
- Understand management practices to reduce groundwater contamination.
- Understand how to protect non-target organisms from pesticides.
- Understand how pesticide resistance develops and how to delay or prevent resistance.

STATE AND FEDERAL LAWS

The *Pesticide Applicator Core Training Manual* (E-2195) discusses federal and state laws governing the use and handling of pesticides. These federal laws include the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), the Occupational Safety and Health Act (OSHA), the Endangered Species Act, and the Worker Protection Standard (WPS). Michigan pesticide laws include the Natural Resources and Environmental Protection Act (Act 451, P.A. 1994, Part 83, Pesticide Control), Regulation 636, Regulation 637, and the Michigan Occupational Safety and Health Act (MIOSHA). Pesticide applicators and technicians should keep up-to-date copies of the laws and review their contents periodically. Copies of these laws can be obtained from Michigan Department of Agriculture (MDA) regional offices. Refer to the core manual (MSU Extension bulletin E-2195) to learn more about these and other laws affecting pesticide use.

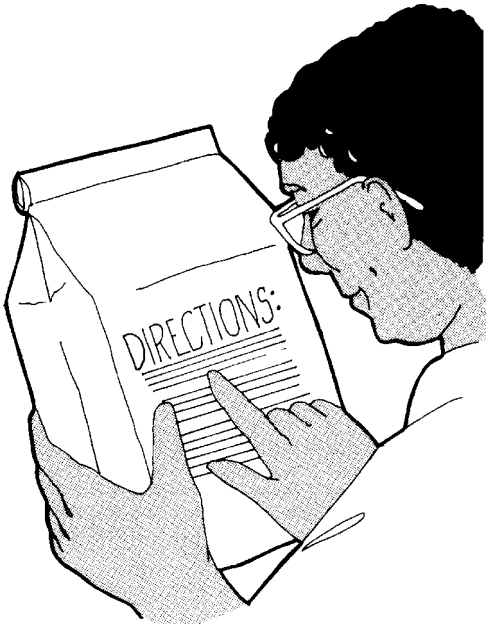
GUIDELINES FOR SELECTION AND USE OF PESTICIDES

The most important law regulating pesticide registration, distribution, sales, and use in the United States is the Federal Insecticide, Fungicide, and Rodenticide Act, or FIFRA. The Environmental Protection Agency (EPA) and the Michigan Department of Agriculture (MDA) administer FIFRA.

Pesticide labels provide use information such as safety precautions, application rates, sites where the pesticide can be applied, and target pests. They contain information to protect the applicator, the environment, and the crop while maximizing pest control. Pesticide labels are legal documents that must be followed. Always read the entire label and all supplemental labeling before using a pesticide. **Supplemental labeling** includes any information you receive from the manufacturer about how to use the product. Supplemental labeling is considered part of the pesticide label and may be supplied at the time of purchase or requested from the dealer. If an applicator applies a pesticide according to a supplemental label, a copy of the supplemental label must be in the applicator's possession at the time of application. Supplemental labels include special local needs labels (24c), emergency exemption labels (section 18), and use information issued by the pesticide manufacturer.

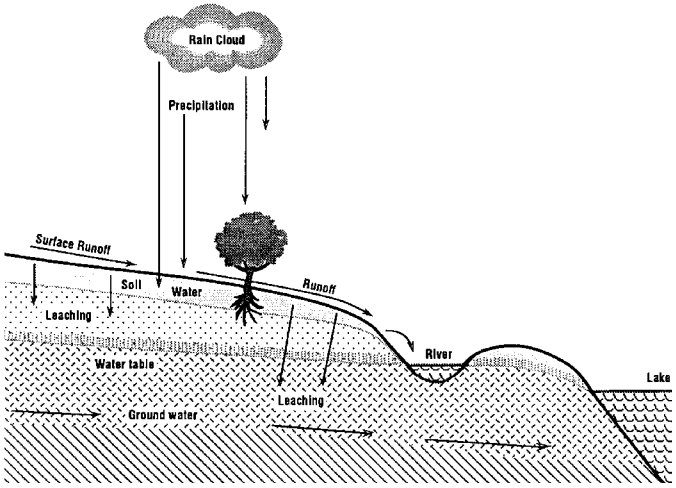
Always:

- Select pesticides labeled for use on your crop.
- Read and understand the label instructions and limitations before each use.
- Follow the application directions on the pesticide label.
- Contact your county MSU Extension office if you have questions or concerns about a particular pesticide.



PROTECTING OUR GROUNDWATER

Groundwater is the water beneath the earth's surface. It is found in the cracks and pores of rocks, and in the spaces between sand grains and other soil particles. Many people living in rural Michigan get their drinking water from wells. It is easy to see why you should be concerned about keeping pesticides out of groundwater.



Groundwater is always moving. Eventually, it reaches the earth's surface at natural places such as lakes, springs, and streams. Sometimes it is pumped to the surface from wells. Every year rain and snow seep into the soil, replenishing the groundwater. The depth at which you first find groundwater is referred to as the **water table**. The water table depth changes during the year, depending on the amount of water added and removed from the ground.

Both **surface water**—visible bodies of water such as lakes, rivers, and oceans—and groundwater are subject to contamination by point and non-point source pollution. When a pollutant enters the water from a specific source, it is called **point source pollution**. For example, a factory that discharges chemicals into a river is a point source. **Non-point source pollution** refers to pollution from a generalized area or weather event, such as land runoff, precipitation, acid rain, or percolation rather than from discharge at a single location.

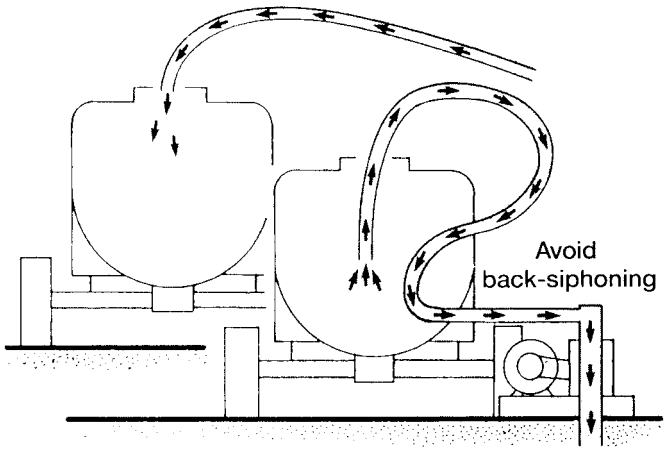
Keeping Pesticides Out of Groundwater and Surface Water

A pesticide that has not become a gas (volatilized), absorbed by plants, bound to soil, or broken down can potentially migrate through the soil to groundwater. Groundwater movement is slow and difficult to predict. Substances entering groundwater in one location may turn up years later somewhere else. A difficulty in dealing with groundwater contaminants is discovering the pollution source when the problem is occurring underground, out of sight. Also, microbial and photodegradation (by sunlight) do not occur deep underground, so pesticides that reach groundwater break down very slowly.

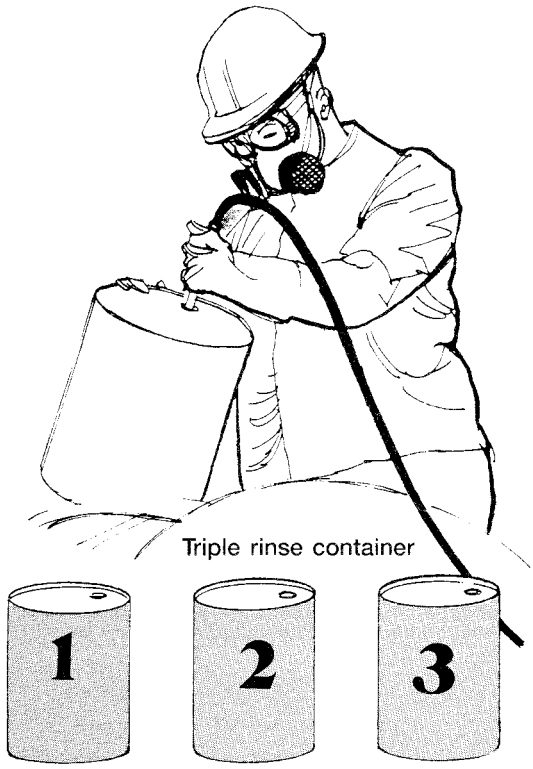
Cleaning contaminated groundwater or surface water is extremely difficult. Following certain practices can reduce the potential for pesticide contamination of groundwater and surface water:

- **Use integrated pest management.** Minimize pesticide use by utilizing other pest management practices to reduce or eliminate pesticide use.
- **Consider the geology of your area** when locating wells, mix/load sites, or equipment washing sites. Be aware of the water table depth and how fast water moves in the geological layers between the soil surface and the groundwater.

- **Select pesticides carefully.** Choose pesticides that are not likely to leach (move downward) in the soil into groundwater or run off into surface water. Pesticides that are very water soluble and not easily bound to soil tend to be the *most likely* to leach. Read pesticide labels carefully, consult the MSU Extension pesticide application guides, and/or seek advice from an MSU specialist or a pesticide dealer to choose the best pesticide for your situation.
- **Follow pesticide label directions.** Container and supplemental pesticide labels are the law. Labels provide crucial information about application rates, timing, and placement of the pesticide. Consult all labels before using the pesticide.
- **Calibrate accurately.** Calibrate equipment carefully and often to avoid over- or underapplication.
- **Measure accurately.** Carefully measure concentrates before placing them into the spray tank. Do not "add a little extra" to ensure that the pesticide will do a better job.
- **Avoid back-siphoning.** Make sure the end of the fill hose remains above the water level in the spray tank at all times. This prevents **back-siphoning** of the pesticide into the water supply. Use an anti-backflow device when siphoning water directly from a well, pond, or stream. Do not leave your spray tank unattended.



- **Consider weather conditions.** If you suspect heavy rain will occur, delay applying pesticides.
- **Mix on an impervious pad.** Mix and load pesticides on an approved impervious mix/load pad where spills can be contained and cleaned up. If mixing in the field, change the location of the mixing area regularly. A portable mix/load pad is required if you fill at the same location ten or more times per year.
- **Dispose of wastes and containers properly.** All pesticide wastes must be disposed of in accordance with local, state, and federal laws. Triple-rinse containers. Pour the rinse water into the spray tank for use in treating the labeled site or crop. After triple rinsing, perforate the container so it cannot be reused. Recycle all metal and plastic triple-rinsed containers. Otherwise, dispose of them in a state-licensed sanitary landfill. Dispose of all paper containers in a sanitary landfill or a municipal waste incinerator. Do not burn used pesticide containers. Burning does not allow for complete combustion of most pesticides, resulting in pesticide movement into the air; it is also a violation of state regulations administered by the Michigan Department of Environmental Quality. Contact your regional MDA office or local county Extension office for more information on pesticide container recycling in your area.



- **Store pesticides safely and away from water sources.** Pesticide storage facilities should be situated away from wells, cisterns, springs, and other water sources. Pesticides must be stored in a locked facility that will protect them from temperature extremes, high humidity, and direct sunlight. The storage facility should be heated, dry, and well ventilated. It should be designed for easy containment and cleanup of pesticide spills and made of materials that will not absorb any pesticide that leaks out of a container. Store only pesticides in such a facility, and always store them in their original containers.

PROTECTING NON-TARGET ORGANISMS

Insecticides can kill **bees and other pollinating insects**. To reduce the chance of bee poisoning:

- **Select the least hazardous pesticide formulation for bees**. Dusts are more hazardous to bees than sprays. Wettable powders are more hazardous than emulsifiable concentrates (EC) or water-soluble formulations. Microencapsulated pesticides are extremely dangerous to bees because the very small capsules can be carried back to the hive. Granular insecticides are generally the least hazardous to bees.

- **Do not apply pesticides that are toxic to bees if the site contains a blooming crop or weed.** Remove the blooms by mowing before spraying.
- **Minimize spray drift** by selecting appropriate nozzles, adding an adjuvant, or postponing the application to a less windy time.
- **Time pesticide applications carefully**. Evening applications are less hazardous than early morning ones; both are safer than midday applications.
- **Do not treat near beehives.** Bees may need to be moved or covered before you use pesticides near hives.

The best way to avoid injury to beneficial insects and microorganisms is to minimize the use of pesticides. Use selective pesticides when possible. Apply pesticides only when necessary and as part of an integrated pest management program.

Pesticides can also be harmful to **vertebrates** such as fish and wildlife. Fish kills may result when a pesticide (usually an insecticide) pollutes water or changes the pH of the water. Pesticides may enter water via drift, surface runoff, soil erosion, and leaching.

Pesticides may result in bird kills if birds ingest granules, baits, or treated seed; are exposed directly to the spray; drink and use contaminated water; or feed on pesticide-contaminated prey.

Endangered and threatened species are of special concern. Under the federal Endangered Species Act, every pesticide posing a threat to an endangered or threatened species or to its habitat must have a warning statement on the label. The warning provides instructions on how to safeguard the species when using the pesticide within its habitat.

POTENTIAL FOR PESTICIDE RESISTANCE

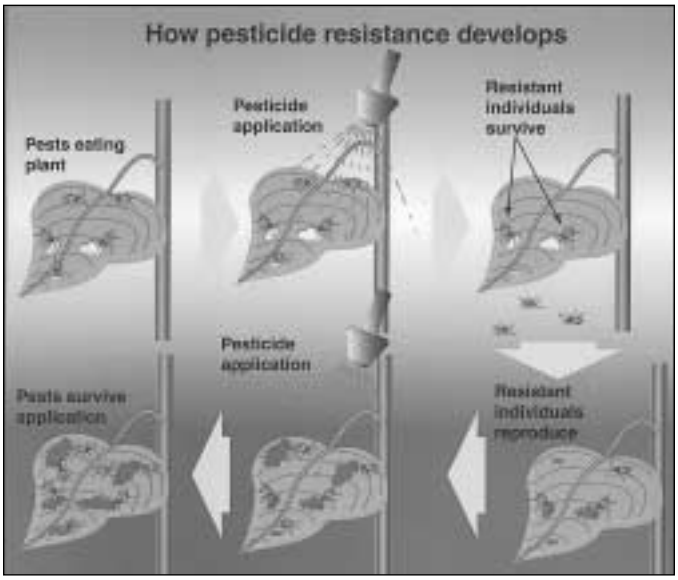
Pesticide resistance is a measurement of a pest's ability to tolerate the toxic effects of a particular pesticide. As the number of resistant individuals increases in a pest population, the original application rate or spray frequency no longer provides adequate control.

The Development of Resistance

Repeated applications of the same pesticide or of pesticides with a common mode of action give a pest population a chance to develop resistance. **Resistance** is an individual's (weed, crop, insect, etc.) ability to survive a specific pesticide application. There are four mechanisms of resistance. Resistant individuals:

1. Change the site of action so that the pesticide no longer functions.
2. Metabolize the pesticide. **Metabolism** is a biochemical process that modifies the pesticide to less toxic compounds.
3. Remove the pesticide from the site of action.
4. Break down (detoxify) the pesticide.

Resistant individuals survive when the pesticide is applied, and their offspring inherit the pesticide resistance. With each generation, more individuals in the population are resistant. Because the pesticide kills most of the non-resistant individuals, the resistant organisms make up an increasingly larger percentage of the surviving pest population. With each use of the pesticide, this percentage increases until the chemical is no longer effective against the pest.



In most cases, pests that are resistant to one pesticide will show resistance to chemically related pesticides. This is called **cross-resistance**. Cross-resistance occurs because closely related pesticides kill pests in the same way—for example, all organophosphate insecticides kill by inhibiting the same enzyme in the nervous system, cholinesterase. If a pest can resist the toxic action of one

pesticide, it can often survive applications of other pesticides that kill same way.

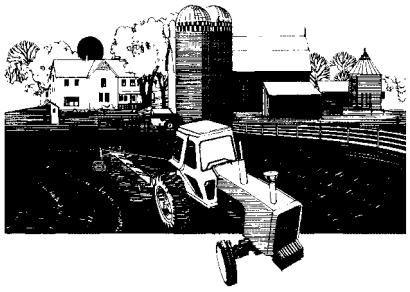
Resistance Management

Resistance management attempts to prevent, delay, or reverse the development of resistance. A resistance management program includes:

- **Using integrated pest management.** Combine cultural, mechanical, biological, and chemical control measures into a practical pest control program. For example, crop rotation can reduce the buildup of pests in a particular crop, reducing the number of pesticide applications needed. This reduces the advantage that resistant individuals have over non-resistant individuals and delays or prevents the buildup of resistance in a population.
- **Using pesticides from different chemical families with different modes of action.** Try to do this whether you apply pesticides against a pest once a year or several times within a treatment season. Generally, pests resistant to the first pesticide will be killed by the second.
- **Using pesticides only when needed, and using only as much as necessary.**

NOTIFYING NEIGHBORS

Good public relations are extremely important when applying pesticides. It is the joint responsibility of landowner and applicator to see that neighboring landowners are not subjected to acts of trespass or exposed to spray drift. As a matter of courtesy, it is a good idea to inform adjacent landowners, neighbors, and beekeepers in advance of any large-scale pesticide application.



If off-target pesticide drift is expected, Michigan Regulation 637 requires a pesticide applicator to have a drift management plan. A drift management plan should contain:

- A map of all areas where pesticide applications occur.
- A list of pesticide-sensitive sites located near an application area—for example, schools, day care facilities, or sensitive crops.
- Pesticide label and mandated restrictions that relate to setback provisions from sensitive areas.
- Information for persons in sensitive areas regarding the type of pesticide used, the method of application, and the applicator's plan to minimize pesticide drift.

A drift management plan should be used by private and commercial applicators as a communication tool to minimize adverse effects of off-target drift. For more information on drift management plans, contact the Michigan Department of Agriculture.

CHAPTER 2

Review Questions

Chapter 2: Minimizing Pesticide Impact

Write the answers to the following questions and then check your answers with those in the back of the manual.

1. A pesticide label is a legally binding document.
   A. True
   B. False

2. What is supplemental labeling? Give an example.

3. A certified pesticide applicator may apply a pesticide labeled for use on alfalfa to soybeans only if:
   A. The same pest is present on both crops.
   B. Use for soybeans is also on the pesticide label.
   C. A lower rate is applied to the soybeans.
   D. The pest density is above the economic threshold.

4. Which of the following is NOT true about groundwater?
   A. It is always moving.
   B. It is measured by the water table.
   C. It is found at the earth's surface.
   D. It is used as drinking water.

5. When applying a pesticide according to the instructions on a supplemental label, you should have
   A. A Michigan Department of Agriculture official with you.
   B. The dealer's phone number with you.
   C. A copy of the Michigan pesticide laws with you.
   D. The label with you.

6. The part of the government that regulates pesticides in the United States is the:
   A. Environmental Protection Agency (EPA).
   B. Food and Drug Administration (FDA).
   C. U.S. Department of Agriculture (USDA).
   D. Occupational Safety and Health Administration (OSHA).

7. The least hazardous pesticide formulation for bees and other pollinating insects is:
   A. Emulsifiable concentrates.
   B. Granular.
   C. Wettable powders.
   D. Dusts.

8. The water table depth changes:
   A. In the summer.
   B. In the winter.
   C. Never.
   D. Throughout the year.

9. Rain and melting snow do NOT affect the water table.
   A. True
   B. False

10. Non-point source pollution is generally easier to trace back to the origin than point source pollution.
    A. True
    B. False

11. List five ways you can reduce the risk of pesticides contaminating groundwater.

12. Which of the following is true about back-siphoning?

    A. It does not occur with an IPM program.
    B. It helps minimize pesticide drift.
    C. It can lead to contamination of water.
    D. It occurs when pesticides volatilize.

13. Which of the following is a proper method of disposing of an empty pesticide container?

    A. Burn it.
    B. Rinse and dispose in a licensed landfill.
    C. Use it to hold other pesticides.
    D. Bring to your local MDA office.

14. The impact of pesticides on bees and other pollinating insects can be reduced by applying:

    A. Pesticides under favorable weather conditions.
    B. When plants are in bloom.
    C. Microencapsulated pesticides.
    D. Broad-spectrum pesticides.

15. Pesticides are NOT harmful to fish and birds.

    A. True.
    B. False.

16. The ability of a pest to detoxify a pesticide and survive is:

    A. Resistance.
    B. Phytotoxicity.
    C. Pollution.
    D. Pesticide drift.

17. A resistance management program will _____ the development of pesticide resistance.

    A. speed up
    B. slow down

18. The ability of a pest to develop resistance to similar pesticides is called:

    A. Mechanical control
    B. Cross-resistance.
    C. Cholinesterase.
    D. Resistance management.

19. In Michigan, a drift management plan is required if off-target pesticide drift is likely to occur.

    A. True.
    B. False.

20. List four items to include in a drift management plan.