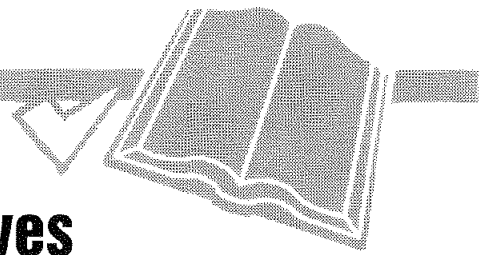
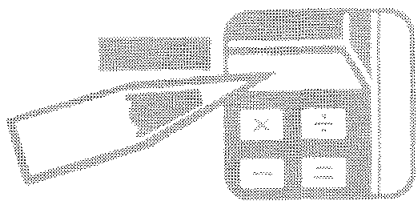

Pesticides in the Environment





Learning Objectives

After you complete your study of this unit, you should be able to:

- Explain the meaning of the word “environment.”
- Distinguish between point-sources and non-point-sources of environmental contamination by pesticides.
- List factors you should consider when you accidentally or intentionally release a pesticide into the environment.
- Explain why sensitive areas are important considerations for pesticide handlers.
- Name the routes by which pesticides can move offsite into the environment.
- Describe factors that influence whether pesticides will move offsite in the air.
- Describe factors that influence whether pesticides will move offsite in water.
- Describe ways that pesticides move offsite in or on objects, plants, or animals.
- Recognize that nontarget plants and animals can be harmed by both pesticides and pesticide residues.
- Describe harmful effects that pesticides can have on surfaces.

Terms To Know

Back-siphoning — The movement of liquid pesticide mixture back through the filling hose and into the water source.

Collection pad or tray — A safety system designed to contain and recover spills, rinsates, leaks, and other pesticide-containing substances.

Concentrates — Pesticides that have a high percentage of active ingredient.

Endangered species — Organisms whose survival as a species has been designated by a Federal agency to be endangered or threatened.

Ground water — Water beneath the earth’s surface in soil or rock.

Labeling — The pesticide product label and other accompanying materials that contain directions that pesticide users are legally required to follow.

Nontarget — Any site or organism other than the site or pest at which the pesticide is being directed.

Offsite — Outside the area where the pesticide is being released.

Personal protective equipment (PPE) — Devices and clothing worn to protect the human body from contact with pesticides or pesticide residues.

Pesticide handler — Person who directly works with pesticides, such as during mixing, loading, transporting, storing, disposing, and applying, or working on pesticide equipment.

Precautionary statements — Statements on pesticide labeling that alert you to possible hazards from use of the pesticide product and that sometimes indicate specific actions to take to avoid the hazards.

Release — When a pesticide leaves its container or the equipment or system that is containing it and enters the environment. Release can be intentional, as in an application, or by accident, as in a spill or leak.

Rinsate — Pesticide-containing water (or another liquid) that results from rinsing a pesticide container, pesticide equipment, or other pesticide-containing materials.

Runoff — The movement of pesticide away from the release site in water or another liquid flowing horizontally across the surface.

Surface water — Water on top of the earth’s surface, such as in lakes, streams, rivers, irrigation ditches, or storm water drains.

Target — The site or pest toward which control measures are being directed.

Use site — The immediate environment where a pesticide is being mixed, loaded, applied, transported, stored, or disposed of, or where pesticide-contaminated equipment is being cleaned.

Volatile — Evaporating rapidly; turning easily into a gas or vapor.

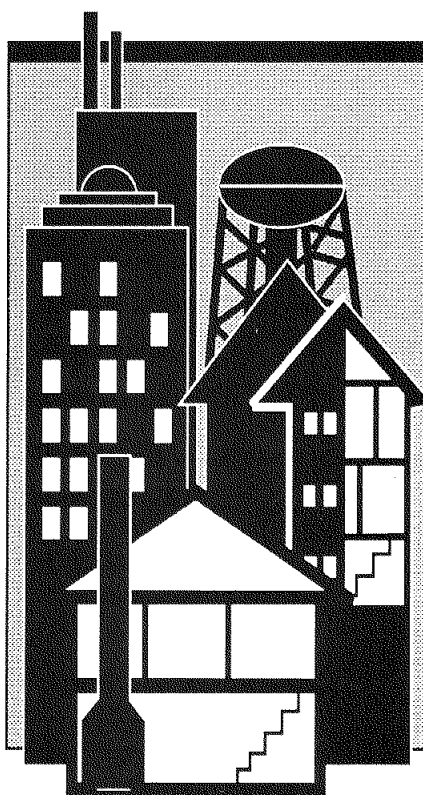
The environment is everything that is around us. It includes not only the natural elements that the word "environment" most often brings to mind, but also people and the manmade components of our world. Neither is the environment limited to the outdoors — it also includes the indoor areas in which we live and work.

The environment, then, is much more than the oceans and the ozone layer. It is air, soil, water, plants, animals, houses, restaurants, office buildings, and factories and all that they contain. Anyone who uses a pesticide — indoors or outdoors, in a city or in the country — must consider how that pesticide will affect the environment.

The user must ask two questions:

- How will this pesticide affect the immediate environment at the site where it is being used?
- What are the dangers that the pesticide will move out of the use site and cause harm to other parts of the environment?

Pesticides can harm all types of environments if they are not used correctly.



Responsible pesticide users know and follow good practices that achieve effective pest control with very little risk of environmental damage.

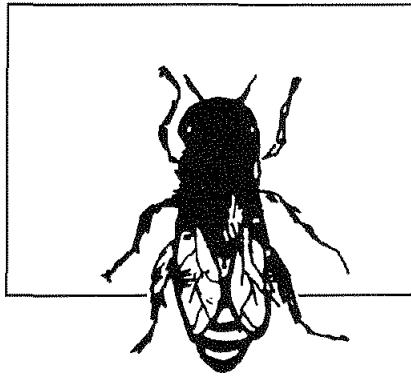
Pesticide product labeling statements are intended to alert you to particular environmental

concerns that a pesticide product poses. Use good judgment, too. The lack of a particular precautionary statement does not necessarily mean that the product poses no hazard to the environment.

Both the public and the Environmental Protection Agency (EPA) are becoming increasingly concerned about harmful effects on the environment from the use of pesticides. As a result, EPA is looking closely at environmental effects as it considers new applications for registration, and it also is taking another look at existing pesticide registrations. Hazards to humans had been the primary reason for EPA to classify a pesticide as a restricted-use product. Now, more and more pesticide labels list environmental effects, such as contamination of ground water or toxicity to birds or aquatic invertebrate animals, as a reason for restriction.

Sources of Contamination

When environmental contamination occurs, it is the result of either point-source or non-point-source pollution. Point-source pollution comes from a specific, identifiable place (point). A



pesticide spill that moves into a storm sewer is an example of point-source pollution. Non-point-source pollution comes from a wide area. The movement of pesticides into streams after broadcast applications is an example of non-point-source pollution.

Non-point-source pollution from pesticide applications is the source that has most commonly been blamed for pesticide contamination in the outdoor environment. But more and more studies are revealing that, in fact, much environmental contamination does not result from non-point-source pollution. Contamination also results from point sources, such as:

- wash water and spills produced at equipment cleanup sites,
- improper disposal of containers, water from rinsing containers, and excess pesticides,
- pesticide storage sites where leaks and spills are not correctly cleaned up, and
- spills that occur while mixing concentrates or loading pesticides into application equipment.

These kinds of tasks are involved with nearly every pesticide use, whether the pesticide is applied outdoors or in or around an enclosed structure.

As a pesticide handler, especially if you use and supervise the use of restricted-use pesticides, you must become aware of the potential for environmental contamination during every phase of your pesticide operation. Many pesticide uses are restricted because of environmental concerns. Whenever you release a pesticide into the environment — whether intentionally or accidentally — consider:

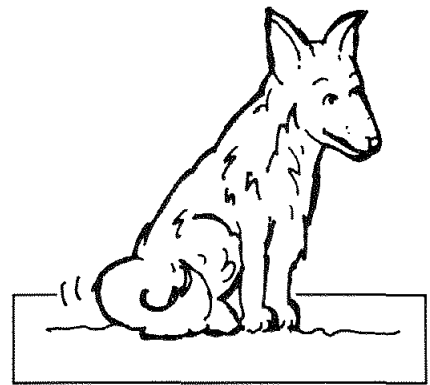
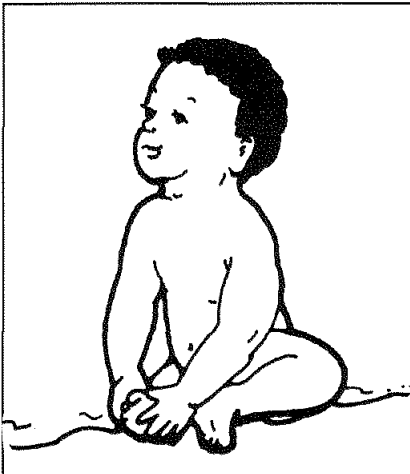
- whether there are sensitive areas in the environment at the pesticide use site that might be harmed by contact with the pesticide,
- whether there are sensitive offsite areas near the use site that might be harmed by contact with the pesticide,
- whether there are conditions in the environment at the pesticide use site that might cause the pesticide to move offsite, and
- whether you need to change any factors in your application or in the pesticide use site to reduce the risk of environmental contamination.

Sensitive Areas

Sensitive areas are sites or living things that are easily injured by a pesticide.

Sensitive areas outdoors include:

- areas where ground water is near the surface or easily accessed



(wells, sinkholes, porous soil, etc.),

- areas in or near surface water,
- areas near schools, playgrounds, hospitals, and other institutions,
- areas near the habitats of endangered species,
- areas near apiaries (honeybee sites), wildlife refuges, or parks, and
- areas near ornamental gardens, food or feed crops, or other sensitive plantings.

Sensitive areas indoors include:

- areas where people — especially children, pregnant women, the elderly, or the sick — live, work, or are cared for,
- areas where food or feed is processed, prepared, stored, or served,
- areas where domestic or confined animals live, eat, or are otherwise cared for, and
- areas where ornamental or other sensitive plantings are grown or maintained.

Sometimes pesticides must be deliberately applied to a sensitive area to control a pest. These applications should be performed by persons who are well trained about how to avoid causing injury in such areas.

At other times, the sensitive area is part of a larger target site. Whenever possible, take special precautions to avoid direct application to the sensitive area. For example, leaving an untreated buffer zone around sensitive areas

is often a practical way to avoid contaminating them.

In still other instances, the sensitive area may be near a site that is used for application, mixing/loading, storage, disposal, or equipment washing. The pesticide users must take precautions to avoid accidental contamination of the sensitive area. For example, a permanent site for mixing/loading or equipment washing could be equipped with a collection pad or tray to catch and contain leaks, spills, or waste water.

Typical pesticide labeling statements that alert you to these concerns include:

Do not use in hospital patient quarters.

Remove all animals from building prior to treatment and keep animals out until spray has dried.

Applications prohibited in areas where food is held, processed, prepared or served.

Do not use around home gardens, schools, recreational parks, or playgrounds.

In living areas, make applications in such a manner as to avoid deposits on exposed surfaces or

introducing the material into the air.

Do not use in or around residences.

Pesticide Movement

Pesticides that move away from the release site may cause environmental contamination. Pesticides move away from the release site both indoors and outdoors and may cause harm in both environments. Pesticides move in several ways, including:

- in air, through wind or through air currents generated by ventilation systems,
- in water, through runoff or leaching,
- on or in objects, plants, or animals (including humans) that move or are moved offsite.

Air

Pesticide movement away from the release site in the air is usually called **drift**. Pesticide particles, dusts, spray droplets, and vapors all may be carried offsite in the air. People who mix, load, and apply pesticides outdoors usually are aware of the ease with which pesticides drift offsite. People who handle pesticides indoors may not realize how easily some pesticides move offsite in the air currents

created by ventilation systems and by forced-air heating and cooling systems.

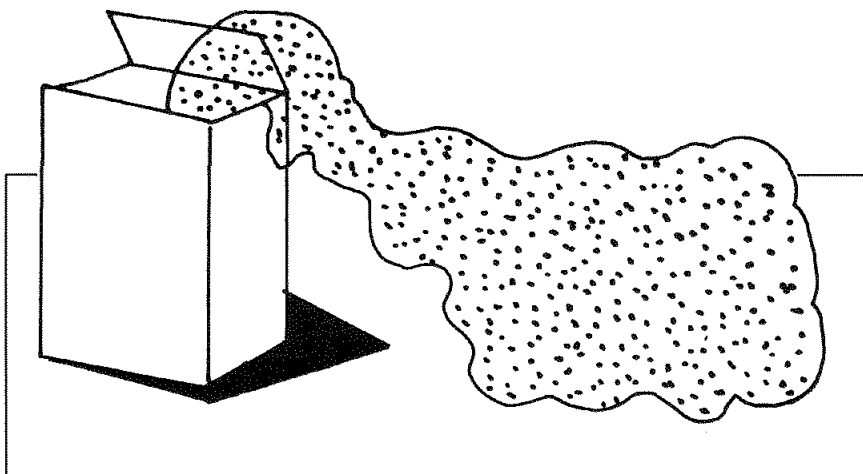
Particles and droplets

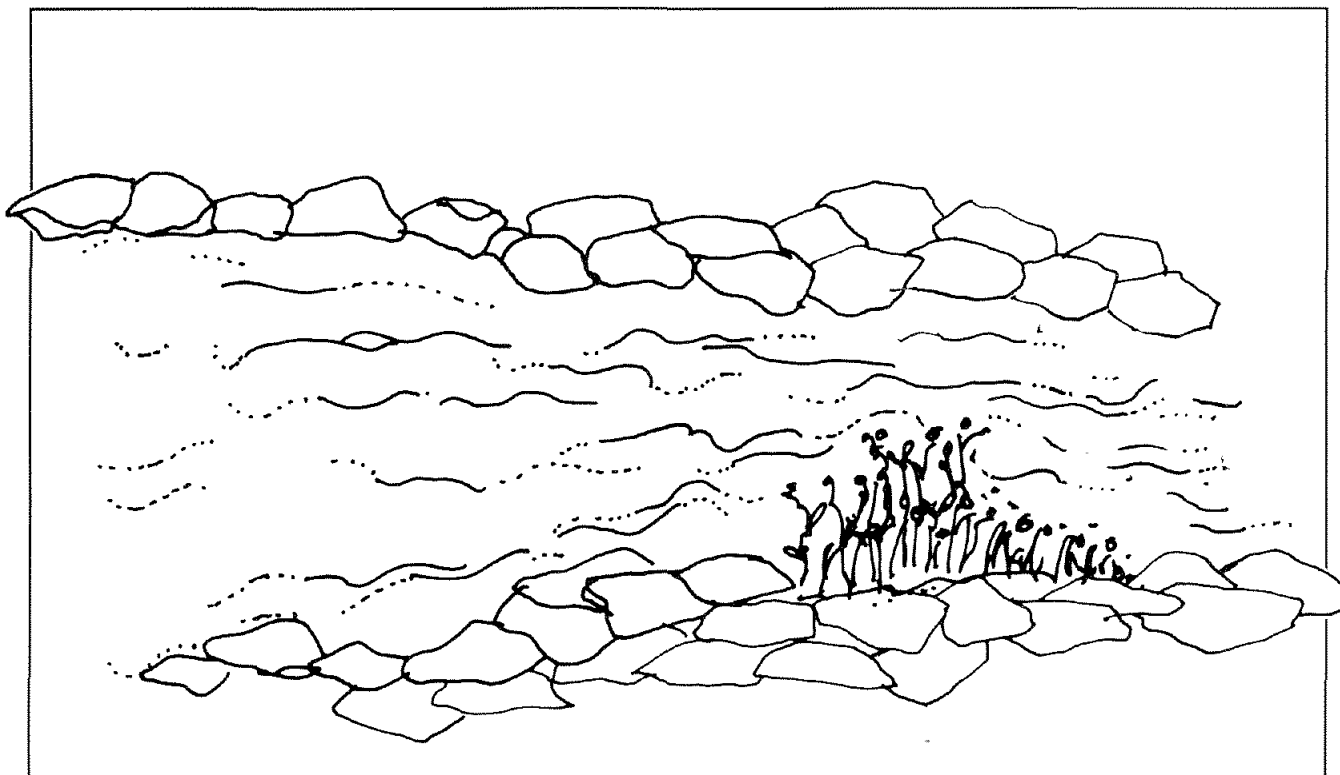
Lightweight particles, such as dusts and wettable powders, are easily carried by moving air. Granules and pellets are much heavier and tend to settle out of air quickly. Small spray droplets also are easily carried in air currents. High-pressure and fine nozzles produce very small spray droplets that are very likely to drift. Lower pressure and coarse nozzles produce larger droplets with less drift potential.

The likelihood that pesticide particles and spray droplets will drift offsite depends partly on the way they are released. Pesticides released close to the ground or floor are not as likely to be caught up in air currents as those released from a greater height. Pesticides applied in an upward direction or from an aircraft are the most likely to be carried on air currents.

Vapors

Pesticide vapors move about easily in air. Fumigant pesticides are intended to form a vapor when they are released. Persons using fumigants must take precautions to make sure the fumigant remains in a sealed container until it is released into the application site, which also must be sealed to prevent the vapor from escaping. Some nonfumigant pesticides also can vaporize and escape into the air. The labeling of volatile pesticides often includes warning statements that the pesticide handler should heed. Any time you release a volatile pesticide in an enclosed area, consider the hazards not only to yourself and to fellow workers, but also to people, animals, and plants that are in or near the release site or that may





enter the area soon after the release.

Typical pesticide labeling statements that alert you to avoid drift include:

Do not apply when weather conditions favor drift from areas treated.

Do not allow drift onto plants intended for food or feed.

Drift from treated areas may be hazardous to aquatic organisms in neighboring areas.

Water

Pesticide particles and liquids may be carried offsite in water. Pesticides can enter water through:

- drift, leaching, and runoff from nearby applications,
- spills, leaks, and back-siphoning from nearby mixing, loading, storage, and equipment cleanup sites, and
- improper disposal of pesticides, rinsates, and containers.

Most pesticide movement in water is across the treated surface (runoff) or downward from the surface (leaching). Runoff and leaching may occur when:

- too much liquid pesticide is applied, leaked, or spilled onto a surface, or
- too much rainwater, irrigation water, or other water gets onto a surface containing pesticide residue.

Runoff water in the outdoor environment may travel into drainage ditches, streams, ponds, or other surface water where the pesticides can be carried great distances offsite. Pesticides that leach downward through the soil in the outdoor environment sometimes reach the ground water.

Runoff water in the indoor environment may get into domestic water systems and from there into surface water and ground water. Runoff can flow into floor drains or other drains and into the water system. Sometimes a careless pesticide handler washes

pesticide down a sink drain and into the water system.

Some pesticides can leach downwards in indoor environments. In a greenhouse, for example, pesticides may leach through the soil or other planting medium to floors or benches below. Some pesticides used indoors may be absorbed into carpets, wood, and other porous surfaces and remain trapped for a long time.

Typical pesticide labeling statements that alert you to these concerns include:

Do not contaminate water through runoff, spills, or improper disposal of excess pesticide, spray mixtures, or rinsates.

Do not allow runoff or spray to contaminate wells, irrigation ditches, or any body of water used for irrigation or domestic purposes.

Do not apply directly to water and wetlands (swamps, bogs, marshes, and potholes).

Maintain a buffer zone (lay-off distance) of 100 feet from bodies of water.

This product is water soluble and can move with surface runoff water. Do not contaminate cropland, water, or irrigation ditches.

On or in Objects, Plants, or Animals

Pesticides can move away from the release site when they are on or in objects or organisms that move (or are moved) offsite. Pesticides may stick to shoes or clothing, to animal fur, or to blowing dust and be transferred to other surfaces. When pesticide handlers bring home or wear home contaminated personal protective equipment, work clothing, or other items, residues can rub off on carpeting, furniture, and laundry items and onto pets and people.

Pesticides may stick to treated surfaces, such as food or feed products that are to be sold. To protect consumers, there are legal limits (tolerances) for how much pesticide residue may safely remain on crops or animal products that are sold for food or feed. Products that exceed these tolerances are illegal and cannot be sold. Crops and animal products will not be over tolerance if the pesticides are applied as directed on the product labeling. Illegal pesticide residues usually result when:

- too much pesticide is applied to the crop or animal,

- the days-to-harvest, days-to-grazing, or days-to-slaughter directions on the pesticide labeling are not obeyed, or

- pesticides move out of the release site and contaminate plants or animals nearby.

Typical pesticide labeling statements that alert you to these concerns include:

Do not apply within 5 days of harvest.

Do not apply under conditions involving possible drift to food, forage, or other plantings that might be damaged or the crops thereof rendered unfit for sale, use, or consumption.

Remove meat animals from treated areas at least 1 day before slaughter if they were present at application or grazed treated areas within 21 days after application.

Do not pasture or feed treated hay to lactating dairy cattle within 21 days after application.

Harmful Effects on Nontarget Plants and Animals

Nontarget organisms may be harmed by pesticides in two ways:

- The pesticide may cause injury by contacting the nontarget organism directly, or
- The pesticide may leave a residue that causes later injuries.

Harmful Effects from Direct Contact

Pesticides may harm nontarget organisms that are present during

a pesticide application. Poorly timed applications can kill bees and other pollinators that are active in or near the target site. Pesticides may harm other wildlife, too. Even tiny amounts of some pesticides may harm them or destroy their source of food.

Pesticides applied over large areas, such as in mosquito, biting fly, and forest pest control, must be chosen with great care to avoid poisoning nontarget plants and animals in or near the target site. Read the warnings and directions on the pesticide labeling carefully to avoid harming nontarget organisms during a pesticide application.

Drift from the target site may injure wildlife, livestock, pets, sensitive plants, and people. For example, drift of herbicides can damage sensitive nearby plants, including crops, forests, or ornamental plantings. Drift also can kill beneficial parasites and predators that are near the target site.

Pesticide runoff may harm fish and other aquatic animals and plants in ponds, streams, and lakes. Aquatic life also can be harmed by careless tank filling or draining and by rinsing or discarding used containers along or in waterways.

Typical pesticide labeling statements that alert you to these concerns include:

Phytotoxic. Do not spray on plants.

Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treatment area.

Extremely toxic to aquatic organisms. Do not contaminate water by cleaning of equipment or disposal of wastes.

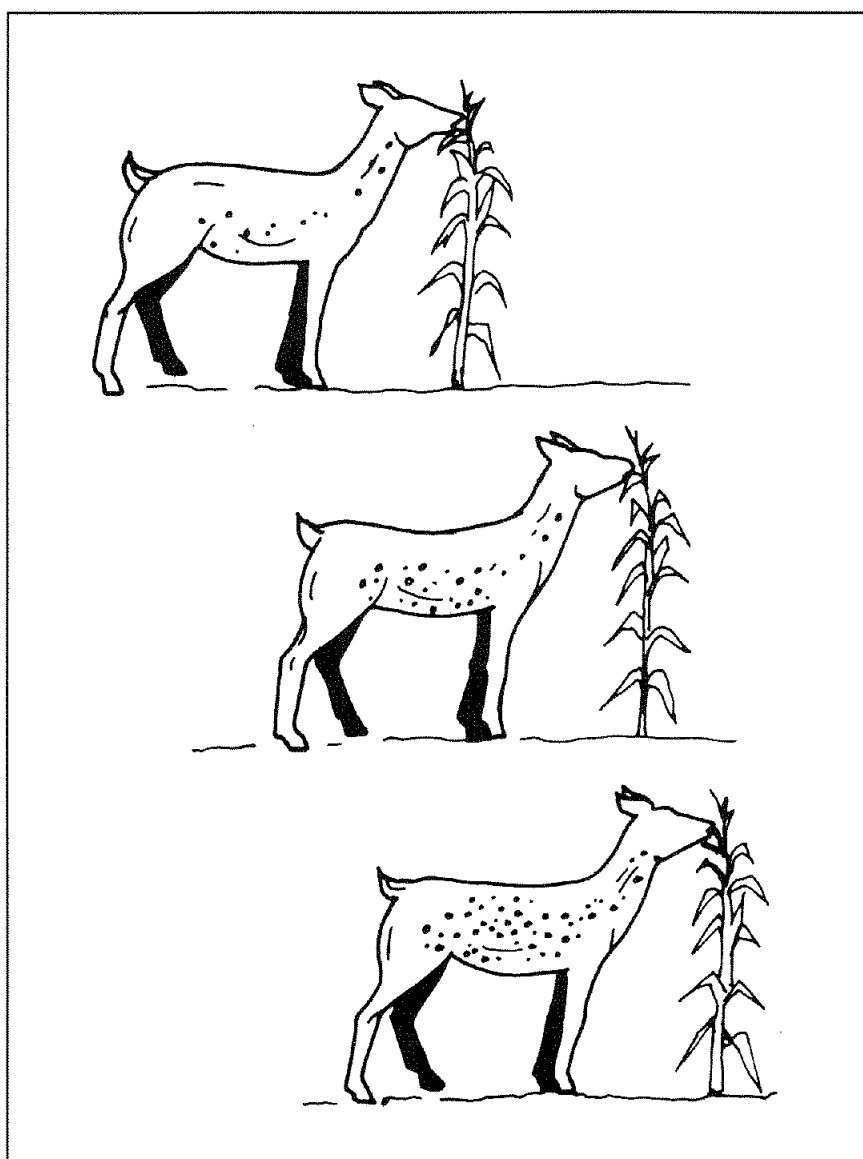
This product is toxic to fish, shrimp, crab, birds, and other wildlife. Keep out of lakes, streams, ponds, tidal marshes, and estuaries. Shrimp and crab may be killed at application rates. Do not apply where these are important resources.

Harmful Effects From Residues

A residue is the part of a pesticide that remains in the environment for a period of time following application or a spill. Pesticides usually break down into harmless components after they are released into an environment. The breakdown time ranges from less than a day to several years. The rate of pesticide breakdown depends mostly on the chemical structure of the pesticide active ingredient. The rate of pesticide breakdown also may be affected by environmental conditions at the release site, such as:

- surface type, chemical composition, and pH,
- surface moisture,
- presence of microorganisms,
- temperature, and
- exposure to direct sunlight.

Persistent pesticides leave residues that stay in the environment without breaking down for long periods of time. These pesticides are sometimes desirable, because they provide long-term pest control and may reduce the need for repeated applications. However, some persistent pesticides that are applied to or spilled on soil, plants, lumber, and other surfaces or into water can later cause harm to sensitive



plants or animals, including humans, that contact them. Clues on pesticide labeling that a particular pesticide product is likely to be persistent include:

Can remain in the soil for 34 months or more and cause injury to certain crops other than those listed as acceptable on the label.

This product can remain phytotoxic for a year or more.

When using persistent pesticides, consider whether their continued presence in the environment is likely to harm plants and animals.

When pesticides build up in the bodies of animals or in the soil, they are said to **accumulate**. When the same mixing/loading site or equipment cleaning site is used frequently without taking steps to limit and clean up spills, pesticides are likely to accumulate in the soil. When this occurs, plants, animals, and objects that come into contact with the soil may be harmed. When pesticides accumulate in the soil, there is also a higher likelihood that the pesticides will move offsite and contaminate the surrounding environment or move into surface or ground water.

Sometimes animals can be harmed when they feed on plants or animals that have pesticide residues on or in them. A special concern is for predator birds or mammals that feed on animals that have been killed by pesticides. The predators may be harmed by the pesticide residues remaining on or in the bodies of the dead animals.

Typical pesticide labeling statements that alert you to these concerns include:

Toxic to fish, birds, and wildlife. This product can pose a secondary hazard to birds of prey and mammals.

Do not use fish as food or feed within 3 days of application.

Animals feeding on treated areas may be killed and pose a hazard to hawks and other birds-of-prey. Bury or otherwise dispose of dead animals to prevent poisoning of other wildlife.

Harmful Effects on Surfaces

Sometimes surfaces are harmed by pesticides or pesticide residues. Some surfaces may become discolored by contact with certain pesticides. Other surfaces may be pitted or marked by contact with some pesticides. Some pesticides can corrode or obstruct electronic systems or metal. Sometimes a pesticide will leave a visible deposit on the treated surface.

Typical pesticide labeling statements that alert you to these concerns include:

Do not apply to carpeting, linoleum, or other porous floor coverings, as discoloration may result.

Do not spray on plastic, painted, or varnished surfaces.

May cause pitting of automobile and other vehicle paint.

Do not spray directly into any electronic equipment or into outlets and switches, or any other location where the pesticide may foul or short-circuit contacts and circuits.

A visible deposit may occur on some dark surfaces.



Test Your Knowledge

Q. What is the “environment”?

A. Environment is everything that surrounds us — indoors and outdoors — including natural elements, manmade objects, people, and other living organisms.

Q. Explain what is meant by point-source and non-point-source contamination of the environment by pesticides, and give an example of each.

A. Point-source pollution comes from a specific, identifiable place (point). A pesticide spill that moves into a storm sewer is an example of point-source pollution.

Non-point-source pollution comes from a wide area. The movement of pesticides into streams after broadcast applications is an example of non-point-source pollution.

Q. Name some ways that careless pesticide handling could lead to point-source pollution.

A. Ways that careless pesticide handling could cause point-source pollution include, for example:

1. Mismanagement of wash water and spills produced at equipment cleanup sites.
2. Improper disposal of containers, water from rinsing containers, and excess pesticides.

3. Failure to correctly clean up leaks and spills at pesticide storage sites.

4. Spilling pesticides while mixing concentrates or loading pesticides into application equipment.

Q. What environmental factors should you consider any time you accidentally or intentionally release a pesticide into an environment?

A. Consider:

1. Whether there are sensitive areas in the environment at the pesticide use site that might be harmed by contact with the pesticide,

2. Whether there are sensitive offsite areas near the use site that might be harmed by contact with the pesticide,
3. Whether there are conditions in the immediate environment that might cause the pesticide to move offsite, and
4. Whether you can change any factors in your application or in the pesticide use site to reduce the risk of environmental contamination.

Q. What is a “sensitive area”? Give four examples of sensitive areas that you must be especially careful to protect when you are handling pesticides.

A. Sensitive areas are sites or living things in environments that are easily injured by a pesticide. Some examples of sensitive areas are: places where pesticides might get into ground water or surface water; homes, schools, playgrounds, hospitals, and other places where people are present; places where there are animals — endangered species, bees, other wildlife, livestock, pets; places where crops, ornamental plants, or other sensitive plants are growing; and areas where food or feed is processed, stored, or served.

Q. List three routes by which pesticides can move offsite.

- A.**
1. In air, through wind or through air currents generated by ventilation systems.
 2. In water, through runoff or leaching.
 3. On or in objects, plants, or animals (including humans) that move or are moved offsite.

Q. What factors influence whether a pesticide will move offsite in the air?

- A.**
1. Droplet or particle size.
 2. Height and direction of release.
 3. Whether the pesticide tends to form vapors.

Q. Name two circumstances that might cause a pesticide to move offsite in water.

- A.**
1. Too much liquid pesticide is applied, leaked, or spilled onto a surface.
 2. Too much rainwater, irrigation water, or wash water gets onto a surface that contains pesticide residue.

Q. Give some examples of ways that pesticides can move offsite on or in objects, plants, or animals.

- A.**
1. Pesticides may be carried offsite if they stick to such things as shoes or clothing, animal fur, or blowing dust — anything that moves from the use site to another location.
 2. Pesticide residues may remain on treated surfaces, such as food or feed products, when they are taken from the use site to be sold.

Q. In addition to direct contact with the pesticide during application or through drift or runoff, how else may nontarget plants and animals be harmed by a pesticide?

A. Nontarget plants and animals may be harmed by the pesticide residues that stay in the environment for a period of time after the release. These can be residues that remain in soil or on surfaces, or they may be residues that build up in the bodies of animals, harming those animals themselves and sometimes other animals that feed on them.

Q. What kinds of damage can some pesticides cause to surfaces?

A. Surfaces may become discolored, be pitted or marked, be corroded or obstructed, or be left with a visible deposit.