

CHAPTER 2

MINIMIZING PESTICIDE IMPACT

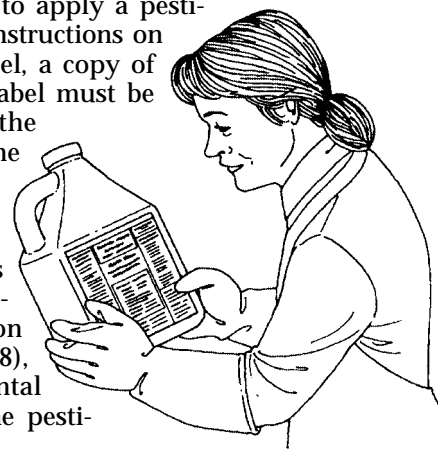
LEARNING OBJECTIVES

After completely studying this chapter, you should:

- Know the importance of reading and understanding the pesticide label.
- Know where to obtain supplemental labeling and when to have it on hand.
- Understand the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the special provision associated with it.
- Be familiar with groundwater, where it is stored, and how it can become contaminated.
- Know how to keep pesticides out of groundwater and surface water.
- Know how to protect bees, birds, beneficial insects, and other non-target organisms from pesticide exposure.
- Understand pesticide resistance, how it develops (including the development of cross-resistance), and how to manage (i.e., prevent, delay, or reverse) resistance.
- Know the requirements for notifying neighbors when pesticides are to be applied.

GUIDELINES FOR SELECTION AND USE OF PESTICIDES

Pesticide use is a serious matter that tree managers must take on responsibly. The pesticide label contains information needed to protect the applicator, the environment, and the crop while maximizing control of the pest. Always read the entire label as well as all supplemental labeling for each pesticide that you consider using. **Supplemental labeling** is pesticide label information that appears on a separate piece of paper and contains information regarding the site, pest, rate, etc. Supplemental labeling may be supplied at the time of purchase or requested from the dealer. If a pesticide applicator chooses to apply a pesticide according to instructions on a supplemental label, a copy of the supplemental label must be in the hands of the applicator at the time of application. Supplemental labels include special local needs labels (24c), emergency exemption labels (section 18), and supplemental labels issued by the pesticide manufacturer.



Always:

- Understand the label instructions and limitations before use.
- Select pesticides labeled for the crop you wish to use them on and the pest(s) you wish to control.

- Apply the pesticide only for the purposes listed and in the manner directed on the label.

FIFRA and the Use of Pesticides for Pests Not on the Label

The law regulating pesticides in the United States is the Federal Insecticide, Fungicide, and Rodenticide Act, or FIFRA. FIFRA is administered by the Environmental Protection Agency (EPA) and in Michigan by the Michigan Department of Agriculture (MDA). FIFRA governs the registration, distribution, sale, and use of all pesticides. A provision within FIFRA allows the use of a pesticide for a pest not noted on the label as long as the application is made to a crop specified on the label. This provision is referred to as 2(ee). All rates and restrictions for the labeled crop, including preharvest intervals, must be followed. Please note, however, that the manufacturer will not assume responsibility for product performance, so 2(ee) applications are made at the applicator's risk. For more information about 2(ee) applications, contact MSU Extension or the Michigan Department of Agriculture.

PROTECTING OUR GROUNDWATER

Many people who live in rural Michigan get their drinking water from wells. Well water is **groundwater**, so it is easy to see why you should be concerned about keeping pesticides out of groundwater. Groundwater is the water beneath the earth's surface occupying the saturated zone (the area where all the pores in the rock or soil are filled with water). Groundwater is stored in water-bearing geological formations called **aquifers**. It moves through the aquifers and is obtained at points of natural discharge such as springs or streams, or from wells drilled into the aquifer.

The upper level of the saturated zone in the soil is called the **water table**. The water table depth below the surface changes during the year, depending on the amount of water removed from the ground and the amount of water added by recharge. **Recharge** is water that seeps through the soil from rain, melting snow, or irrigation.

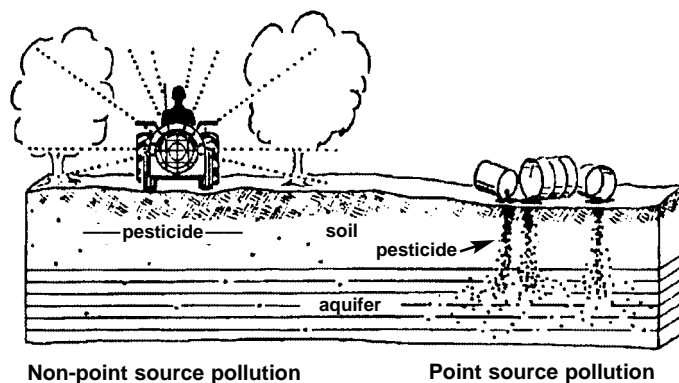


Figure 2.1. Point and non-point source pollution (Texas Agricultural Extension Service).

Surface waters are visible bodies of water such as lakes, rivers, and oceans. Both surface water and groundwater are subject to contamination by **point** and **non-point source pollution**. Point source pollution refers to movement of a pollutant into water from a specific site. 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 is not volatilized (becomes a gas), absorbed by plants, bound to soil, or broken down can potentially migrate through the soil to groundwater. The movement of groundwater is often slow and difficult to predict. Substances that enter groundwater in one location can turn up years later in other locations. A major difficulty in dealing with groundwater contaminants is that the sources of pollution are not easily discovered. The problem is occurring underground, out of sight.

It is very difficult to clean contaminated groundwater or surface water. Therefore, the best solution is to prevent contamination in the first place. The following practices can reduce the potential for surface and groundwater contamination by pesticides:

Use integrated pest management programs. Keep pesticide use to a minimum by combining chemical control with other pest management practices.

Consider the geology of your area. Be aware of the water table depth and how porous the geological layers are between the soil surface and the groundwater.

Select pesticides carefully. Choose pesticides with the least potential for leaching into groundwater or for runoff into surface water. Pesticides that are very soluble, relatively stable, and not easily adsorbed onto soil tend to be the **most likely** to leach. Read pesticide labels carefully, consult the MSU Extension pesticide application guides, or seek the advice of an MSU specialist or a pesticide dealer to help you choose the best pesticide for the purpose.

Follow label directions. The container label and any supplemental labeling accompanying the container carry crucial information about the proper rate, timing, and placement of the pesticide. Seek out and consult supplemental labeling as well as the container label before using the pesticide.

Calibrate accurately. Calibrate equipment carefully and often to avoid over- or underapplication.

Measure accurately. Carefully measure concentrates before they are placed into the spray tank. Do not "add a little extra" to ensure the pesticide will do a better job.

Avoid back-siphoning. The end of the fill hose should remain above the water level in the spray tank at all times to prevent back-siphoning of chemical into the water supply. Use an anti-backflow device when siphoning water directly from a well, pond, or stream.

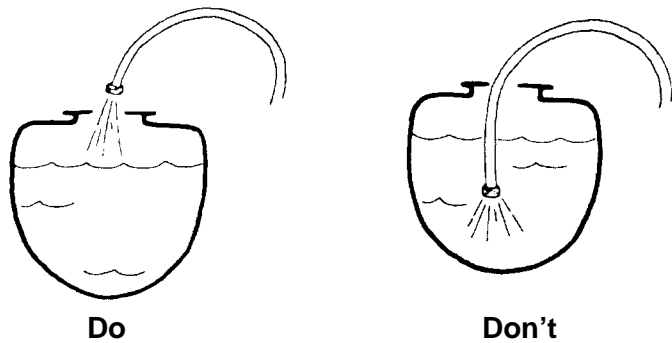


Figure 2.2. Keep hoses out of contaminated water.

Consider weather. If you suspect heavy rain will occur, delay applying pesticides.

Mix on an impervious pad. Mix and load pesticides on an impervious pad, if possible, where spills can be contained and cleaned up. If mixing is done in the field, change the location of the mixing area regularly. Consider using a portable mix/load pad.

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 site or the crop on the label. After triple rinsing, perforate the container so it cannot be reused. All metal and plastic triple-rinsed containers should be recycled, if possible. If this option is not available, 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 and results in pesticide movement into the air. 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 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.

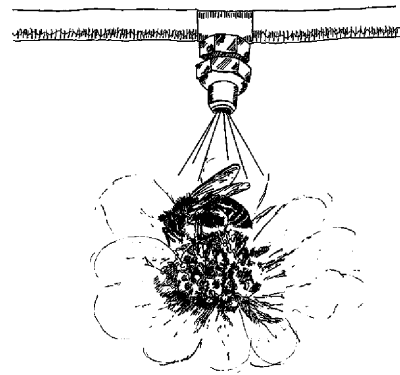
PROTECTING NON-TARGET ORGANISMS

Bees and other pollinating insects can be killed by insecticides. Take the following precautions to reduce the chance of bee poisoning:

- Select pesticides that are least harmful to bees and select the safest formulation. Dusts are more hazardous to bees than sprays. Wettable powders are more hazardous than emulsifiable concentrates or water-soluble formulations. Granular insecticide formulations are generally the least hazardous to

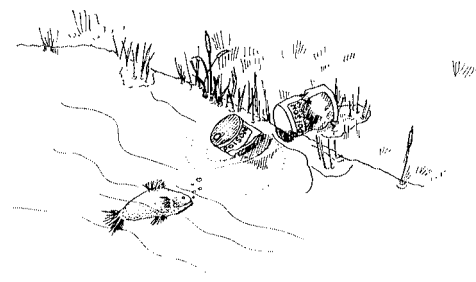
bees. Microencapsulated pesticides are extremely hazardous because the minute capsules can be carried back to the hive.

- Do not apply insecticides that are toxic to bees if the site contains a crop or weeds in bloom. Mow the weeds to remove the blooms before spraying.
- Minimize spray drift by choosing different nozzles or adding adjuvant, or postpone spraying if it is windy.
- Time pesticide applications carefully. Evening applications are less hazardous than early morning ones; both are safer than midday applications.
- Do not treat near hives. Bees may need to be moved or covered before using insecticides near colonies.



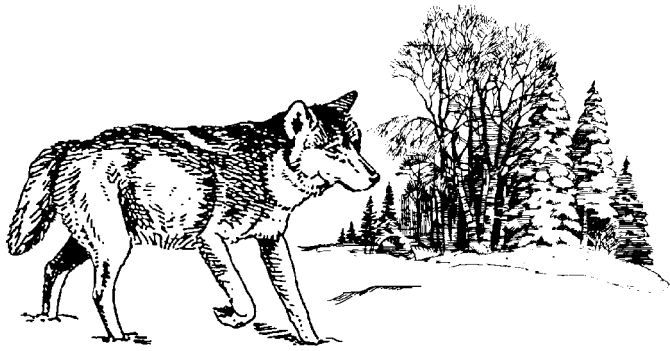
The best way to avoid injury of **beneficial insects and microorganisms** is to minimize the use of pesticides. Use selective pesticides whenever possible, and apply only when necessary as part of a total integrated pest management program.

Pesticides harm vertebrates such as **fish, birds, and mammals**. Fish kills can result from water polluted by a pesticide (usually insecticides). Pesticides can enter water via drift, surface runoff, soil erosion, and leaching.



Bird kills from pesticides can occur when birds ingest the toxicant in 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 its habitat will have a warning statement on the label regarding its use within the geographic range of the species. The statement will instruct applicators in actions they need to take to safeguard the species.

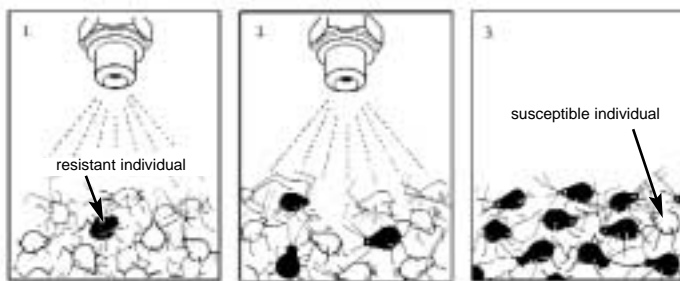


POTENTIAL FOR PESTICIDE RESISTANCE

Pesticide **resistance** is the inherited ability of a pest to tolerate the toxic effects of a particular pesticide. As resistance increases in a pest population, so will the application rate of the pesticide or the spray frequency needed to provide adequate control.

The Development of Resistance

When organisms reproduce, the offspring receive copies of the parent genetic material. The copies are not always perfect—mistakes, called mutations, may appear. Most mutations are either harmful or of no consequence. Sometimes, however, a mutation benefits an organism. An example of such a mutation is one that confers resistance to a pesticide. These resistant individuals survive when we apply the pesticide and at least some of their offspring inherit the resistance. Because the pesticide kills most of the non-resistant individuals, the resistant organisms will make up a larger percentage of the surviving population. With each use of the pesticide, this percentage increases, and eventually most of the pest population will be resistant.



Some individuals in a pest population have genetic traits that allow them to survive a pesticide application.

A proportion of the survivors' offspring inherit the resistance traits. At the next spraying these resistant individuals will survive.

If pesticides are applied frequently, the pest population will soon consist mostly of resistant individuals.

Figure 2.3. Resistance involves a change in the genetic characteristics of pest populations and is inherited from one generation to the next (David Kidd, Univ. of Calif., Davis).

In most cases, pest populations that become resistant to one pesticide also become resistant to other chemically related pesticides. This is called **cross-resistance**. Cross-resistance happens because closely related pesticides kill pests in the same way (e.g., all **organophosphate** insecticides kill by inhibiting **cholinesterase**); if a pest can resist the toxic action of one pesticide, it can usually resist other pesticides that act in the same way.

Resistance Management

Resistance management attempts to prevent, delay, or reverse the development of resistance. You should incorporate the practices described below into your resistance management program.

- Use an integrated pest management program. Combine cultural, mechanical, biological, and chemical management measures into a practical pest control program.
- Where possible, practice crop rotation. By discouraging the buildup of pests associated with any one crop, crop rotation will reduce the number of pesticide applications directed at a given pest. This reduces the advantage that resistant individuals have over non-resistant individuals and will delay or help prevent the buildup of resistance in a population.
- Use pesticides from different chemical families. Try to do this whether you apply pesticides against a pest once a year or several times within a treatment season. This way, pests resistant to the first pesticide will be killed by the second.
- Use pesticides only when needed, and use 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 and neighbors in advance of any large-scale pesticide application. When pesticide off-target drift is anticipated, a **drift management plan** must be used by private and commercial applicators to minimize the occurrence and adverse effects of off-target drift. For more information on the Michigan regulation (Reg. 637) that requires a drift management plan, contact the Michigan Department of Agriculture.

Occasionally you may be asked questions about pesticide applications or consequences. If you are unsure of the answer, don't guess. Help is available from your local Extension office.

CHAPTER
2

Review Questions

Chapter 2: Mimimizing Pesticide Impact

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

- If an applicator applies a pesticide according to the instructions on the supplemental label, he/she must:
 - Notify the Michigan Department of Agriculture.
 - Notify the pesticide dealer before the application.
 - Notify the pesticide dealer after the application.
 - Have the supplemental label in his/her possession at the time of the application.
- The pesticide label contains information on:
 - Ways to protect the applicator.
 - Ways to protect the environment.
 - Ways to protect the crop.
 - All of the above
- You should always select pesticides for the crop that you wish to use them on and the pest(s) that you wish to control.
 - True
 - False.
- FIFRA is:
 - A federal law.
 - A law only in the state of Michigan.
 - The law that regulates fertilizers.
 - Administered by the Michigan Department of Natural Resources.
- FIFRA regulates the registration and use but not the distribution and sale of pesticides.
 - True
 - False
- Another term for water obtained from a well is:
 - Surface water.
 - Groundwater.
 - Potential water.
 - Runoff water.
- If an aquifer is polluted, one or more wells drilled into the aquifer may also be polluted.
 - True
 - False
- The water table fluctuates:
 - Only in the summer.
 - Only in the winter.
 - Never.
 - Throughout the year.
- Recharge water that seeps through the soil from rain, melting snow, and irrigation:
 - Raises the water table.
 - Lowers the water table.
 - Has no effect on the water table.
 - None of the above
- Non-point source pollution is generally easier to trace back to the origin than point source pollution.
 - True
 - False
- Keeping pesticides from polluting groundwater is harder than cleaning up polluted water.
 - True
 - False
- By using an integrated pest management program, you can always avoid using pesticides to control pests.
 - True
 - False
- Back-siphoning can occur if there is no air gap between the water level and the hose.
 - True
 - False.

14. Mixing/loading a spray tank on an impervious pad and proper disposal of pesticide containers are two practices that can reduce the potential for:
- Pest resistance.
 - Surface and groundwater contamination.
 - Back-siphoning.
 - Drift.
15. Which pesticide form is the most hazardous to bees?
- Dust
 - Granules
 - Emulsifiable concentrates
 - Sprays
16. Which pesticide form is the least hazardous to bees?
- Dust
 - Granules
 - Microencapsulation
 - Sprays
17. If weeds are in bloom near plants that must be sprayed with insecticide, which is the best practice to avoid killing pollinators?
- Wait for the weeds to finish blooming.
 - Spray without regarding the weeds.
 - Mow the weeds and then spray.
 - None of the above.
18. If bees are in an area to be sprayed, what is the best time of the day to spray?
- Early morning
 - Midday
 - Evening
 - None of the above
19. Pesticide use poses a threat to fish, wildlife, and birds.
- True
 - False
20. The inherited ability of a pest to tolerate the toxic effects of a pesticide is called:
- Pesticide resistance.
 - Pesticide toxicity.
 - Pesticide use.
 - Pesticide management.
21. If a pest can resist the toxic action of one pesticide, it can usually resist other pesticides that act in the same way.
- True
 - False
22. The ability of a pest to develop resistance to pesticides it has never encountered is called:
- Mechanical control.
 - Cross-resistance.
 - Toxic action.
 - Microencapsulation.
23. There is no way to delay the onset of pesticide resistance.
- True
 - False
24. Rotating pesticides from different chemical families to kill a particular pest is one way to:
- Manage pesticide resistance.
 - Calibrate spray equipment.
 - Encourage pest buildup.
 - Minimize drift.
25. Why is it important to maintain good public relations when applying pesticides?
26. If the applicator is asked a question about the pesticide application that he/she can't answer, he/she should:
- Refuse to respond to the question.
 - Be polite and give your best guess.
 - Leave the site and not return.
 - Find out the answer and get back to the person.