Volume

1

ATLANTIC CANADA PESTICIDE APPLICATOR TRAINING MANUAL SERIES

Applicator Core Training Manual

Cooperatively developed by the Atlantic Working Group for Pest Management Education and Training Standards

ATLANTIC CANADA PESTICIDE APPLICATOR TRAINING MANUAL SERIES

Applicator Core

This manual can be obtained from the following Provincial Agencies:

Government of Newfoundland & Labrador	**Government of Nova Scotia**	**Government of New Brunswick**	**Government of Prince Edward Island**
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Chapter 1

GENERAL INFORMATION

Many pests affect our daily lives. Insect, weed, and disease pests attack crops, forests, and ornamental plants. Insect pests invade homes and buildings. When pests impact human health, property values, farming or forest operations, they may require control.

Pest managers can use chemical pest control or pesticides. Pesticides are hazardous. Some are very toxic to humans, while others threaten water, fish, wildlife, or livestock. Any pesticide must be handled and applied safely. Failure to use them in a proper manner may result in exposure to humans, or contamination of food crops or the environment.

This chapter looks at:

- The way in which pesticides work
- Types of pesticides
- Advantages and disadvantages of each type

Learning Objectives

Completing this chapter will help you to:

- **Understand the need for safe and effective pesticide use.**
- **Understand words related to pesticides.**
- **Know how different types of pesticides work.**
- **Identify pesticide formulations by abbreviations and the benefits, and uses of each.**
- **Know the function of adjuvants.**
- **Identify different adjuvants.**

Learning Objectives cont'd.

- **Know the meaning of pesticide compatibility and when it is proper to mix products in the same spray tank.**
- **Know how to tell if pesticides are compatible.**
- **Know the risks of mixing pesticides that are not compatible.**

Sources of Information

There are a number of ways to get information on the safe and effective use of pesticides. The label attached to each container is the best source of information. Pesticide handlers must be familiar with the label information. This information results from tests and studies carried out by the manufacturer. It is also reviewed and approved by Health Canada during registration. Failure to follow directions on the label is a violation of the federal *Pest Control Products Act* (PCP Act) and Regulations under Health Canada.

Information on proper handling and use of pesticides can be accessed at the following internet sites:

Pest Management Regulatory Agency (PMRA) e-mail questions to:
PMRA_INFOSERV@hc-sc.gc.ca

PMRA Website:
http://www.pmra-arla.gc.ca/english/index-e.html

Croplife Canada Website
www.croplife.ca

Provincial Websites:
www.gov.ns.ca/enla/envin/ipm/default.asp
www.gov.pe.ca
www.gov.nf.ca/env/Env/PollPrev/pesticides/pesticide_control2.asp
www.gnb.ca/0009/index-e.asp

Information can be obtained from:

- Material Safety Data Sheets (MSDSs) **(See Chapter 3: Labeling)**
- Manufacturers
- Researchers
- Federal and provincial publications
- Pest control experts

General Pesticide Terminology and Definitions

Pest

A pest is any harmful, noxious, or problem organism that causes an unwanted effect. Pests include:

- Fungi
- Bacteria
- Viruses
- Weeds
- Insects
- Mites
- Rodents
- Birds

Wildlife (e.g., raccoons, wolves, deer) can sometimes be named as pests. If left unmanaged, pests may impact human health or cost money.

Pesticide

A pesticide is designed to kill, control, repel, attract, or manage pests. Any product that claims to do any of these things is a pesticide under the *Pest Control Product Act* and Regulations. Pesticides include chemicals that regulate plant growth, defoliants, or plant desiccants.

Components of a Pesticide

Formulation

A formulation is one or more active ingredients combined with formulants to make an effective product. The pesticide manufacturer develops the formulation to make it safe, convenient, and effective. Active ingredients and formulants are reviewed and approved for registration and use by Health Canada.

A formulation is one or more active ingredients combined with one or more formulants (inerts or non-active materials).

Active Ingredient

The active ingredient is the part of the formulation that gives the desired or toxic effect. A pesticide can have more than one active ingredient.

Formulant

A formulant is an inert (non-active) substance added by the manufacturer to the active ingredient. This allows it to be stored, handled, or applied. A formulant can be liquid or solid.

Carrier

A carrier is mixed with an active ingredient to make the pesticide:

- Safer to handle
- Easier to apply
- Better suited for storage

Carriers include water, oil, solvents, or clay. Some pesticides do not need a carrier. These are called Ready-to-Use (RTU) formulations.

Adjuvant

The manufacturer can add an adjuvant to the formulation. An adjuvant can also be added to the spray tank by the applicator. Adjuvants change application traits to make products:

- Safer
- More effective
- Easier to handle
- Easier to apply

Adjuvants increase the effectiveness of a pesticide by changing a physical or chemical trait. These broaden the conditions under which a pesticide can be used **(See Table 1-1)**.

Table 1-1: Adjuvants.

Type	*Activity*
Penetrants	Allow the pesticides to get through the outer layer of a treated surface.
Spreaders	Allow the pesticides to form a uniform coating over the treated surface.
Stickers	Allow the pesticide to remain on the treated surface.
Surfactants	Improve the spreading, dispensing, or wetting properties of a pesticide.
Wetting Agents	Allow wettable powders, and dry flowables to mix with water and better stick to target surfaces.
Antifoaming Agents	Reduce foaming of spray mixtures that require vigorous agitation.
Buffering Agents	Increase the solubility of pesticides in water or slow the chemical breakdown of some pesticides by lowering the pH of alkaline water.
Drift Retardants or Thickeners	Increase the droplet size of the spray material, reducing particle drift.
Emulsifiers	Allow oil-based pesticides to mix with water.
Invert Emulsifiers	Allow water-based pesticides to mix with oil-based carriers.

Formulation Types

Pesticides can be liquids, solids, or gases. Liquid formulations include:

- Emulsifiable concentrates
- Flowables
- Microcapsulated suspensions
- Solutions

Solid formulations include:

- Dusts
- Granules
- Pellets
- Soluble granules
- Soluble powders
- Baits
- Tablets
- Dry flowable powders
- Wettable powders

Gas formulations are fumigants. These can be purchased as solids, liquids, or gases.

A list of solid, liquid and gas formulations and their positive and negative characteristics is given in **Table 1-2**.

Applicators must look at more than cost when choosing a pesticide. It must be:

- Designed to control the pest
- Registered for the intended use (e.g., crop, ornamentals, turf, etc.)
- Approved for use with available application equipment

Care should be taken to select a formulation with the lowest risk to:

- Applicators
- Bystanders
- Non-target organisms
- Crops or target areas
- The environment

Abbreviations of Some Common Formulations

The formulation types of many pesticides appear as Abb. on the pesticide label. A list of those used for common formulations and descriptions of each are given in **Table 1-2**.

Table 1-2: List of Formulation Types

Name	*Abb.*	*Description*	*Advantage(s)*	*Disadvantage(s)*	*Typical Use(s)*
Baits	B	Particulates that are active ingredients mixed with an attractant or edible base.	Easy to handle. Used for spot treatment.	Attractive to children and pets.	Insect and rodent control.
Dry Flowables	DF	A wettable powder (WP) formulated into small pellets or granules.	Easy to handle, with less dust than wettable powders (WP).	Agitation required.	General use.
Dusts or Powders	DU	Finely ground dry material with a low concentrate of active ingredient(s).	No dilution required. Ready to use.	Applicator exposure and drift.	Direct application as a spot treatment.
Emulsifiable Concentrates or Emulsions	EC	Liquids containing the active ingredient(s), solvents, and emulsifiers. Forms milky spray mixtures when mixed with water.	Little agitation required. Non-abrasive. Low visible residue.	Possibly flammable. May require respirator when handling.	General use.
Flowables or Suspensions	F	Liquids that consist of solid particles of active ingredient(s) suspended in a liquid. Usually need to be diluted.	Less bulk due to high concentration of active ingredient. Seldom clog nozzles.	Constant agitation required.	General use.

Table 1-2: List of Formulation Types, cont'd.

Name	*Abb.*	*Description*	*Advantage(s)*	*Disadvantage(s)*	*Typical Use(s)*
Granulars	GR	A mix of dry, large free-flowing particles usually in a low concentration of active ingredient.	No mixing required. Minimal potential for drift.	Special application equipment required.	Soil treatment, for insect and vegetation control.
Micro-encapsulated Suspensions	MS	Small capsules of active ingredient suspended in the liquid. Slow release of active ingredient.	Increase of residue of active ingredient. Reduced hazard to operator.	May be expensive.	Insecticides.
Pellets	PE	Preformed mixtures of active ingredients and inert materials to form small solid spheres or cylinders.	Easy to spot treat.	Attractive to children and pets.	Baits to control rodents, slugs, etc.
Pressurized Products	PP	Aerosols, sprays, foam, and dusts packaged in a pressurized container. May be liquids, solids, or gases.	No mixing required.	Hazard from pressurized container.	Flying insect control.
Soluble Granulars	SG	Solid materials like granular, but soluble in water.	Containers empty easily. No liquid spills.	Dusty.	General use.
Soluble Powders	SP	Dry material similar to dust or granulars, but soluble in water.	Containers empty easily. No liquid spills.	Dusty.	General use.

Table 1-2: List of Formulation Types, cont'd.

Name	*Abb.*	*Description*	*Advantage(s)*	*Disadvantage(s)*	*Typical Use(s)*
Solutions	S	Active ingredient is in solution and remains clear when mixed with water.	Requires little agitation.	Possible corrosive.	General use.
Tablets	T	Active ingredients alone or with formulants formed into small blocks or spheres.	Easy to measure and use.	Attractive to children and pets.	Fumigation.
Wettable Powders	WP	Active ingredient plus a powder. Contains a wetting agent and a dispersing agent. Mix with water to form a suspension.	Containers empty easily with no splashing, or liquid spills. No special heated storage required.	Dusty. Requires agitation to remain in suspension.	General use.

Special Formulations

Pesticide manufacturers produce special formulations to meet the needs of specific applicators. These include fumigants and soluble packages.

Fumigants

Fumigants are available as gases, liquids, and solids. Carbon dioxide and ethylene oxide are compressed gases used as fumigants. Liquid fumigants become gases when applied. Solid fumigants come as dust, pellets, or tablets that release gases when exposed to moist air.

Soluble Packages

Pre-weighed amounts of wettable or soluble powder can be packaged in water-soluble plastic bags. When bags are placed in spray tank water, they dissolve and release their contents. These formulations reduce hazards around mixing and loading; there is no need to measure and no leftover product.

Naming Pesticides

A pesticide can be identified by product name, common name, or chemical name. Understanding the use of these can reduce confusion when seeking information on a pesticide. **Table 1-3** gives a listing of some product and common names.

Product Name

The product name is the registered trade name or trademark chosen by the manufacturer. The product name is clearly displayed on the principal panel of the label (e.g., Roundup).

Common Name

The common name is the name(s) of the active ingredient(s) in the product. It appears in lower case letters, often next to the word "Guarantee" on the principal panel of the label. The same active ingredient may be present in a number of products. Active ingredients are not always limited to one manufacturer. For example, the active ingredient glyphosate is made by a number of companies.

Chemical Name

The chemical name refers to the complex chemical structure of the active ingredient(s). Mostly chemists use these. The chemical name does not always appear in full on the label. It is found in the Material Safety Data Sheet for the product.

Table 1-3: Product and Common Names

Product Name	*Common Name*
2,4-D	2,4-D
Aatrex	atrazine
Ambush, Pounce	permethrin
Avadex BW	triallate
Basudin	diazinon
Cymbush, Ripcord	cypermethrin
Dithane M-22	maneb
Dual	metolachlor
Garlon 4	triclopyr
Gramoxone	paraquat
Lannate	methomyl
Monitor	methamidaphos
Princep Nine-T	simazine
Polyram	metiram
Ridomil, Subdue	metalazyl
Thimet	phorate
Thiodan	endosulfan
Tordon	picloram

Grouping Pesticides

There are many pesticides available. They can be grouped in a number of ways. The most common groupings are based on:

- Target pests
- The way they work (mode of action)
- Chemical family

Grouping by Target Pest

The most common way to group pesticides is by the pest(s) they are registered to control. Common pesticide types and the groups of pests they are designed to control are given in **Table 1-4.**

Table 1-4: List of pesticide type with target pest.

Pesticide Type	*Target Pest*
Acaricide	spiders, mites & ticks
Algicide	algae
Avicide	birds
Bactericide	bacteria
Fungicide	fungi
Growth regulator	plants & insects
Herbicide	plants (mostly weeds)
Insecticide	insects
Miticide	mites
Molluscicide	snails and slugs
Nematicide	nematodes
Piscicide	fish
Rodenticide	rodents

Grouping by Mode of Action or Route of Entry

Pesticides can be grouped by the way in which they work to control target pests (mode of action). Two main modes of action are contact and systemic. A list of other modes of action is given in **Table 1-5**. Many pesticides fall into more than one mode of action group.

Contact Pesticides

Contact pesticides control pests when they come in direct contact with the pest. Weeds are killed when enough of their surface area is covered with a contact herbicide. Insects are controlled when sprayed directly, or when insects travel across treated surfaces.

Systemic Pesticides

Systemic pesticides control pests when applied to one area of a plant or animal. The pesticide eventually moves throughout the entire plant or animal. A systemic herbicide absorbed through a plant's roots moves throughout the whole plant and kills it.

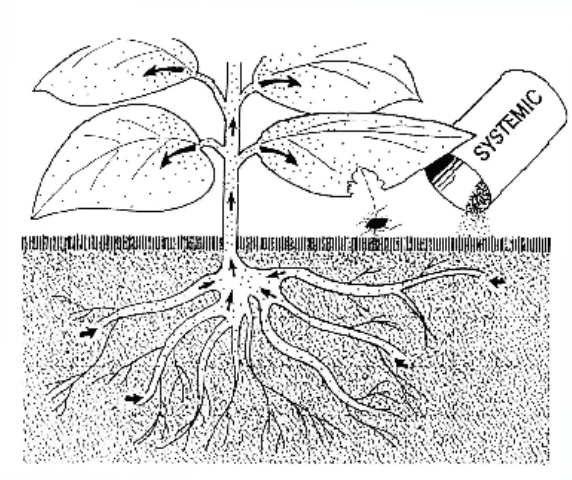


Figure 1-1: Systemic pesticide

Systemic insecticides enter plants through the roots or plant surfaces. These move throughout the plant and kill insects that feed on plant juices **(See Figure 1-1)**. A systemic insecticide applied to the skin of an animal (e.g., beef cow) will control internal parasites and pests when it moves throughout the animal's body.

Table 1-5: Some pesticide modes of action.

Group	*Mode of Action*
Attractants	Pesticides that have a particular odour or scent that attracts insects to a trap for identification or control.
Eradicants	Fungicides that can kill a pest once the pest has infected a plant, but before the pest becomes well established. Eradicants provide better pest control than protectants, because they have an element of post-infection control.
Fumigants	Pesticides that work in the gaseous form and control pests when the pests breathe in gases, or the gases are absorbed into their bodies through another manner.
Growth regulators	Pesticides that, once taken in by the pest, act like a pest's own hormones, disrupting normal development, causing it to die before it can become fully developed.
Protectants	Fungicides that prevent disease infection by creating a barrier between the pest and the plant preventing the disease from becoming established.
Repellents	Pesticides that produce an odour, repelling the pest from the treated area or plants.
Stomach ingestion	Pesticides that poison the pest once they are eaten.
Contact	Contact pesticides control pests when they come in direct contact with the pest.
Systemic	Systemic pesticides, when applied to one area of a plant or animal, are transported throughout the plant or animal. They kill all pests which feed on or in that plant or animal.

Grouping by Chemical Family

Pesticides can also be grouped by chemical family. A chemical family is a group of chemicals that have similar chemical structures and properties such as:

- Poison symptoms
- Persistence (ability to stay in the environment without changing)
- Mode of action

Pesticides in the same chemical family tend to have similar guidelines for first aid, cleanup, and safe handling.

Applicators should be aware that repeated use of pesticides from the same chemical family might increase the chance of pest resistance. This is especially so with insecticides. Using insecticides from different chemical families reduces the chance of resistance. Alternating insecticides from different chemical families extends the life of each product. Pest resistance is covered in detail in **Chapter 7: Integrated Pest Management**.

Knowing the chemical family of a pesticide will help the applicator to better know how it works and how to use it safely.

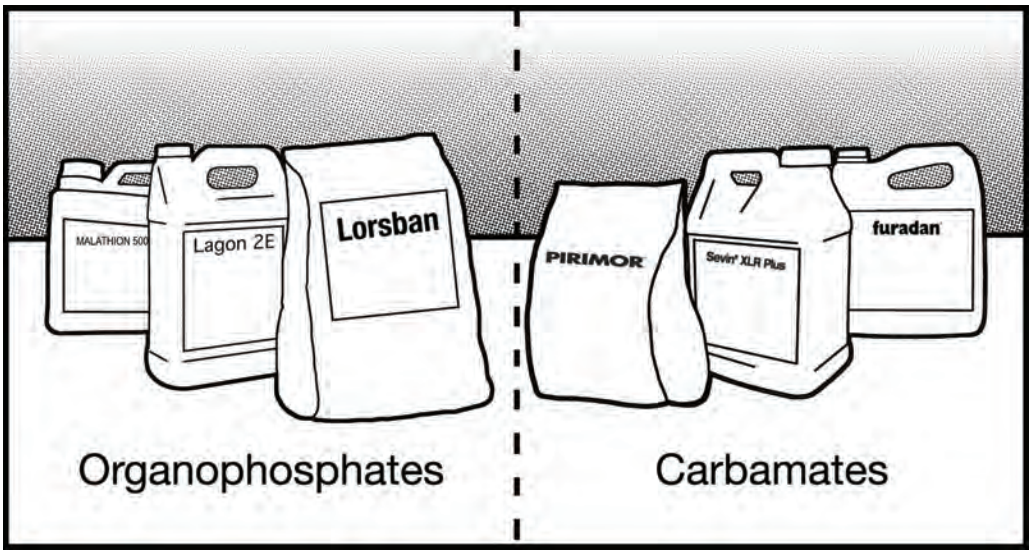


Figure 1-2: Examples of Two Chemical Families.

Pesticide active ingredients can be grouped as being inorganic or organic. Inorganic pesticides do not contain carbon. They are usually made from mineral ores such as copper, sulphur, or their salts (e.g., copper sulphate, sodium chlorate, ferrous sulphate).

Organic pesticides contain carbon in their chemical structure. Most organic pesticides are made from petroleum compounds. Organic pesticides taken from plants are called 'botanicals'.

Chemists have grouped organic pesticides into groups or families with similar molecular structures. Organic pesticides within a group often have similar properties. The most important organic groups are noted below.

ORGANOPHOSPHATE PESTICIDES (OP'S)

Most organophosphate pesticides are insecticides. This group contains some of the most toxic pesticides used in Canada. They often have a short persistence in soil, food, and animal feed. All OP's are cholinesterase inhibitors **(See Chapter 4: Human Health)**. Common organophosphate insecticides include phorate, malathion, diazinon, and dimethoate.

CARBAMATE PESTICIDES

The carbamates include insecticides, fungicides, and herbicides **(See Table 1-6).** Most have short persistence in the environment. Carbamate pesticides range in their level of toxicity from slightly to very toxic. Carbamate insecticides are cholinesterase inhibitors **(See Chapter 4: Human Health).**

Table 1-6: Pesticides in the Carbamate Family.

Classification	*Common Names*
Insecticides (carbamates)	aldicarb, carbaryl, carbofuran, methomyl, and pirimicarb
Herbicides (thiocarbamates)	triallate, EPTAC, and butylate
Fungicides (dithiocarbamates)	maneb, mancozeb, metiram, and thiram

ORGANOCHLORINE PESTICIDES (OC'S)

Organochlorine pesticides are rarely used today because they have a long persistence in the environment. They also tend to accumulate in human and animal fatty tissues. Some organochlorine insecticides with shorter persistence and lower toxicity to mammals are still available. Endosulfan and methoxychlor are examples of organochlorine pesticides.

TRIAZINE PESTICIDES

Compounds in this chemical group are all herbicides. All are mildly toxic to humans. These include amitrole, atrazine, hexazinone, metribuzin, and simazine. Most are systemic and enter the plant through its roots. A few are absorbed through leaves and then move through the plant. Triazines are persistent and residues may stay in the soil for a long time.

PHENOXY PESTICIDES

Grains and grasses are resistant to phenoxy herbicides. As a result, these are widely used for broadleaf weed control in grain crops and on turfgrass. The most common members of this group are 2,4-D, MCPA, and mecoprop. They have low to moderate human and animal toxicity.

Compatibility

Compatible pesticides can be mixed together to control a wider range of pests in a single application. Some product labels may state that the pesticide is "compatible" with another pesticide. This is not the same as stating that these products can be used in a "tank mix". These statements only indicate physical compatibility.

The mixture of two non-compatible pesticides can result in:

- Chemical reaction
- Reduced pest control
- Crop damage
- The forming of precipitate (e.g., gluey globs)

Pesticides should never be mixed unless they are listed as compatible on the label.

Mixing pesticides that are not compatible can cause plant or crop injury, reduced pest control, or damage to non-target organisms. A non-sprayable mixture may also form; and damage to spray equipment may occur.

Tank Mixing

A "tank mix" of more than one pesticide can be undertaken when it is clearly stated on the pesticide label. They are mixed together in the same spray tank. Label directions on the order to add the pesticides to the tank and the correct amount of each to add must be followed exactly. Pesticides whose labels indicate that they can be tank mixed have been tested to ensure their safety and effectiveness, that they are physically compatible and that no negative impacts on crop residue will result.

The applicator assumes the risk and responsibility with respect to safety, effectiveness, and damage, if he or she decides to tank mix pesticides whose labels do not clearly state that this can be done. The manufacturer or Canadian registrant is only responsible for the pesticide's performance when the pesticide is used according to label directions.

Figure 1-3: Pesticides should never be mixed in the same spray tank unless directions to do so are stated on the label of each product.

Summary

Pesticides are registered products designed to kill or control pests. Pests can impact humans, pets, livestock, crops, or valued parts of the environment. Formulated products consist of one or more active ingredients that control the pest. Adjuvants and additives can be added to make pesticides safer, more effective, or more convenient to use.

Pesticides are grouped by what they control, mode of action, and chemical family. Pesticides in the same chemical family have similar chemical structures, poisoning symptoms, level of persistence, and modes of action. Applicators should know pesticide-related terminology. They should also know the benefits and disadvantages of different formulations. This information allows applicators to make informed decisions on pesticide selection and proper use. Applicators need to know the importance of treating pesticides with care. The product label is the main source of information for safe and proper use of a pesticide.

Terms and meanings can be found in the Glossary of Terms in Appendix B.

Self-test Questions

Answers are located in Appendix A of this manual.

1. Explain the role of the active ingredient in a pesticide.

   _____

   _____

   _____

2. What is the name of a substance added by the manufacturer to a product formulation, or by the applicator to the spray tank, to improve the way in which a pesticide works?

   _____

3. What pests do each of the following pesticides control?

   a). Rodenticides _____

   b). Fungicides _____

   c). Herbicides _____

4. Name the type of formulation each abbreviation stands for. Give two advantages of each.

   a). GR _____

   _____

   b). F _____

   _____

   c). PE _____

5. When is it proper to "tank mix" two or more pesticides?

_____

_____

6. How does a contact herbicide act?

_____

_____

7. How does a systemic insecticide act?

_____

_____

8. Organophosphate pesticides are very toxic to humans. **True or False?**

Chapter 2

REGULATIONS

In Canada, federal and provincial governments regulate pesticides. This ensures that applicators, consumers, the public, and the environment are protected. Federal laws are enforced across Canada. These deal mainly with registration, manufacturing, labelling, import/export, and transportation of pesticides. Provincial laws are more restrictive than federal laws. Sale of pesticides, training, certification, and licensing of applicators, vendors and businesses are all provincial responsibilities. Some municipalities in the Atlantic Region have by-laws that can affect the way pesticides are managed.

This chapter looks at federal and provincial laws that govern safe and proper use of pesticides in Canada. Sources of information on these laws are also given. Anyone using or handling pesticides should be familiar with all applicable laws. This ensures compliance and good practice.

Learning Objectives

Completing this chapter will help you to:

- **Recognize the need for pesticide regulations.**
- **Know that the *Pest Control Products Act* regulates pesticides in Canada.**
- **Understand the purpose of the *Pest Control Products Act*. Understand the administration of the *Pest Control Products Act*.**
- **List four federal pesticide classes and describe their major characteristics.**
- **List and describe federal laws that govern the use of pesticides.**
- **Identify and describe provincial laws on pesticides.**

Federal Pesticide Legislation and Codes

Federal pesticide laws and codes are written and enforced to give a single clear position for all of Canada. This relates to how pesticides are registered, transported, handled, and disposed of.

Laws and codes also define penalties for those who fail to comply. Most of these laws are contained in the *Pest Control Products Act.* Other federal acts and codes deal with some aspects of enforcement or handling. Applicators must be familiar with these federal laws. This minimizes pesticide-related hazards to people and the environment. Federal pesticide laws include the following:

- *Pest Control Products Act* (PCPA)
- *Agriculture and Agri-Food Administrative Monetary Penalties Act* (AAAMPA)
- *Transportation of Dangerous Goods Act* (TDG)
- Canada Labour Code (CLC)
- *Food and Drugs Act* (FDA)
- *Migratory Birds Convention Act* (MBCA)
- *Fisheries Act* (FA)
- *Fertilizer Act* (FA)
- National Fire Code (NFC)
- National Building Code (NBC)

Pest Control Products Act

The major federal law that governs pesticides in Canada is the *Pest Control Products Act* and Regulations (PCP Act). The Pest Management Regulatory Agency (PMRA) of Health Canada administers these laws. Laws are designed to protect human health, the environment, and pesticide performance.

The PCP Act and Regulations ensure that:

- No person manufactures, stores, displays, distributes, or uses any pest control product under unsafe conditions

- No person packages, labels, or advertises any pest control product in a manner that is false, misleading, or deceptive, or is likely to create a false impression about the pest control product
- No person sells or imports a pest control product unless it is registered

Pesticide Registration

Before a pesticide can be sold or used in Canada, it must first be registered under the PCP Act. The decision to register a pesticide is made by the Pest Management Regulatory Agency. This is based on scientific data put forth by the manufacturer. A great deal of data is needed to register a pesticide. There must be information on:

- Product effectiveness in Canadian conditions
- Toxicity to humans, animals, and plants
- Food and feed residues
- Product fate in the environment
- The chemistry of the pesticide

A decision is made after a complete review of the safety, effectiveness, and merits of the product. When a pesticide is registered, it is given a unique *Pest Control Products Act* or PCP registration number. This number gives the manufacturer the right to distribute, sell, or make the pesticide in Canada **(See Chapter 3: Labelling)**.

CLASSIFICATION OF PESTICIDES IN CANADA

Registered pesticides are classed as Domestic, Commercial, Restricted, or Manufacturing. This depends on toxicity and intended use. Classification of a pesticide appears on the principal panel of the label (**See Chapter 3: Labelling**).

Domestic Class

Domestic class pesticides are registered for home use. These are packaged in small containers. They are intended for a single application or a single use season. Domestic class pesticides pose little risk to users or the environment, if label directions are followed. They can be safely handled with little personal protective equipment (PPE) and no special training.

Commercial Class

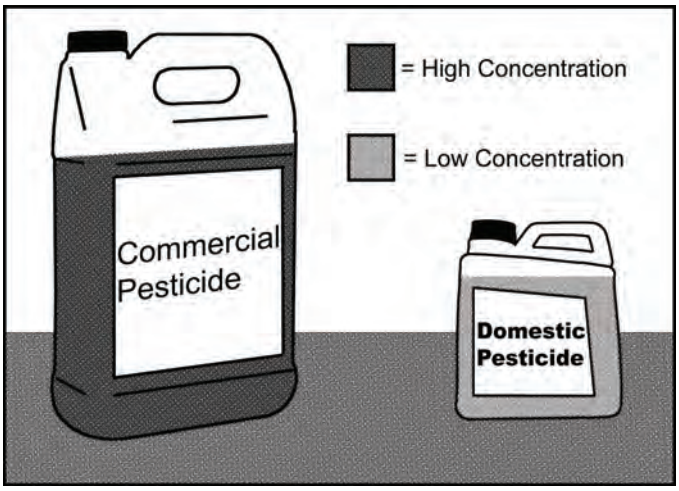
Commercial class pesticides are used in agriculture, forestry, industry, or other commercial operations. Active ingredients may be the same as those of

Domestic class pesticides, but are more concentrated. Commercial class products can pose a greater risk because of the concentration of active ingredient(s) or the size of the container.

Some pesticides are classed as Commercial because they are too toxic, persistent, or hazardous to be used by the general public. Applicators of Commercial class pesticides in the Atlantic Region are required to demonstrate knowledge of safe handling, application, transport, storage procedures, and proper use of personal protective equipment.

Applicators are advised to refer to provincial laws on licensing or certification requirements. These must be met before buying or using Commercial class pesticides.

The word "Agricultural" or "Industrial" may appear on a pesticide label as a substitute term for a Commercial class pesticide.



Restricted Class

Restricted class pesticides have more limits placed on them than Commercial class pesticides. These limits appear on the label and may be due to

- Increased toxicity
- Method of use (e.g., aerial application to forest land)
- Specific risk to the environment

Limitations may involve pesticide display, storage, distribution, application, or the qualifications of the end user. Applicators are advised to refer to provincial

laws on licensing or certification requirements to be met before purchase or use.

Manufacturing Class

Manufacturing class pesticides are used in manufacturing, formulating, or repackaging. They are not designed for general applicator use.

Pest Management Information Services

The PMRA, under Health Canada, provides a Pest Management Information Service. Information available includes:

- **Alternative pest management practices**
- **The pesticide registration process**
- **Pesticide labels or use pest control product labels**
- **Safety precautions**

This service can be accessed by using the following:
Call 1-800-267-6315
E-mail: PMRA_INFOSERV@hc-sc.gc.ca
PMRA website at http://www.pmra-arla.gc.ca/english/index-e.html

Agriculture and Agri-Food Administrative Monetary Penalties Act

This Act provides a system for issuing Administration of Monetary Penalties (AMPs). This is used in place of prosecution for violations under the *Pest Control Products Act*. Penalties are comparable to court-levied fines. They are handled through an administration process by the PMRA. No criminal records or imprisonments result. Violations under the PCP Act may be classed as minor, serious, or very serious. More details on these laws can be obtained by contacting:

AMPs Administration
2720 Riverside Drive
Ottawa, ON
K1A 0K9
Fax 613-736-3540
e-mail: pmra_amps_administration@hc-sc.gc.ca

Other Federal Legislation

Other federal laws or national codes govern aspects of pesticide use. These include:

- Transport of dangerous goods
- Labour laws
- Pesticide residues in food
- Damage to migratory birds
- Damage to fish or fish habitat
- Pesticides used in combination with fertilizers

Transportation of Dangerous Goods Act (TDG)

The *Transportation of Dangerous Goods Act* (TDG) is administered by Transport Canada. It regulates the transportation of hazardous materials. This includes Commercial and Restricted class pesticides. These laws cover a number of aspects:

- Offering for transport
- Handling during transport
- Transporting of pesticides

Persons who ship, receive, and transport a pesticide must comply with the act. A pesticide supplier, manufacturer, distributor, or provincial Department of Transportation employee responsible for the transportation of dangerous goods can explain the legal requirements. They can also advise if pesticides being transported are dangerous goods under the TDG Act. These sources can tell you what documents, training, labels, and/or placards are required.

Specific details on the TDG Act can be reviewed on the Transport Canada web site at:

www.tc.gc.ca/tdg/clear/tofc.htm

Canada Labour Code (CLC)

The Canada Labour Code (CLC) is administered under the *Canada Occupational Health and Safety Act* and Regulations. It is there to minimize workplace accidents and injuries. Employers must ensure the safety and health of employees at work by following the standards in these laws. These standards have been developed to ensure that employees are not put at risk by dangerous substances in the workplace. Those working with dangerous substances must receive proper training. Every effort must be made to minimize hazards. The Canada Labour Code recognizes all dangerous goods classed under the TDG Act.

Workplace Hazardous Materials Information System (WHMIS)

The Workplace Hazardous Materials Information System (WHMIS) was developed to give employers and employees information on hazardous materials in the workplace. Topics include safe use, storage, handling, and disposal. An employer must inform employees of possible workplace dangers. It is the employee's right to have access to information on substances that he/she works with. This includes material safety data sheets (MSDSs) when available. Product information is given in three ways:

- Warning labels
- Material Safety Data Sheets (MSDSs)
- Worker education and training requirements

Pesticides are exempt from WHMIS rules on labelling and MSDSs. These are covered under the *Pest Control Products Act*. Many pesticide manufacturers see the value of MSDSs and provide copies for pesticides they produce. Material safety data sheets for pesticides can be obtained from:

- Pesticide manufacturers or suppliers
- Canadian Centre for Occupational Health and Safety at 1-800-263-8466 or www.ccohs.ca
- North American Compendiums Ltd., P.O. Box 39, Hensall, Ontario N0M 1X0 (1-800-350-0627) or fax (519-263-2936)

- Agrichemical Warehouse Standards Association at www.awsacanada.com
- Croplife Canada at www.croplife.ca

Food and Drugs Act (FDA)

Canada's *Food and Drugs Act* (FDA) protects the health of consumers. The sale of food that contains harmful or poisonous substances is prohibited. If residues in food are involved, safety to consumers must be proven to Health Canada before a pesticide can be registered for use on a food crop under the PCP Act.

The maximum residue limit (MRL) is the maximum amount of pesticide residue that may be safely contained in food products. MRLs are established under the *Food and Drugs Act* for all food products.

Food with too much pesticide residue can be seized. Those responsible can be charged. The level of residue in grazing or feed crops for livestock is also governed. Exceeding MRLs can be prevented by reading and following:

- Pesticide label rates
- Days to harvest statements
- Number of applications allowed per crop/season
- Other guidelines on the secondary display panel **(See Chapter 3: Labelling)**

Migratory Birds Convention Act (MBCA)

The *Migratory Birds Convention Act* (MBCA) protects waterfowl and other migratory birds. Under these laws, it is an offence to release pesticides or harmful substances into waters or areas frequented by migratory birds. If migratory birds are harmed, an applicator may be prosecuted under federal law. If non-migratory birds are harmed, an applicator may be prosecuted under provincial law.

Fisheries Act (FA)

The *Fisheries Act* (FA) protects fish and fish habitat such as:

- Spawning grounds
- Nursery sites
- Rearing areas
- Food supplies
- Migration areas

The *Fisheries Act* strives to keep pesticides and other harmful substances from water inhabited by fish. This act considers a substance to be harmful unless it is exempted by law. Fisheries and Oceans Canada and Environment Canada jointly administer pollution prevention in the *Fisheries Act*.

When handling pesticides where there is a stream, pond, lake, etc., the *Fisheries Act* and its associated laws must be observed. Putting pesticides in fish-bearing waters either directly or indirectly may be a violation of the *Fisheries Ac*t.

Fertilizer Act (FA)

The *Fertilizer Act* (FA) is administered by Agriculture and Agri-Food Canada. It governs all fertilizers used in Canada, including those that contain pesticides. Before a fertilizer–pesticide mixture can be sold or used in Canada, it must be registered under the *Fertilizer Act*. This act governs import and sale of fertilizer and supplements by setting standards, and packaging and labeling requirements. Authority to inspect and sample products for legal compliance is also provided.

National Fire Code (NFC)

The National Fire Code of Canada (NFC) 1990 provides minimum fire safety requirements for buildings, structures, and areas. This applies to places where hazardous materials (e.g., pesticides) are used and stored. The NFC ensures a level of fire protection and prevention in the operation of buildings. Part V of the NFC notes that flammable, combustible, and other hazardous materials must be stored and handled in a way that does not present a risk of fire or explosion. A facility that stores flammable or combustible pesticides must meet provisions set by the NFC. The NFC classification system for hazardous materials is used to determine placards needed for

transport. The NFC requires fire safety plans for emergencies. This reduces the risk of fires, particularly for areas that may threaten the community.

National Building Code (NBC)

The National Building Code of Canada (NBC) provides minimum requirements for health, safety, and structure in new buildings that store hazardous materials (e.g., pesticides). The NBC should be checked before constructing or changing a pesticide storage facility.

In Review

Federal pesticide laws and codes govern all phases of pesticide use and handling.

The *Pest Control Products Act* deals with registration of pest control products (pesticides) and label information.

Other federal laws deal with other aspects of pesticide handling and use. Rules to ensure safety when working with pesticides are given by the *Canada Occupational Health and Safety Act*, WHMIS, and the *Transportation of Dangerous Goods Act*.

The *Food and Drugs Act* protects the consumer from excess pesticide residues in food.

The *Migratory Birds Convention Act* and *Fisheries Act* protect the environment.

Provincial Pesticide Legislation

Each Canadian province has laws that govern the transport, storage, sale, handling, mixing, application, and disposal of pesticides. Pesticide laws vary among provinces. These are more specific, but lend support to, the federal *Pest Control Products Act*.

Pesticide Training

All four Atlantic Provinces have adopted the *Basic Knowledge Requirements for Pesticide Education in Canada*. The National Task Force on Pesticide Education, Training, and Certification prepared this. This standard gives ten application categories:

- Aerial
- Agricultural
- Aquatic
- Forestry
- Fumigation
- Greenhouse
- Industrial vegetation
- Landscape
- Mosquito and biting flies
- Structural

There is a vendor category that provides information to those who sell pesticides. In the Atlantic Region, only approved persons may purchase or use Commercial or Restricted class pesticides. Applicators wishing to apply pesticides commercially in more than one province must contact provincial pesticide regulatory bodies for specific training or certification requirements.

Pesticide Legislation in the Atlantic Provinces

Provincial law governs many aspects of pesticide use. These include pesticide handling, transport, application, storage, and disposal. Applicators must be familiar with

provincial pesticide laws. This ensures safe handling of pesticides and legal compliance.

Provincial legislation is provided in Appendix B of this Manual.

Nova Scotia

In Nova Scotia, pesticides are governed under the *Environment Act* and the *Pesticide Regulations*. Copies of the Act and regulations can be obtained by calling 1-800-670-4357. The *Environment Act* can be downloaded at:

http://www.gov.ns.ca/legi/legc/statutes/environ1.htm .

Pesticide Regulations can be viewed at:

http://www.gov.ns.ca/just/regulations/regs/env6195.htm

Prince Edward Island

In Prince Edward Island, pesticides are governed under the *Pesticides Control Act* and Regulations. This Act is administered by the Department of Environment, Energy and Forestry. The *Pesticides Control Act* can be viewed at:

www.gov.pe.ca/go/peipesticidelegislation

New Brunswick

In New Brunswick, pesticides are governed under the *Pesticides Control Act*. The Department of the Environment and Local Government administers this. The Act and regulations can be obtained by calling the Pesticides Management Unit:

1-800-561-4036 or by e-mail at: pesticides@gnb.ca

Newfoundland and Labrador

In Newfoundland and Labrador, pesticides are governed under the *Environmental Protection Act* and *Pesticides Control Regulations*. This is administered by the Department of Environment and Conservation.

The Act can be viewed at http://www.gov.nl.ca/hoa/statutes/e14-2.htm
and the Regulations can be viewed at:

http://www.gov.nl.ca/hoa/regulations/rc030057.htm

The *Environmental Protection Act* and the *Pesticides Control Regulations* can also be obtained by contacting the Provincial Queen's Printer: (709) 729-3649 or by e-mail at: QueensPrinter@gov.nl.ca

Municipal Pesticide Legislation

Some municipalities have by-laws or building codes that can restrict the location, construction, or use of pesticide storage facilities. They can also restrict the use of pesticides. Applicators should check with municipal or county offices for specific details.

Summary

Pesticides are governed in Canada at federal and provincial levels. Provincial acts and laws are often more detailed and specific. Pesticide applicators must be familiar with all relevant legal requirements. This promotes safety and reduces risk to people and the environment. The main federal law is the *Pest Control Products Act*. The PCP Act deals with pesticide registration and labeling. The label provides the applicator with information on approved pesticide uses, rates, and handling requirements. Provincial laws govern all aspects of pesticide use within a province.

Municipal by-laws may further govern the sale, storage, or use of pest control products.

Self-test Questions

Answers are located in Appendix A of this manual.

1. What federal act provides the main regulation of pesticides in Canada?

   _____

2. List four classes of pesticides under the *Pest Control Products Act* and Regulations. Briefly define each.

   _____

   _____

   _____

   _____

3. Domestic class pesticides come in small containers. They are registered for field crop and barn pests only. **True or False**?

4. List two terms that are often used in place of the term 'Commercial' on the label of Commercial class pesticides.

   _____

5. What does the term 'MRL' stand for?

   _____

6. Provincial pesticide laws are often less specific than the federal *Pest Control Products Act*. **True or False**?

7. Only approved persons may use Commercial and Restricted class pesticide in the Atlantic Region. **True or False**?

8. The Workplace Hazardous Materials Information System (WHMIS) provides employers and employees with standards for training on safe use, storage, handling, and disposal of pesticides**. True or False**?

Chapter 3

LABELLING

Any pesticide sold and used in Canada must be registered by the Pest Management Regulatory Agency (PMRA). It must have an approved product label that contains key information on the pesticide. Information is based on PMRA approved studies carried out by the manufacturer. These studies involve human health, environmental concerns and effectiveness against specific pests.

The information on a pesticide label is very important. It helps applicators make sound decisions on pesticide storage, handling, application, and disposal. While each pesticide has its own label, the format of the label is standard. Those who buy and use pesticides must know how to interpret the label. Following label information protects the applicator, the public, and the environment. This also ensures the best level of pest control.

Material safety data sheets (MSDSs) are developed by product manufacturers. These are a major source of information on pesticides. MSDSs are **not** legal documents. The information on a MSDS is based on research data. This supports label information. MSDSs also have information to protect human health and the environment. MSDSs help applicators to make informed decisions on handling, applying, and storing pesticides.

Learning Objectives

Completing this chapter will help you to:

- **Use the information on pesticide product labels.**
- **Use the information on Material Safety Data Sheets (MSDSs).**

Pesticide Product Label

The pesticide label is a legal document. This is defined under the *Pest Control Products Act* (***See*** **Glossary of Terms**). It is illegal to use a pesticide in any way other than for the purpose and in the manner stated on the label. Label information serves as a legal guide for proper handling and use. Critical information is lost if a label is removed or damaged. A pesticide can only be sold legally with a label on the container that is in good condition. Ensure that the container has a valid Canadian label before buying or handling a pesticide. It should provide the *Pest Control Products Act* registration number. If the label is lost or cannot be read after purchase, ask for a replacement from the vendor. Attach the new label to the container. A pesticide cannot be identified without the label. The label ensures safe handling and proper application rates.

Do not buy or store a pesticide unless it has a proper label attached.

Manufacturers often provide more information than what is found on the label. They may print information on the wrapper, or stickers/tags attached to the container. This supports label information. It does not serve as a legal substitute for it.

Components of a Label

A pesticide label has two parts:

1. The front or principal display panel
2. The back or secondary display panel

Principal Display Panel

The principal display panel is the front of a pesticide product label. This panel contains information that allows an applicator to identify a pesticide in a number of ways. The principal display panel also warns of hazards and their nature. Applicators must understand the information on the principal display panel. This ensures that the right product is bought and handled safely. There are nine items on the principal display panel **(*See* Figure 3-1)**.

Figure: 3-1: Example of Principal Display Panel

List of Items on Principal Display Panel

1. **Trade name or product name**
2. **Class designation**
3. **Use or purpose**
4. **Registration number (P.C.P. Act number)**
5. **Guarantee statement**
6. **Directions to read the label**
7. **Precautionary shapes, symbols, and pictograms**
8. **Net contents**
9. **Name and address of the registrant**

1. Trade Name or Product Name

The trade or product name includes:

A. The **brand name** or **trade name** registered with the Pest Management Regulatory Agency. CONTROL-ALL is the registered trademark of the example pesticide.

B. The **formulation** of the pesticide (this is either printed in full or shown as an abbreviation). This pesticide is a liquid, an emulsifiable concentrate (EC).

C. A **description of use.** This pesticide is a herbicide used to control weeds.

2. Classification

This provides the pesticide classification, as assigned by the Pest Management Regulatory Agency and agreed to by the manufacturer. In Atlantic Canada, classification can determine how the pesticide is stored

and displayed for sale. It can also affect who may sell, buy, or apply the pesticide. There are four classifications (Domestic, Commercial, Restricted, Manufacturing).

Domestic Class

Domestic class pesticides are registered for home use. They are packaged in small containers for a single application or use season. Domestic class pesticides pose a low risk to users or the environment when label directions are followed. They can be safely handled with little personal protective equipment (PPE), and there is no need for special training.

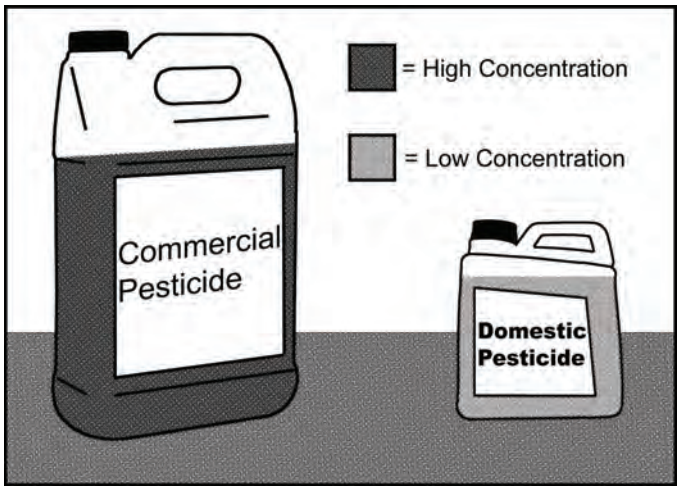


Figure 3-2: Pesticide concentration differs according to classification.

Commercial Class (Agricultural or Industrial)

Commercial class pesticides are designed for use in farming, forestry, industry, or other commercial uses. Active ingredients may be the same as those in Domestic class pesticides, but are more concentrated. Commercial class pesticides can pose a greater risk because of the greater concentration of the active ingredient or larger container size. Some products are classified as Commercial because they are too toxic, persistent, or hazardous for home use. Commercial class pesticide applicators in the Atlantic Region are required to demonstrate knowledge of:

- Safe handling
- Application

- Transport
- Storage procedures
- Proper use of personal protective equipment

The words "Agricultural" or "Industrial" on a pesticide label indicate a Commercial class pesticide.

Applicators should refer to provincial laws on license or certification requirements before buying or using Commercial class pesticides.

Restricted Class

Restricted class pesticides have more limits placed on them then Commercial class pesticides. Limitations appear on the label. These can be due to increased toxicity, method of use (e.g., aerial application), or because they pose a specific risk to the environment. Limitations may involve:

- Pesticide display
- Storage
- Distribution
- Application
- User qualifications

Applicators are advised to refer to provincial laws on license or certification requirements. These must be met before buying or using these pesticides.

Manufacturing Class

Manufacturing class pesticides are used in manufacturing, formulating, or repackaging. They are not designed for general use.

3. Use or Purpose

The use of a pesticide refers to the type of pest it is intended to control. This use (e.g., as an insecticide, a herbicide, or a fungicide) will always be clearly stated on the principal display panel of a pesticide label. For example, the sample label indicates that this pesticide is a herbicide.

4. Registration Number (P.C.P. Act Registration Number)

This number shows that the pesticide is registered by the Pest Management Regulatory Agency. It identifies the pesticide to the government and the manufacturer. The P.C.P. Act number must be shown on the principal display panel of every label. It can appear as REG. NO. 12345 P.C.P. ACT or Registration Number 12345 *Pest Control Products Act*. No two pesticides or pest control products are given the same number. This number can be used to find a pesticide's:

- Chemical nature
- Poisoning symptoms
- First aid treatment information
- Environmental toxicity

The registration number also gives emergency personnel quick access to information on how to deal with a poisoning.

- **Pesticide or pest control products for sale or use in Canada must have a P.C.P. Act Registration Number.**
- **The P.C.P. Act Registration Number is unique to a pesticide formulation. This can be used to get detailed information.**
- **Pesticide or pest control products registered in the United States have an E.P.A. (Environmental Protection Agency) number. These cannot be sold or used in Canada.**
- **It is illegal to sell or use pesticide or pest control products in Canada that are labeled only with an E.P.A. number.**

5. Guarantee

The guarantee gives the common name of the active ingredients and the concentration of each. **The active ingredient is the part of the pesticide that controls the pest.** The chemical name is sometimes used on the label in place of the common name. There can be more than one active ingredient in a pesticide. Each active ingredient will be listed on the label.

- Monolochlor is the common name of the active ingredient in the example label in **Figure 3-1**.
- The guarantee provides the concentration of active ingredient(s) that is contained in that particular pesticide.
- Concentration can be measured by the weight of active ingredient per unit volume.
- In the sample label, Control-All (**Figure 3-1),** we see that there are 500 grams of the active ingredient monolochlor, in every litre of Control-All.
- Biological pesticides show the active ingredient as ITU(International Toxic Units)/mg

6. Directions to "Read the Label"

"READ THE LABEL BEFORE USING**."**

The *Pest Control Products Act* requires that this warning appear on the principal display panel. The label contains key information on proper storage, handling, and use. An applicator must read the label to ensure that the correct pesticide is chosen.

7. Precautionary Shapes, Symbols, and Signal Words

Symbols (shapes and pictograms) and signal words indicate the type of hazard posed by a given pesticide. These are regulated under the *Pest Control Products Act* and must be included on the label.

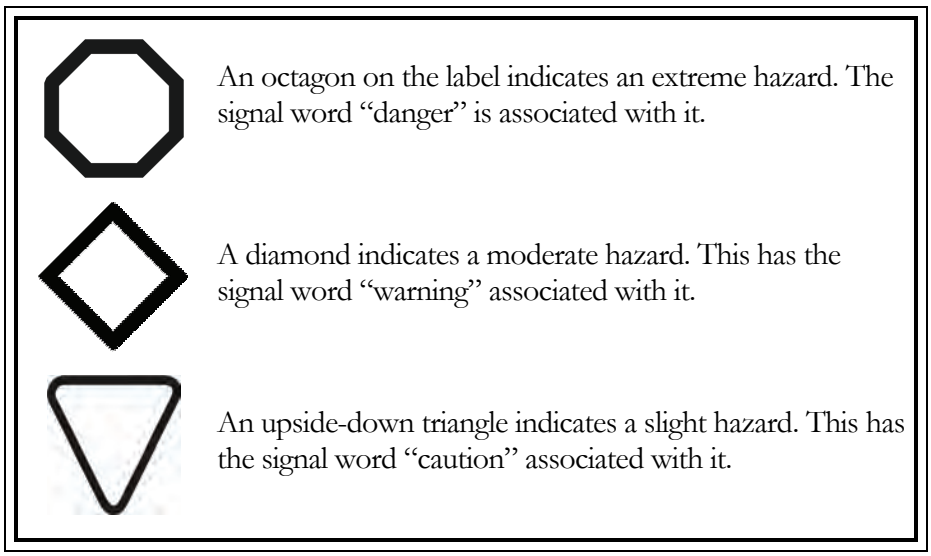


Figure 3-3: Precautionary Shapes

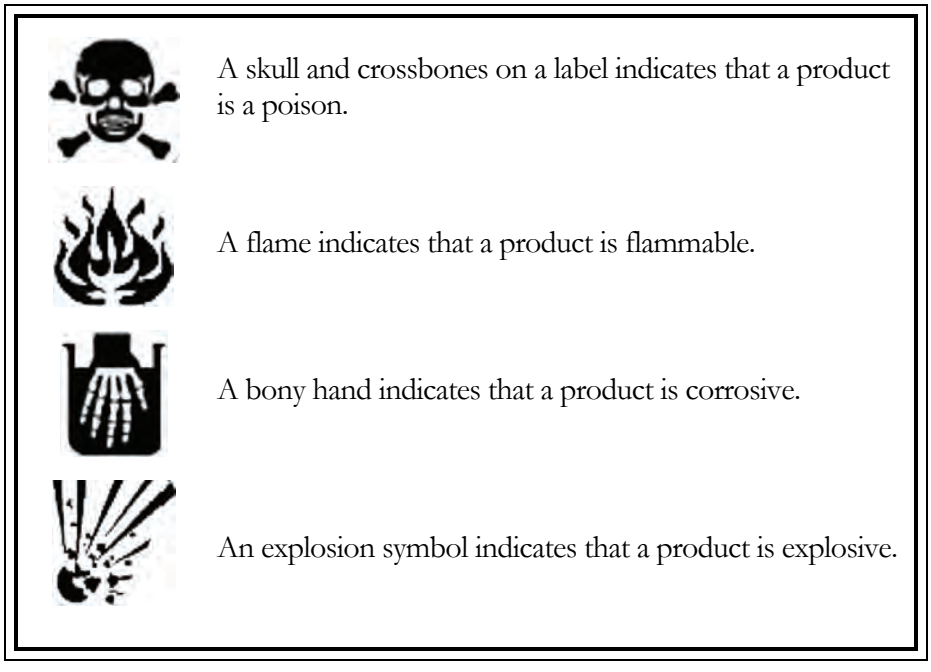


Figure 3-4: Precautionary Pictograms

Multiple Symbols

A pesticide can pose more than one type of hazard. All related precautionary symbols must appear on the label. **Only the warning signal word for the most dangerous hazard must appear**.

No Symbols or Signal Word

A pesticide label may not have a precautionary symbol and/or signal word, if the hazards of the pesticide are such that they are not required. However, precautions still need to be taken, and the applicator or handler should still proceed with care when using the pesticide.

8. Net Contents

The net contents indicate the amount, by weight or volume, of pesticide in a package. This is given in metric units (ml, L, g, kg, etc.). **Figure 3.1** shows that there are 10 L (10 litres) of formulated product in this container.

9. Name and Address

The name and address of the company or organization that registered the pesticide (registrant) must appear on the label. Company XYZ is the registrant in the example label provided in **Figure 3-1.**

In Review

The principal display panel gives important information on the pesticide or pest control product in the container. Each piece of information on the principal display panel is there for a reason. Applicators need to know how to read and use this information.

The label identifies the classification and use of a pesticide.

The name and address of the registrant is a contact for more information on the pesticide or pest control product.

The P.C.P. Act Registration Number on the principal display panel is unique to that product. This can be used to access information. For example, toxicological data can be accessed in case of a poisoning. Symbols and signal words indicate the general hazard.

Quiz # 3-1: Principal Display Panel

Answers are located in Appendix A of this manual.

This page contains a sample copy of a pesticide label, principal display panel. Use the information found on this label to answer the questions that follow.

Control Plus brand 70 WP Insecticide

Contains Triochemical

AGRICULTURAL

Guarantee: Triochemical……70.35% by weight

WARNING **POISON**

READ THE LABEL AND BOOKLET BEFORE USING

KEEP OUT OF REACH OF CHILDREN

REGISTRATION NO. 95,000
PEST CONTROL PRODUCTS ACT

The Pesticide Company
21 Nowhere St.
Somecity, Ont, X1X 1X1

IN CASE OF SPILLS, POISONING OR FIRE, TELEPHONE EMERGENCY RESPONSE NUMBER: 1-800- 111-1111

NET CONTENTS: 340 g

Figure 3-6: Sample Label

1. What is the trade or product name?

_____

2. What is this pesticide's P.C.P. Act Registration Number?

_____

3. What is the active ingredient in this pesticide?

_____

4. How much active ingredient is guaranteed in this pesticide?

_____

5. What type of formulation is this pesticide?

_____

6. Who is the manufacturer of this pesticide?

_____

7. What are the net contents of the product package?

_____

8. What is the classification of this pesticide?

_____

9. Does the precautionary symbol on this pesticide mean it is slightly poisonous, moderately poisonous, or very poisonous?

_____

Secondary Display Panel

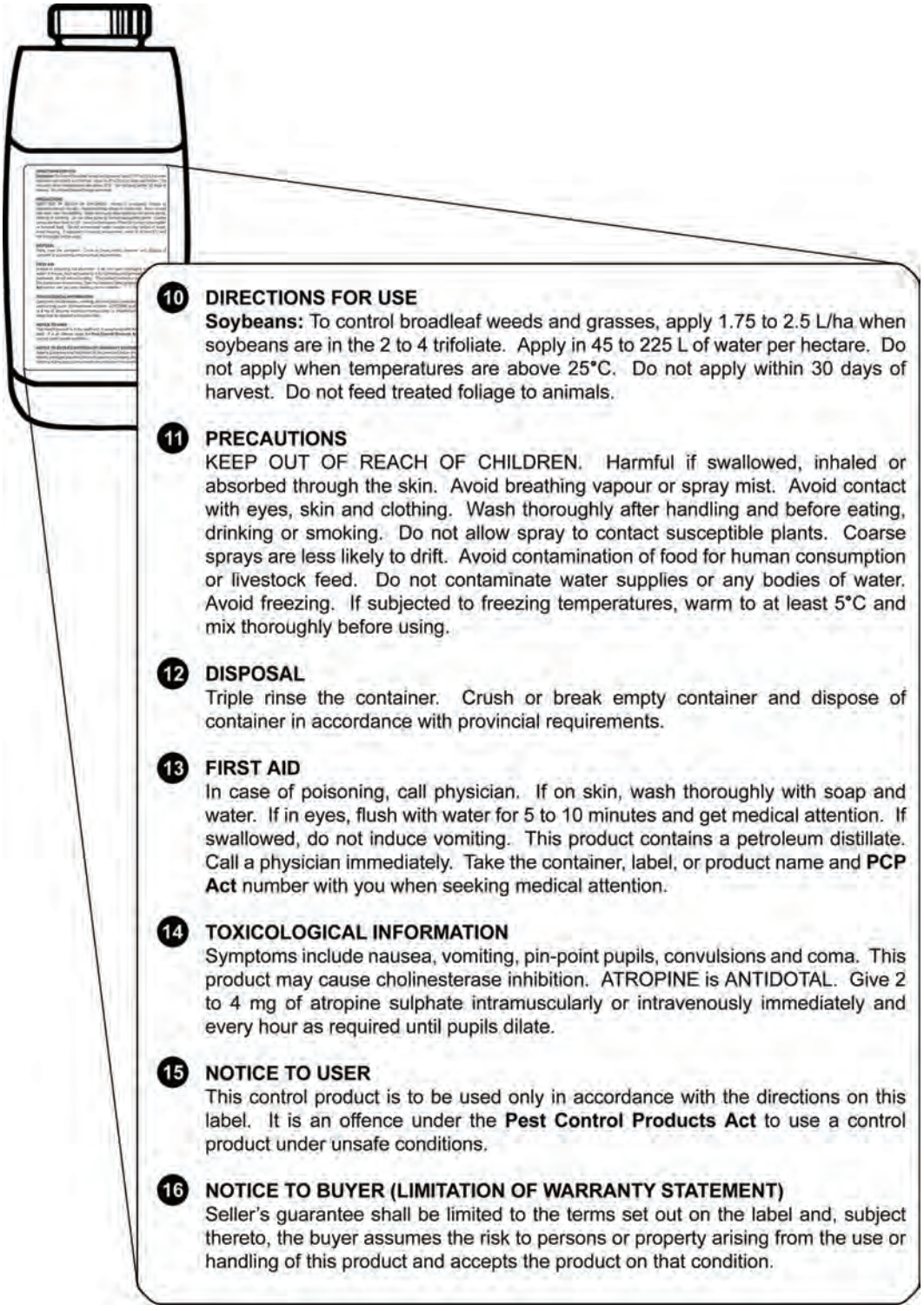
The back or side of a label is called the secondary display panel. For pesticides with a number of uses, the secondary display panel may be a small booklet attached to the label. This secondary panel gives instructions on how to use the pesticide and at what rate. This allows an applicator to match the pest control need to the pesticide. It can then be mixed at the right concentration and applied at the correct label rate. The secondary display panel identifies human or environmental hazards and gives first aid instructions.

List of Items on Secondary Display Panel

10. **Directions for use**
11. **Precaution statements**
12. **Disposal methods**
13. **First aid**
14. **Toxicological information**
15. **Notice to user**
16. **Notice to buyer**

When Domestic class pesticides are packaged in small containers, the lower half of the secondary display panel may show information usually found on the principal display panel, such as:

- The name and address of the registrant/agent
- Net contents
- P.C.P. Act Registration Number
- The guarantee



10 DIRECTIONS FOR USE

Soybeans: To control broadleaf weeds and grasses, apply 1.75 to 2.5 L/ha when soybeans are in the 2 to 4 trifoliate. Apply in 45 to 225 L of water per hectare. Do not apply when temperatures are above 25°C. Do not apply within 30 days of harvest. Do not feed treated foliage to animals.

11 PRECAUTIONS

KEEP OUT OF REACH OF CHILDREN. Harmful if swallowed, inhaled or absorbed through the skin. Avoid breathing vapour or spray mist. Avoid contact with eyes, skin and clothing. Wash thoroughly after handling and before eating, drinking or smoking. Do not allow spray to contact susceptible plants. Coarse sprays are less likely to drift. Avoid contamination of food for human consumption or livestock feed. Do not contaminate water supplies or any bodies of water. Avoid freezing. If subjected to freezing temperatures, warm to at least 5°C and mix thoroughly before using.

12 DISPOSAL

Triple rinse the container. Crush or break empty container and dispose of container in accordance with provincial requirements.

13 FIRST AID

In case of poisoning, call physician. If on skin, wash thoroughly with soap and water. If in eyes, flush with water for 5 to 10 minutes and get medical attention. If swallowed, do not induce vomiting. This product contains a petroleum distillate. Call a physician immediately. Take the container, label, or product name and **PCP Act** number with you when seeking medical attention.

14 TOXICOLOGICAL INFORMATION

Symptoms include nausea, vomiting, pin-point pupils, convulsions and coma. This product may cause cholinesterase inhibition. ATROPINE is ANTIDOTAL. Give 2 to 4 mg of atropine sulphate intramuscularly or intravenously immediately and every hour as required until pupils dilate.

15 NOTICE TO USER

This control product is to be used only in accordance with the directions on this label. It is an offence under the **Pest Control Products Act** to use a control product under unsafe conditions.

16 NOTICE TO BUYER (LIMITATION OF WARRANTY STATEMENT)

Seller's guarantee shall be limited to the terms set out on the label and, subject thereto, the buyer assumes the risk to persons or property arising from the use or handling of this product and accepts the product on that condition.

Figure 3-7: Example of Secondary Display Panel

10. Directions for Use, Use Area, and Limitations

All registered pesticide uses must be stated on the label. If a use is not listed, it is considered illegal. Sometimes, a new registered use may not yet appear on the label. When in doubt, contact the Pest Management Regulatory Agency or provincial pesticide regulatory agency.

The directions for use include:

- Pests that the pesticide will control (weeds, insects, diseases, etc.)
- Crops or animals on which it can be used
- Amount of pesticide to use and how to mix it
- Application methods
- Approved rates of application
- Recommended application equipment
- What to avoid when using the pesticide
- Harvest instructions (pre-harvest interval, days-to-harvest, pre-slaughter interval)
- Re-entry times (the length of time to stay out of the treated area)
- Other restrictions
- Special application statement

Label statements vary with each pesticide. It is important to read and understand all label information before using a pesticide.

SPECIAL APPLICATION STATEMENT

Pesticide labels often have a number of special application statements. These include the following:

- Aerial Application Statement
- Crop Rotation Statement
- Number of Applications Statement
- Buffer Zone Statement
- Forest and Woodlands Management Statements

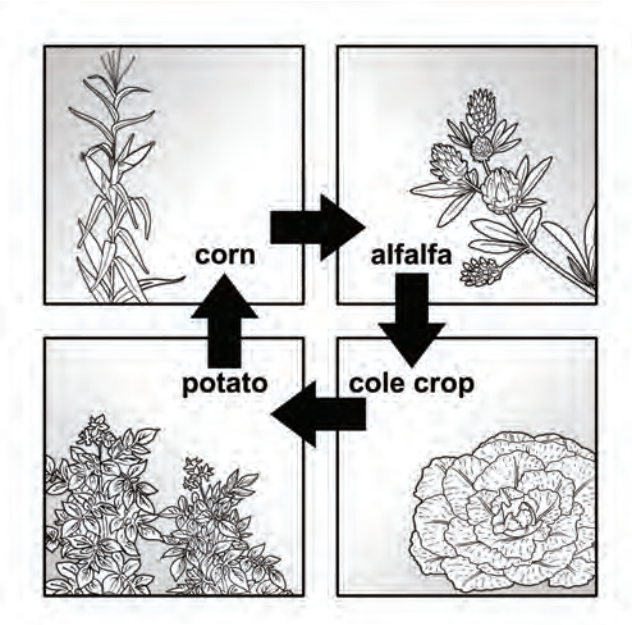
AERIAL APPLICATION STATEMENT

The policy on aerial application of pesticide products was clarified on January 1, 2000. Pesticides cannot be applied by air unless the label gives

specific instructions to do so. Aerial applicators must follow all use instructions for mixing and use (buffers, rates, crop, etc.). Pesticides not registered for aerial application should bear the label statement "Do not apply by air". Some pesticide labels may not reflect this policy change. Applicators are advised to contact the PMRA, or provincial regulatory authority if they are uncertain whether a pesticide is approved for aerial application.

Aircraft may only be used to apply pesticides that are approved for aerial application.

CROP ROTATION STATEMENT



Crop rotation statements give the type of crop that can be safely planted the next year. An active ingredient can sometimes be carried over in the soil to the next use season. The label may state that only those crops named on the label may be planted.

Figure 3-8: Crop Rotation

NUMBER OF APPLICATIONS STATEMENT

Some pesticide labels state the total number of applications for a use season. This protects the applicator from:

- Excess pesticide residues in soil or food/feed crops
- Crop damage
- Pest resistance

BUFFER ZONE STATEMENT

Buffer zones are areas left untreated to protect a nearby area. The need for a buffer zone during application is reviewed by the PMRA on a case-by-case basis. Decisions are based on:

- The organism that needs to be protected
- Environmental concentration of the pesticide being used that affects the organism
- Methods of application

Buffer zone statements vary with each pesticide and may not appear on all labels. These statements can give a setback distance (e.g., 10 metres). They can also be more general (e.g., avoid overspray or drift on wildlife habitats like shelterbelts, wetlands, woodlots, vegetated ditches, ponds, or lake banks.

Figure 3-9: Buffer Zone

You may be given provincial regulatory requirements and a label buffer zone statement. The stricter of the two must be followed when applying pesticides:

- To an area adjacent to aquatic habitats, such as streams, ponds, rivers, and lakes
- To areas that drain into these habitats
- To any other sensitive area identified

FOREST AND WOODLANDS MANAGEMENT STATEMENTS

Aerial applications to forests, bodies of water, or residential areas are restricted uses. Forest and woodlands management areas are grouped as:

- Forest or forest management – Restricted (These include wooded areas or sites to be planted to forest of more than 500 hectares.)

- Woodlands management – Restricted (These include 500 hectares or less of wooded areas or sites to be planted to forest.)

- Woodlands management – Commercial (These include 500 hectares or less of a wooded area [e.g., tree nurseries, right-of-ways, and seed orchards).

11. Precautionary Statements

Precautionary statements provide hazards to avoid when using or handling a pesticide. They explain how to use the pesticide safely. Steps are given to protect the applicator and others when mixing, applying, storing, and disposing of the pesticide. Precautionary statements can relate to human health or environmental concerns. You will find the child hazard warning "KEEP OUT OF REACH OF CHILDREN" here for Restrictive and Commercial class products. This warning must be on the principal display panel of Domestic class pesticides.

12. Disposal

This section gives information on safe disposal of empty containers. See **Chapter 2: Regulations** for details on provincially approved methods of container disposal.

13. First Aid Instructions

First aid instructions provide actions that should be taken if someone is poisoned or injured by a pesticide. Applicators should read this section with care before using any pesticide.

14. Toxicological Information

Toxicological information describes signs and symptoms of pesticide poisoning. This information can tell medical authorities what antidote to use. It is important to give this information to medical personnel if there is an accident.

Medical personnel can obtain additional information on a pesticide by referencing the P.C.P. Act Registration Number.

15. Notice to User

The Notice to User tells the applicator to follow directions on the label. It is against the law to use a pesticide in a manner not approved on the product label.

16. Notice to Buyer

The Notice to Buyer can also appear as a Seller's Guarantee. It states that the guarantee is limited to the label instructions. The buyer accepts all risks associated with the pesticide.

In Review

The secondary display panel tells the applicator:

- **Where the pesticide may be used**
- **Which pests it will control**
- **Specific application rates**

The secondary display panel allows an applicator to make an informed decision on choosing the best pesticide to control a pest. Correct mixing rates are given to ensure that pesticides are applied at a proper rate. Precautionary or special application statements are found on the secondary display panel. These warn the applicator of possible human or environmental hazards. Statements on the need for crop rotation can address:

- **Carry-over of active ingredient to the next growing season**
- **Concerns of residues in crops**

Pesticides toxic to aquatic life may have special statements calling for a buffer from water.

The secondary display panel gives the symptoms of poisoning and first aid instructions for that pesticide. This allows quick action in the case of a poisoning or exposure.

Quiz # 3-2: Secondary Display Panel

The next few pages contain a sample copy of a pesticide label. Use the information found on this label to answer the questions that follow. This is not a complete label! As with all pesticides or pest control products, read the entire label before using.

Sample Label

Control Plus brand 70 WP Insecticide

Contains Triochemical

AGRICULTURAL

Guarantee: Triochemical……70.35% by weight

WARNING POISON

READ THE LABEL AND BOOKLET BEFORE USING

KEEP OUT OF REACH OF CHILDREN

REGISTRATION NO. 95,000
PEST CONTROL PRODUCTS ACT

The Pesticide Company
21 Nowhere St.
Somecity, Ont, X1X 1X1

IN CASE OF SPILLS, POISONING OR FIRE, TELEPHONE EMERGENCY RESPONSE NUMBER: 1-800- 111-1111

NET CONTENTS: 340 g

Figure 3-10: Sample Label

PRECAUTIONS:
KEEP OUT OF REACH OF CHILDREN. Harmful if inhaled or absorbed through the skin. Avoid breathing vapors or spray mist. Avoid contact with eyes, skin or clothing. Keep away from of domestic animals. Wear long sleeved shirt, long pants and chemical resistant gloves during mixing, loading, applying, and clean-up and repair activities. Workers should not enter treated areas for 12 hours following application. Discard clothing that has been drenched or heavily contaminated with this product's concentrate. Do not reuse them. Follow manufacturer's instructions for cleaning/maintaining personal protective equipment. Keep and clean personal protective equipment separate from other laundry and household items. Users should wash their hands before eating, drinking, chewing gum, using tobacco or using the toilet. Remove clothing immediately if clothing becomes contaminated by pesticide. Then wash thoroughly and put on clean clothing. Remove personal protective equipment immediately after handling this product. Wash the outside of gloves before removing them. As soon as possible, wash thoroughly and change into clean clothing. Do not apply Control Plus brand 70 WP Insecticide directly to water, or to areas where surface water is present. Do not contaminate water when disposing of equipment wash water or rinsate. Do not contaminate water used for irrigation or domestic purposes.

ENVIRONMENTAL PRECAUTIONS:
A buffer zone of 20 meters for application by ground boom sprayer, should be established between the last spray swath and the edge of aquatic systems such as rivers, lakes, ponds, streams and other bodies of water. A buffer zone of 2 meters for application by ground boom sprayer should be established between the last spray swath and the edge of terrestrial habitats such as hedgerows, windbreaks, woodlots, vegetative strips and other vegetation. Triochemical is toxic to honey bees exposed to direct treatment. Do not apply when bees are present in the area to be treated.

FIRST AID:
Contact a physician IMMEDIATELY in all cases of suspected poisoning. Transport patient to a physician or hospital IMMEDIATELY taking container, label or product name and Pest Control Products Act Registration Number with you when seeking medical attention.

IF SWALLOWED: Call a physician or Poison Control Center. Drink one or two glasses of water and induce vomiting by touching back of throat with finger, or if available, by administering syrup of ipecac. **This should only be given upon the instruction of a Poison Control Centre or doctor, and if the patient is alert!** If syrup of ipecac is available, administer 1 tablespoonful (15 mL) of syrup of ipecac followed by 1 to 2 glasses of water. If vomiting does not occur within 20 minutes, repeat the dose once. Do not induce vomiting or give anything by mouth to an unconscious person.

Figure 3-10: Sample Label, cont'd.

If in Eyes: IMMEDIATELY flush eyes with plenty of water.
If on Skin: Wash thoroughly with soap and water.
If Inhaled: Move from contaminated area and call a physician.

TOXICOLOGICAL INFORMATION:
There is no specific antidote. All treatment should be based on observed signs and symptoms of distress in the patient.

STORAGE CONDITIONS:
Do not store in or around the home. Store unused product in a cool, ventilated, dry, locked area. Do not allow prolonged storage in areas where temperatures frequently exceed 46°C (115°F). Never transfer this product to another container for storage.

DISPOSAL:
1. Triple- or pressure-rinse the empty container. Add the rinsings to the spray mixture in the tank.
2. Make the empty rinsed container unsuitable for further use.
3. Dispose of the container in accordance with provincial requirements.
4. For information on disposal of unused, unwanted product, contact the manufacturer or the provincial regulatory agency. Contact the manufacturer and the provincial regulatory agency in the event of a spill and for clean up of spills.

NOTICE TO USER: This control product is to be used only in accordance with the directions on this label. It is an offense under the Pest Control Products Act to use a control product under unsafe conditions

NOTICE TO BUYER: Seller's guarantee shall be limited to the terms set out on the label and, subject thereto, the buyer assumes the risk to persons or property arising from the use or handling of this product and accepts the product on that condition.

DIRECTIONS FOR USE:
METHOD OF APPLICATION: Apply by ground only. Do NOT apply by air.

APPLICATION TIMING:
Begin application when insect populations reach recognized economic threshold levels. Consult the provincial extension service, or professional consultants or other qualified authorities to determine appropriate threshold levels for treatment in your area.

MIXING INSTRUCTIONS
1. Fill tank ¼ full with the required amount of total spray volume of water.
2. Add Control Plus brand 70 WP Insecticide at recommended rates for the pest and crop type and begin agitation.
3. Allow to mix in tank for 2 minutes or until thoroughly mixed before applying.

Figure 3-10: Sample Label, cont'd.

ROW CROPS
Apply a minimum spray volume of 200 L/ha by ground unless otherwise directed under specific crop directions. For best results, it is important to obtain thorough and uniform spray coverage of the plant. Use higher dosage rates for heavy infestations or dense foliage. The specific length of residual control depends on environmental factors, plant growth, dosage rate, and degree of insect infestation.

To clean the sprayer after use, drain and flush with water. Use rinsings on crop according to label instructions or dispose of in an approved manner (See Storage and Disposal).

FIELD CROPS
To achieve optimum pest control, it is important to obtain thorough and uniform spray coverage of the plant. Choose a spray volume appropriate for the stage of growth or height of crop and amount of foliage that will provide thorough coverage throughout the canopy. Use higher dosage rates for heavy infestations or dense foliage. The specific length of residual control depends on environmental factors, plant growth, degree of insect infestation and dosage rate.

To clean the sprayer after use, drain and flush with water. Use rinsings on crop according to label instructions or dispose of in an approved manner (See Storage and Disposal).

INTEGRATED PEST MANAGEMENT (IPM) USE OF THIS PRODUCT
Control Plus brand 70 WP Insecticide can be effectively utilized in IPM programs. Control Plus brand 70 WP has been shown to leave substantial populations of many beneficial insects and spiders after use. The lower rates allow for maximum beneficial survival and faster rebound of beneficial populations.

RESISTANCE MANAGEMENT
Appropriate resistance management strategies should be followed. To delay insecticide resistance:
• Where possible, rotate the use of this pesticide with pesticides from different groups that are registered to control the same pests.
• Insecticide use should be based on an integrated pest management (IPM) program that includes crop scouting and record keeping and considers cultural, biological, and other pest control practices.
• Monitor treated pest populations for resistance development.
• Contact the local extension specialist or certified crop advisor for any additional pesticide resistance-management and IPM recommendations for the specific site and pest problems in the area.
• For further information or to report suspected resistance, contact The Pesticide Company at 1-800-111-1111.

Figure 3-10: Sample Label, cont'd.

COLE CROPS

Spray Volume for Cole Crops: Apply in a minimum spray volume of 200 L/ha by ground application.

SITE	PEST	RATE: GRAMS Control Plus /HA	SPECIFIC DIRECTIONS	RESTRICTIONS AND PRECAUTIONS: Cole Crops
COLE CROPS Broccoli, Brussels Sprouts, Cabbage, Cauliflower, Collards, Kale, Kohlrabi, Mustard Greens, Mustard, Spinach, Rape Greens	Aphids	56-86	Begin applications when economic threshold levels have been reached. Thorough coverage is important to obtain optimum control.	• For any of the pests listed, use the highest rate under heavy pest pressure. • Do not make more than 5 applications per season. • Do not apply more than once every 7 days. • Do not apply less than 7 days before harvest. • There are no rotational crop plant back restrictions for this product.

FIELD CROPS

Spray Volume for Field Crops: Apply in a minimum spray volume of 500 L/ha by ground application.

SITE	PEST	RATE: GRAMS Control Plus/HA	SPECIFIC DIRECTIONS	RESTRICTIONS AND PRECAUTIONS: Field Crops
FIELD CROPS Wheat, Barley	Aphids Leafhoppers	80-120	Begin applications when economic thresholds levels have been reached. Adequate coverage is essential for optimum control. Consult your local extension service for recommendations.	• For any of the pests listed above, use the high rate under heavy pest pressure. • Do not make more than 4 applications per season. • Do not apply more than once every 12 days. • Do not apply less than 7 days on barley before harvest. • Do not apply less than 15 days on wheat before harvest.
	Wheat moth Grasshoppers	120-240 67-240		

Control Plus is a trademark of The Pesticide Company

Figure 3-10: Sample Label, cont'd.

Questions

Answers are located in Appendix A of this manual.

1. Is this product approved for use in fixed wing aircraft?

   _____

2. For field crops in general, how much water should be used with the rates given on the label?

   _____

3. How long should you wait before making a second application of this product in field crops? _____

4. Place a checkmark beside each of the following crop/pest combinations on which you can use this product.

   _____ Wheat/Wheat moth
   _____ Cranberries/Cranberry girdler
   _____ Rutabagas/Aphids
   _____ Broccoli/Cabbage looper
   _____ Broccoli/Aphids
   _____ Rape Greens/Diamondback moths
   _____ Wheat/Grasshopper

5. How many days must you wait after application before you can harvest the following crops (pre-harvest interval)?

   _____ Broccoli
   _____ Wheat
   _____ Barley

6. What is the correct rate of application for the following crop/pest combinations?
   _____ Cabbage/Aphids
   _____ Barley/Leafhoppers
   _____ Wheat/Wheat moth
   _____ Barley/Grasshopper

7. What is the antidote for triochemical? _____

_____

8. What protective clothing and equipment should be worn when handling this product?

_____

_____

9. How long must you wait before entering a treated area without protective clothing (re-entry time)?

_____

10. Can you use this product on food crops grown in a greenhouse?

_____

11. What should you do if the product has been swallowed?

_____

_____

12. Should you reuse empty containers from this product? _____

Material Safety Data Sheets (MSDSs)

A Material Safety Data Sheet (MSDS) provides information on health hazards, personal safety, and environmental protection for hazardous products. They are divided into nine sections. The order of these sections varies among manufacturers. Information includes the following:

1. Product Information

Product information gives the trade name, chemical name, and primary use of the product. It also includes the name, address, and emergency telephone numbers of the manufacturer and supplier.

2. Hazardous Ingredients

The active ingredient is listed in this section. Other ingredients may be listed if included in the pesticide formulation. Chemical registration numbers and transportation classification are given.

3. Physical Data

Physical data includes information on a product's appearance, odour, specific gravity, pH, boiling point, etc.

4. Occupational Procedures and Prevention Measures

Occupational procedures and prevention measures provide information on safe handling and storage. This section identifies personal protective equipment needed when handling or applying the product (e.g., eye, skin, and respiratory protection).

5. First Aid and Emergency Procedures

First aid and emergency procedures explain what to do if someone is exposed to the product.

6. Fire and Explosion Hazard

The fire and explosion hazard section gives the temperature of the flash point and the fire point for the pesticide. Guidelines are provided for fighting a fire that involves a given product.

7. Toxicity and Health Effects

The toxicity and health effects section presents manufacturer research on human health effects of product exposure. This data can help medical personnel during an emergency.

8. Reactivity Data

Special chemical properties of the product are given in this section. Acceptable storage temperatures are listed for the product.

9. Preparation Date and Group

This section tells who prepared the MSDS and when it was done. MSDSs must be updated at least every three years, or within 3 months if a pesticide is changed.

MATERIAL SAFETY DATA SHEET	THE PESTICIDE COMPANY Nowhere St. Some City, Ont X1X 1X1 Emergency Number - 24 hours: 519-000-0000
Chemical Product and Company Identification	
1 **Product Identifier:**	CONTROL-ALL 500 EC
Registration Number:	54321
Chemical Class:	aromatic hydrocarbon solvent 40%
Product Use:	herbicide to control broadleaf weeds and grasses
9 **Preparation Date:**	05/21/04
Supercedes:	08/11/02
Manufacturer/Distributor:	see above
Composition/Information on Ingredients	
2 **Active Ingredient:**	monolochlor, 500 g/L emulsifiable concentrate
CAS No:	10101-22-3
Chemical Identity:	3-(1-methylethyl)-2H-2,1-monolochlor
Hazards Identification	
Warning Statements:	
7 PRECAUTION! Keep out of reach of children. MAY CAUSE EYE AND SKIN IRRITATION. HARMFUL IF SWALLOWED. This product is slightly toxic to fish and aquatic invertebrates.	
Potential Health Effects:	
Likely routes of exposure: eyes, skin, lungs, mouth. Eye contact: may cause eye irritation. Skin contact: may cause skin irritation. Prolonged contact may cause increased skin irritation. Inhalation: may cause irritation to the nose, throat and lungs. Ingestion: ingestion may produce irritation of the mouth, nausea, vomiting and diarrhea.	
5 **First Aid Measures**	
Skin Contact:	Immediately remove contaminated clothing and wash affected skin with soap and water.
Eye Contact:	Flush eyes with plenty of water for 15 minutes and seek medical advice immediately.
Inhalation	Remove victim to fresh air and if breathing has stopped, give artificial respiration. Seek medical attention. If swallowed, do not induce vomiting but rush victim to nearest hospital taking the container or this sheet with you.
Ingestion:	Use gastric lavages and saline cathartics.
Storage Precautions:	Do not handle or store near flame, heat or strong oxidants. Do not store near food or animal feed. Avoid freezing temperatures.

Figure: 3-11: Sample Material Safety Data Sheet (MSDS)

MATERIAL SAFETY DATA SHEET	THE PESTICIDE COMPANY Nowhere St. Some City, Ont X1X 1X1 Emergency Number - 24 hours: 519-000-0000
6 Fire Fighting Measures	
Flash Point and Method:	70°C Setaflash closed cup
Ignition Point:	N/D
Extinguishing Media:	Dry chemical, foam or carbon dioxide. Water or foam may cause frothing when applied to flammable liquids with flash points above 100°C. Fire-fighters should wear full protective clothing and self-contained breathing apparatus.
Accidental Release Measures	
Procedures for dealing with release or spills: Before handling any spills, wear protective equipment. For small spills, absorb with sand or other non-combustible material like clay or kitty litter. For large spills, dike up and contain the spill. Collect into a suitable container. Absorb the rest with sand, earth or clay. Decontaminate the area and equipment with laundry bleach or hydrated lime.	
Handling and Storage	
Handling Practices: Keep Out of Reach of Children. Avoid contact with eyes, skin or clothing, and wash immediately after exposure. Avoid contact with eyes, skin or clthing, and wash immediately after exposure. Avoid inhalation of spray. Always wash thoroughly after handling. Remove contaminated clothing promptly, and wash it before wearing again. **Appropriate storage practices:** Store in a well-ventilated, secure area set aside for pesticides. Do not store food, beverages, or tobacco in the same area. Protect from heat.	
4 Exposure Control/Personal Protection	
Personal Protective Measures:	Wear respirator, neoprene gloves, goggles or face shield
Preventative Measures:	Do not smoke, eat or drink while working with this product and wash thoroughly before doing so.
Technical Protective Measures:	Avoid breathing vapours, ventilate enclosed spaces and wear cartridge type respirator.
3 Physical and Chemical Properties	
Appearance:	clear, viscous, yellow
pH:	8 -8.5
Odour:	aromatic odour
Form:	liquid
Water Solubility:	miscible EC formulation
Boiling Point:	86°C
Specific Gravity:	1.002

Figure: 3-11: Sample MSDS, cont'd.

MATERIAL SAFETY DATA SHEET	THE PESTICIDE COMPANY Nowhere St. Some City, Ont X1X 1X1 Emergency Number – 24 hours: 519-000-0000
8 Stability and Reactivity	
Chemical Stability:	Stable
Hazardous Polymerization:	Will not occur
Incompatibility:	Avoid contact with strong acids, alkalis, and strong oxidants, nitric acid, acetaldehyde, hydrogen peroxide, chlorinated compounds.
Hazardous Decomposition Products:	Thermal decomposition may produce toxic smoke, CO and CO_2.
7 Toxicological Information	
Acute Oral LD_{50}:	756 mg formulated product/kg body weight (rats)
Acute Dermal LD_{50}:	1480 mg formulated product/kg body weight (rats)
Inhalation LC_{50}:	>3.63 mg/L air (4 hour) (rats)
Dermal Irritation:	mild irritant (rabbits)
Dermal Sensitization:	Dermal sensitization, Guinea pig -not a sensitizer
Carcinogenicity:	Monolochlor was found not to be carcinogenic in studies with rats and mice.
Reproductive toxicity:	Monolochlor is not developmentally toxic, and does not affect reproductive performance.
Teratogenicity:	Monolochlor was not teratogenic in a study with rats.
Ecological Information	
Aquatic Invertebrates:	48-hr EC_{50} Daphnia magma: 24-37 mg/L; slightly toxic
Warmwater Fish:	96-hr LC_{50} Bluegill sunfish: 5.8-14 mg/L; slightly to moderately toxic
Terrestrial Invertebrates:	48-hr LD_{50} Honeybee: >0.1 mg/bee; practically nontoxic
The results of degradation and bioconcentration studies with this material indicate that the active ingredient is rapidly adsorbed to soil, readily biodegrades in soil and water, and does not bioaccumulate.	
Disposal Considerations	
Waste Disposal: Treatment, storage, transportation, and disposal must be in accordance with applicable federal, provincial, and local regulations. Do not flush to surface water or sanitary sewer system. Triple rinse the container. Offer for recycling or reconditioning or puncture and dispose of in a sanitary landfill in accordance with rovincial and local regulations. Do not re-use empty containers.	
Transport Information	
TDG Classification -Road/Rail: not regulated	

Figure: 3-11: Sample MSDS, cont'd.

MATERIAL SAFETY DATA SHEET	THE PESTICIDE COMPANY Nowhere St. Some City, Ont X1X 1X1 Emergency Number – 24 hours: 519-000-0000
Regulatory Information	
	Regulated under the **Pest Control Products** Act. WHMIS classification: Exempt This MSDS has been prepared in accordance with WHMIS requirements.
Other Information	
	The above information is intended to describe our product in respect to safety and handling requirements only. We have attempted to be complete and correct; however, liability for any damage or injury is hereby declined since conditions of use and utilization of the product are beyond our control. Observance of all legal requirements is the responsibility of the user.

Figure: 3-11: Sample MSDS, cont'd.

Material Safety Data Sheets can be obtained from:

- **Pesticide manufacturers or suppliers**
- **Canadian Centre for Occupational Health and Safety at 1-800-263-8466 or www.ccohs.ca**
- **North American Compendiums Ltd., P.O. Box 39, Hensall, Ontario N0M 1X0 1-800-350-0627 or fax (519) 263-2936)**
- **Agrichemical Warehousing Standards Association (AWSA) at www.awsacanada.com**
- **CropLife Canada at www.croplife.ca**

In Review

Material Safety Data Sheets (MSDSs) are an additional source of information on a pesticide. MSDS information can help pesticide handlers make environmentally sound decisions on emergency response and safe handling practices. MSDSs detail hazards, precautions, and emergency response information. Information is based on the WHMIS concept that individuals have the right to know the hazards of products they are handling.

Copies of the MSDS for most Commercial and Restrictive class pesticides can be obtained from licensed/certified vendors. Pesticide applicators should be familiar with the MSDS for each product they are using or storing. This ensures that they are handling them in as safe a manner as possible.

Summary

It is important for applicators to have the information needed to make informed decisions on pesticide purchase, storage, handling, application, and disposal. This ensures health and environmental safety. The label on a pesticide container is a legal document and is the most important source of this information. Labels must be legible and present on each container when a pesticide is offered for sale. All legal product uses are stated on the label. If an application is made for a use not listed on the label, then it is an illegal use of the pesticide. Sometimes a new use will be registered, but will not appear on old labels. When in doubt, or for the most current label, contact Pest Management Information Services (1-800-267-6315) or your provincial pesticide regulatory agency.

The label is divided into a principal display panel and a secondary display panel. The principal display panel gives information on:

- **The pesticide product name**
- **Name(s) and amount(s)of active ingredient(s)**
- **The *Pest Control Products Act* registration number**
- **Hazards to humans, indicated by using precautionary shapes, symbols and words**

The secondary display panel has information that allows the applicator to mix and apply the pesticide for the best control of target pests. It identifies special precautions for safe application. The secondary display panel is the best source of information on symptoms of poisoning and first aid guidelines. Applicators need to understand this information to safely and effectively apply pesticides.

The label should be read <u>before</u> buying a pesticide. This ensures that the right pesticide is being chosen. The label should also be read again <u>before</u> mixing and applying in order to find:

- **Mixing rates**
- **Guidelines on personal protective equipment**
- **First aid directions**

The label should also be read <u>before</u> storing, transporting or disposing of unused pesticide.

Material Safety Data Sheets (MSDSs) provide additional product information.

Self-test Questions

Quiz # 3-3: Principal Display Panel

Answers are located in Appendix A of this manual.

1. Match the pictogram symbol to the precaution.

1)		A) The product is corrosive
2)		B) The product is explosive
3)		C) The product is a poison
4)		D) The product is flammable

2. Describe the warning shape or symbol for an **extreme hazard.**

_____

_____

3. The pesticide label is a legal document. **True or False?**

4. It is a violation under the *Pest Control Products Act* to use a pesticide in any other way than that stated on the label. **True or False?**

5. List four (4) classes under which a pesticide can be registered.

   _____

   _____

   _____

   _____

6. Pesticides that display the term "Agricultural" on their principal display panel are classed as Restricted Class pesticides. **True or False?**

7. The active ingredient is the part of the pesticide that controls the pest. **True or False?**

8. List two (3) ways in which concentration of a pesticide's active ingredient may be stated on the product label.

   _____

   _____

   _____

9. The P.C.P. Act Registration Number shows that the product is registered by Health Canada for sale and use in Canada. **True or False?**

10. It is legal to sell and use a pesticide in Canada if it is labeled with a U.S. Environmental Protection Agency (E.P.A.) number. **True or False?**

Quiz # 3-4: Secondary Display Panel

Answers are located in Appendix A of this manual.

1. The maximum number of applications given in the Number of Applications Statement on a pesticide product's secondary display panel may be exceeded. **True or False?**

2. A buffer zone can be given on a pesticide label or stated in provincial laws. The least strict of these must be followed. **True or False?**

3. What is the most important product information that should be given to medical personnel if pesticide poisoning is suspected?

_____

_____

Quiz # 3-5: MSDSs

Answers are located in Appendix A of this manual.

1. What does MSDS stand for?

_____

2. List any 5 Sections on a MSDS. _____

_____ _____

_____ _____

Chapter 4

HUMAN HEALTH

Properties that allow pesticides to control pests can also pose a hazard to humans. Exposure to pesticides can be from inhalation, skin or eye contact, or ingestion. Poisoning symptoms can be mild, severe, or result in long-term health problems. Poisoning depends on the toxicity of the pesticide and the amount of exposure to it. Symptoms can appear after just one exposure or after repeated exposures to small doses of pesticide over time. Applicators must know how pesticides work, symptoms of poisoning, and routes of exposure. This will allow them to do what they must to reduce risk.

Before a pesticide can be registered for use in Canada under the *Pest Control Products Act*, research data to determine the pesticide's potential to cause harm to humans must be submitted to the Pest Management Regulatory Agency. This data is used to determine if the pesticide will be registered for use, the personal protective equipment needed and care required for safe handling and use.

This chapter looks at these issues and provides direction to reduce risk.

Learning Objectives

Completing this chapter will help you to:

- **List the two types of toxicity.**
- **Describe the differences between acute and chronic toxicity.**
- **List the routes of entry into the body for pesticides.**
- **List ways to prevent entry of pesticides into the body.**
- **List the factors that affect exposure to pesticides.**
- **List ways to prevent exposure.**
- **List the symptoms of different levels of acute pesticide exposure.**
- **List the pesticide families that affect the human nervous system.**

Risk

Risk is the chance that a pesticide may cause harm. When a pesticide is handled or applied, there is some human risk. The amount of risk depends on:

- The toxicity of the pesticide
- The amount of exposure to the pesticide.

Risk = Toxicity X Exposure

From this equation, it follows that the greater the toxicity, the greater the risk. The type or concentration of active ingredient will affect pesticide toxicity. Some active ingredients are more toxic than others. Higher concentrations of an active ingredient also increase a pesticide's toxicity. A brief exposure to a very toxic pesticide might have the same effect as long-term exposure to a less toxic pesticide.

Proper attitude and care will reduce risk.

- Read labels.
- Always keep safety in mind.
- Follow pesticide use instructions.
- Choose less toxic pesticides.
- Wear proper personal protective equipment.

Wearing the personal protective equipment called for on the pesticide label can reduce risk.

Toxicity

Toxicity is the degree to which a pesticide can cause harm to an organism. Most chemicals, including pesticides, can be poisonous to humans if taken into the body in large amounts. Sensitivity to a pesticide, or even an adjuvant, can vary among people. Such sensitivity can sometimes increase after a number of exposures. One person may show no reaction to an exposure that causes severe illness in another person. An individual's age and body size will also influence the response to a pesticide exposure. Infants and young children are normally affected more by milder exposures than are adults. Similarly, adult females are often affected by milder exposures than are adult males.

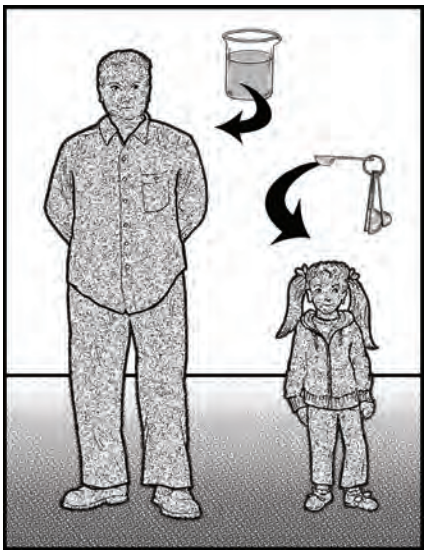


Figure 4-1: A child who is 1/5 the weight of an adult would require only 1/5 the amount of pesticide to suffer the same toxic effects as an adult.

Individuals may vary in sensitivity or reaction to the same level of pesticide exposure.

Acute and Chronic Toxicity

Toxicity can be either acute or chronic. Acute toxicity means the ability of a substance to cause ill effects that develop soon after exposure (i.e., a few hours to a few days). Acute toxic effects may develop, for example, if you splashed pesticide on yourself or if you were exposed to drift while spraying. Symptoms of acute toxicity may be relatively mild such as nausea, headaches, or stomach cramps, or as severe as convulsions, coma, or death. Acute toxic effects may be either reversible or irreversible, but usually they are reversible.

Chronic toxicity means the ability of a substance to cause ill effects that last a long time. Chronic toxic effects may not appear for some time after exposure. They may last many years and are often irreversible. Acute toxicity effects are often reversible.

Acute toxicity is measured by LD_{50} values. The LD_{50}, or Lethal Dose 50%, is the amount of a substance in one treatment which kills 50% of the animals (such as rats and mice) in a test. These treatments are given through the skin, (dermal) or through the mouth (oral). The LD_{50} value is measured in mg of pesticide per kg of body weight of the test animal.

Toxicity can also be measured with an LC_{50}. The LC_{50} (Lethal Concentration 50%) is the concentration (expressed in parts per million) of a pesticide in the air or water sufficient to kill half of the test animals exposed to the pesticide.

The smaller the LD_{50} or LC_{50} value, the more toxic the pesticide.

The acute toxicity of a pesticide is indicated on the label by a precautionary symbol, word, and statement. It is determined by measuring the LD_{50} or LC_{50} of the pesticide.

Laboratory tests are conducted on a number of standard test animal species (e.g., mice or rats) to determine LD_{50} or LC_{50}. The values for animal trials are used to determine probable LD_{50} or LC_{50} values for people.

You will not find the LD_{50} value on the label. Rather, estimated LD_{50} and LC_{50} values for a pesticide are indicated on the pesticide label using precautionary symbols or pictograms, signal words, and/or statements. The LD_{50} value forms the basis for determining whether a pesticide is slightly, moderately, or highly toxic. This will determine which signal word must appear on the label.

Symptoms of Acute Pesticide Poisoning

Symptoms of acute pesticide poisoning range from being mild and flu-like to severe and debilitating. Acute pesticide poisoning symptoms can appear within a few minutes or up to 96 hours later. Symptoms of acute poisoning are divided into three levels of severity. Levels and symptoms are general for all pesticides. These include:

Figure 4-2: Pesticide poisoning can mimic other common illness.

- **Mild symptoms** include: headache, feeling tired, loss of appetite, dizziness, weakness, nervousness, nausea, sweating, diarrhea, weight loss, thirst, moodiness, and irritation of the skin, eyes, nose, and/or throat.
- **Moderate symptoms** include: nausea, trembling, loss of co-ordination, excessive saliva, blurred vision, tightness of throat or chest, laboured breathing, flushed or yellow skin, stomach cramps, vomiting, diarrhea, confusion, sweating, rapid pulse, and coughing.
- **Severe symptoms** include: vomiting, loss of reflexes, trouble breathing, increased breathing rate, muscle twitching, pin-point pupils, convulsions, unconsciousness, thirst, fever and death.

People working with or around pesticides must know the symptoms of poisoning. This will allow them to limit exposure and put preventive actions or first aid procedures in place. Pesticide products do not all have the same poisoning symptoms. Applicators and handlers of a pesticide should be able to recognize symptoms based on the type of pesticide being used. Symptoms of poisoning are described in MSDSs and on pesticide labels.

Always know the symptoms of poisoning that can occur from exposure to the pesticides you are handling. Share this information with your family and co-workers.

A doctor or Poison Control Centre should be contacted at once if anyone who may have come into contact with a pesticide exhibits symptoms of poisoning. Give them any precautionary statements (such as an antidote) from the label and the P.C.P. Act Registration Number. Medical staff can use this information to make a diagnosis and give advice.

Those who handle or apply a pesticide should know the precautionary statements on the secondary panel of the pesticide label. Medical staff may request this information if a poisoning occurs.

Table 4-1: Lists of Pesticides and Their Poisoning Symptoms.

Pesticide Group	*Examples*	*Typical Symptoms*
Organochlorines	endosulfan, lindane, methoxychlor	apprehension, nausea, vomiting, weakness, excitability, dizziness, disorientation, twitching, convulsions.
Organophosphates	Guthion (azinphos-methyl), Dyfonate (fonofos), Lorsban (chlorpyrifos), diazinon, dichlorvos, malathion, parathion	headaches, dizziness, weakness, tremors, nausea, diarrhea, blurred vision, convulsions.
Carbamates	Temik (aldicarb), Furadan (carbofuran), Sevin (carbaryl), Lannate (methomyl)	headaches, dizziness, weakness, tremors, nausea, diarrhea, blurred vision, convulsions.
Dinitrophenols	dinoseb, Karathane (dinocap), DNOC	fever, sweating, rapid breathing, rapid heart rate.
Bipyridyliums & Pyridyliums	Reglone (diquat), Gramoxone (paraquat)	respiratory distress, lung damage.
Fumigants	methyl bromide, Telone (1-3 dichloropropene), Vapam (metam-sodium), chloropicrin	double vision, slurred speech, uncoordination, chemical pneumonia, kidney damage.
Dithiocarbamates & Thiocarbamates	ziram, maneb, Eptam, Surpass (vernolate)	irritation of the eyes, skin, nose, and lungs, nausea, vomiting, muscle weakness.
Chlorophenoxys	2,4-D, MCPA	skin rash, muscle weakness, convulsions, coma.

Pesticide Group	*Examples*	*Typical Symptoms*
Petroleum Products	kerosene, solvent distillate, diesel oil	nausea, vomiting, cough, irritation to lungs, central nervous system depression.
Anticoagulants	warfarin, diphacinone, brodifacoum	nosebleeds, bleeding gums, abdominal pains, weakness.

Effects of Chronic Toxicity

Chronic toxicity is an adverse response to a pesticide exposure that persists over time.

Chronic effects are often permanent. These result from single or repeated exposures. Chronic effects include:

- Skin irritation
- Weight loss
- Organ damage
- Tumours
- Nerve damage
- Birth defects

Chronic effects are more difficult to recognize than acute effects. There is no standard measure such as the determination of LD_{50} or LC_{50} values. Chronic effects can occur:

- As a complication of an acute exposure
- As a slowly progressive condition
- As the development of negative health effects years later

Symptoms of chronic or long-term exposure may not develop for days, months, or even years. Some people are more prone to be affected by pesticides than others.

In Review

Toxicity is the ability of a pesticide to cause harm. Acute toxicity refers to an injury or symptom that appears within a few minutes to several days after exposure. Acute toxicity can result from a single exposure or a series of exposures. This often occurs within 24 hours, but it can take up to 96 hours before symptoms occur. Symptoms may appear as mild or severe, depending on the level of exposure. Some people are more prone to be affected by pesticides than others.

The acute toxicity for each pesticide is found by measuring the dose or concentration required to kill half of the test animals. This is referred to as Lethal Dose 50% (LD_{50}) or Lethal Concentration 50% (LC_{50}). The lower the value of the LD_{50} or LC_{50}, the higher the toxicity of the pesticide.

Exposure to pesticides can cause long-term health effects without causing acute effects. Long-term effects are called chronic toxicity.

Applicators can protect themselves from acute and chronic toxicity when handling pesticides by wearing the recommended personal protective

Exposure

Exposure occurs when you come in contact with a pesticide. The higher the level of exposure to a pesticide, the greater the risk associated with its use. High levels of exposure, even to a pesticide having a low toxicity, can create risk. An unprotected applicator, working throughout the entire spray season with a pesticide having a low toxicity, is still at some risk because the level of exposure has been increased. However, eliminating or minimizing exposure to a very toxic pesticide can minimize risk.

Risk = Toxicity x Exposure

Routes of Exposure

A toxic effect can only occur if there is exposure. The risk equation shows that by reducing exposure to a pesticide, associated risk is also reduced. Pesticide handlers need to know how and where exposure can occur, so that they can take action to prevent or reduce risk. Exposure can result from inhalation, ingestion, dermal absorption, or absorption of a pesticide through the eyes.

Inhalation

Inhalation exposure results from breathing in airborne particles of a substance. Fine powders, spray droplets, vapours, or gases can be inhaled into the lungs. When the pesticide reaches the lungs, it can damage the lungs directly, or it can be absorbed into the bloodstream and cause poisoning elsewhere in the body. Risk of inhalation exposure is increased when using:

- High spray pressures that produce small droplets
- An ultra low volume (ULV) product
- Fogging equipment

Small droplets can be inhaled into the lungs where they are easily absorbed into the body. Unprotected workers exposed to vapours in enclosed spaces (e.g., cleaning up a spill in a storage area or application in a greenhouse) are also at high risk from inhalation exposure. In a confined space, the pesticide is not dispersed and can continue to expose workers. Some, but not all, pesticides produce vapours that have an unpleasant smell to warn of their presence. Most pesticides that are more likely to produce vapours will have a warning on the label, and label directions will instruct the applicator to wear a respirator.

PREVENTION AND PROTECTION

Reduce the risk of inhaling pesticides by:

- Wearing a proper fitted respirator (with a fresh pesticide-grade filter) when mixing and handling some volatile pesticides.

- Wearing a properly fitted respirator (with a fresh pesticide-grade filter) when working in an enclosed space where pesticides are applied or have been spilled.

- Staying away from areas where pesticides have just been applied.
- Following precautionary statements on the pesticide label.

Ingestion or Oral Exposure

Ingestion or oral exposure results from the intake of a substance through the mouth. Exposure can result from an accidental ingestion, a suicide attempt, or the eating of contaminated food. Ingestion most often occurs when pesticides are removed from their original container, or stored in food or beverage containers, and then accidentally swallowed.

Serious poisonings may result when pesticides enter the body and are absorbed. Some pesticides may be petroleum-based or corrosive, as well as toxic. These can burn the mouth, throat, and stomach if ingested.

PREVENTION AND PROTECTION

Prevent pesticide exposure through ingestion:

- Store pesticides in original containers. Never use food, coffee, or soft drink containers.
- Keep pesticides away from children or unauthorized persons.
- Clean clogged nozzles correctly. Never put a nozzle to the lips or blow into it to clear a clog.
- Wash your hands and face after mixing, applying, or handling pesticides or pesticide containers. Do this before eating, drinking, or smoking.
- Store pesticides away from food, drink, or tobacco products.

Figure 4-3: Pesticide ingestion occurs easily. Never eat, drink, or smoke when handling pesticides.

Store pesticides only in their original containers.

Dermal Absorption

Dermal absorption is the intake of a substance through the skin. It can result from:

- Contact with unprotected skin due from a splash back of the pesticide concentrate during mixing.
- Exposure to spray or dust during an application.
- Contact with residues on application equipment, treated crops, or contaminated personal protective equipment.

Dermal contact is the most common route of exposure when using pesticides.

The amount of pesticide absorbed through dermal exposure varies according to:

- Skin condition
- Location of exposure
- Pesticide characteristics

The body takes in pesticides more easily through broken skin, such as a cut, scrape, or abrasion. More of the pesticide may be absorbed into the body when the pesticide stays on the skin for a long time. Skin absorbs pesticides at different rates depending on the area of the body. Pesticides can be absorbed more quickly through skin covering the head, armpits, small of the back, genitals, and any area where moisture/sweating occurs.

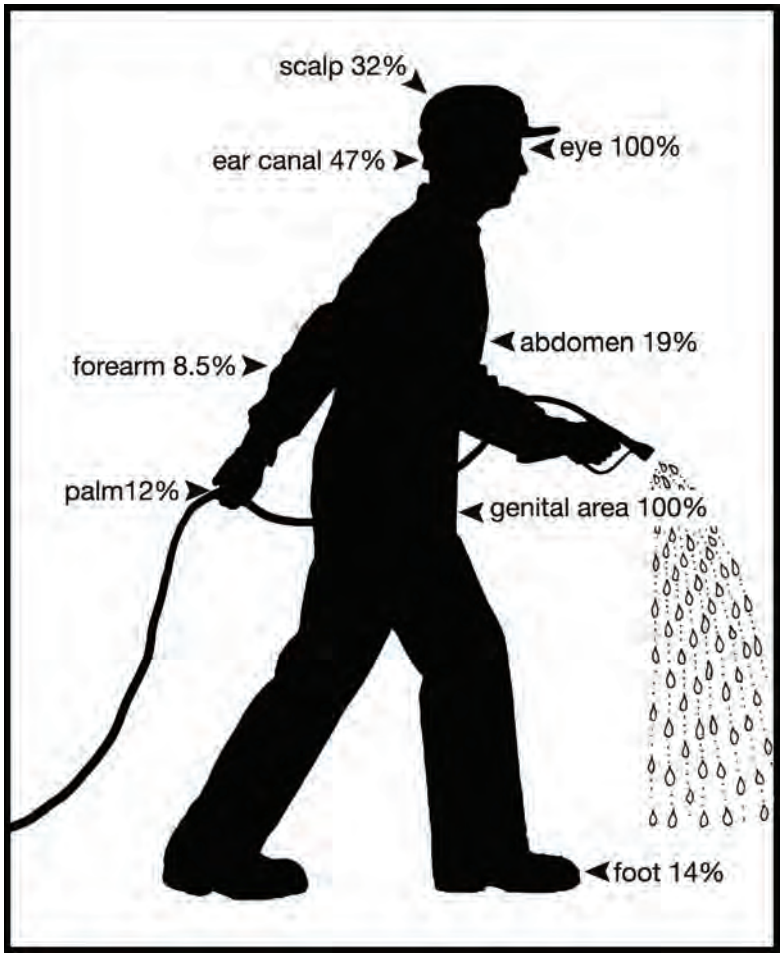


Figure 4-4: Absorption rates for different parts of the body.

Exposed hands and forearms are the most common sites of dermal absorption.

PREVENTION AND PROTECTION

Reduce the risk of exposure to pesticides through the skin:

- Keep personal protective equipment clean and in good order.
- Remove gloves after pesticide application and prior to clean up.
- Wash your hands and face right after handling pesticides or pesticide containers. Do this before eating, drinking, using the toilet, or smoking.
- Keep contaminated gloves or clothing away from the face and eyes.
- Immediately wash any area where a pesticide has been spilled on the body. Carefully remove any contaminated clothing.
- Follow re-entry times before going into a treated area.
- Store personal protective equipment, clean clothing, or personal items separate from where pesticides are stored or handled.
- Wear appropriate personal protective equipment (especially chemically resistant gloves) when:
    - Mixing pesticides
    - Applying pesticides
    - Handling pesticides
    - Handling empty containers
    - Cleaning up spilled pesticides

Ocular Exposure

Ocular exposure is the intake of a substance through the eyes. The eyes have many blood vessels that can absorb pesticides. If exposed to the eye, some pesticides can cause irritation or blindness (short-term or permanent). Pesticides can also enter the body through the eyes, and cause damage to other organs or parts of the body. Precautionary statements and symbols on the pesticide label and in MSDSs will provide a warning for this. Exposure can result from a splash, pesticide drift, or rubbing the eyes with contaminated gloves.

PREVENTION AND PROTECTION

Care should be taken with eye protection. This is particularly so when handling concentrates. Eye protection (e.g., safety goggles or splash shield) can reduce ocular exposure. Most prescription eyeglasses do not provide proper protection from pesticide drift or splash from the side. Washing hands after handling pesticides can reduce the risk of exposure from rubbing the eyes.

- Measure and pour pesticide concentrates below eye level.
- Never wear contact lenses when handling pesticides.

In Review

Applicators need to know how and where exposure to pesticides can occur. Actions can then be taken to reduce risk. Pathways into the body for exposure to a pesticide are:

- **The lungs (inhalation)**
- **The stomach (ingestion)**
- **The skin (dermal)**
- **The eyes (ocular)**

Exposure can result from contact with pesticides at any stage of handling or use. This includes:

- **Cleaning or maintenance of equipment**
- **Removing PPE**
- **Re-entry to a treated area**
- **Pesticide spill, splash, or drift**

Follow label directions on the use of personal protective equipment to reduce exposure. To protect the lungs, a fitted respirator with a fresh pesticide-grade filter should be worn if there is a chance of fumes or vapours. The danger of ingestion can be reduced by storing pesticides only in original containers and by washing your hands and face after handling pesticides. Wearing proper gloves, boots, clothing, and removing the gloves last reduces the chance of dermal exposure. Safety goggles or a splash shield should be worn when there is a risk of pesticide splashing.

Minimizing Exposure and Associated Risk

Knowing how to handle pesticides and putting safety first allows applicators to reduce the risk of exposure to pesticides. Factors include:

- Attitude
- Method of application
- Personal protective equipment
- Risk management

Attitude

An applicator shows the right attitude by:

- Being safety conscious
- Practicing good personal hygiene
- Considering all routes of pesticide entry
- Taking the action needed to reduce exposure
- Practicing safe work habits
- Selecting pesticides of lower toxicity when possible

Method of Application

When applying a pesticide:

- Keep application equipment clean and maintained.
- Only spray when winds are within legal requirements (check with provincial regulations).
- Do not allow other workers or bystanders in the area.
- Avoid working in confined spaces—if you must do this, wear a respirator.

Use of Personal Protective Equipment

When handling or applying a pesticide, personal protective equipment should be:

- Clean
- In good repair
- Suited for use with the specific pesticide (as stated on the pesticide label)

Risk Management

To reduce the risks associated with pesticide use, applicators should follow safety practices when:

- Transporting, handling, and applying pesticides
- Cleaning personal protective equipment
- Cleaning and maintaining application equipment

In Review

To reduce the risk of exposure to pesticides, applicators must have a responsible attitude toward safety. A good attitude includes following label safety warnings and using approved personal protective equipment as needed. Cleaning and maintaining application equipment can lower the risk of exposure.

Summary

Risk associated with the use of pesticides is related to the toxicity of the pesticide being used and the amount of exposure to it. Decreasing toxicity and/or exposure decreases risk. Toxicity is the capacity of a substance to cause harm. Toxicity can cause short-term (acute) effects or long-term (chronic) effects.

Acute toxicity is the ability of a substance to cause ill effects that develop soon after exposure (i.e. a few hours to a few days). Measuring Lethal Dose 50% (LD_{50}) or Lethal Concentration 50 (LC_{50}) reflects acute toxicity. The smaller the value for the LD_{50} or $LC_{50,}$ the more toxic the pesticide.

Chronic toxicity is the ability of a substance to cause ill effects, which last a long time. Symptoms are more difficult to see at the time of exposure than acute effects. Chronic effects are often permanent. Pesticides can cause chronic effects without acute effects.

Toxic effects of pesticides can vary with sex, health, age, weight, or prior exposure to other pesticides. Toxicity can also vary depending on the type of exposure. Risk tends to increase as the toxicity of the pesticide or duration of exposure increases.

Pesticides can enter the body through the lungs, mouth, skin, or eyes. Applicators must have a professional attitude on pesticide use and safety in order to limit the chance of exposure and risk. This includes wearing and taking care of personal protective equipment according to the label. Application equipment must be cleaned, maintained, and repaired. Risk should be considered when transporting, handling, or applying pesticides.

Self-test Questions

Answers are located in Appendix A of this manual.

1. Toxic health effects can vary with sex, health, age, or weight. **True or False**?

2. Which term, "Acute" or "Chronic" toxicity, refers to adverse effects that develop within a few hours or days after exposure to a pesticide?

   _____

3. The larger the number for acute LD_{50}, the more toxic the pesticide**. True or False**?

4. Effects of chronic toxicity are easy to detect and often reversible. **True or False**?

5. List four routes of pesticide exposure.

   _____

   _____

   _____

   _____

6. Most prescription eyeglasses provide protection from pesticide drift. **True or False**?

7. Storing pesticides only in original containers can reduce the risk of exposure to pesticides through ingestion. **True or False**?

Chapter 5

PESTICIDE SAFETY

Safety is always an issue when using pesticides. Applicators, bystanders, and the environment can be harmed by exposure to pesticide concentrates or vapour drift. Those who work with pesticides must know and follow safe practices to reduce risk.

Pesticide safety begins with choosing the correct product. Safety is important in pesticide storage, transportation, mixing, and loading. Equipment cleanup and maintenance must be done safely. Unwanted pesticides and empty pesticide containers must be properly disposed.

Learning Objectives

Completing this chapter will help you to:

- **Know why pesticides must be handled with care and knowledge.**
- **Follow safety procedures when handling pesticides.**
- **Select the right pesticide.**
- **Buy the proper quantity of pesticide.**
- **Select personal protective clothing and equipment (PPE) for handling pesticides.**
- **Properly wear personal protective equipment for handling pesticides.**
- **Maintain personal protective equipment.**
- **Clean application equipment safely and effectively.**
- **Maintain application equipment**.

Learning Objectives, cont'd.

- **Know how to safely transport, store, mix, load, and apply pesticides.**
- **Dispose of excess pesticide and empty containers in a safe and legal way.**
- **Reduce bystander exposure to pesticides by limiting re-entry into treated areas.**
- **Keep full and accurate records of pesticide use.**

Attitude and General Precautions

Safe pesticide use begins with:

- Adopting a responsible attitude
- Following basic safety guidelines
- Providing the necessary training for anyone who will handle or apply pesticides

Employees, employers, and supervisors should understand each of these steps.

Attitude

Pesticides can be poisonous to humans, pets, and livestock. They can also harm beneficial organisms and the natural environment. Safe pesticide use reduces risk to applicators, the public, and the environment. The safe use and handling of pesticides is the applicator's responsibility. Work responsibly at all times.

Pesticide handlers should review safety procedures on a regular basis. These can be obtained from the pesticide label. Safety procedures should be checked because:

- Applicators can become careless with a product or process they have become used to.
- Pesticide information and safety procedures may have changed since last reviewed.
- Repetition can bring about poor safety practices.

General Precautions

Safe pesticide handling practices include:

- Reading and following label information and directions
- Wearing clean personal protective equipment (PPE)
- Removing contact lenses before handling pesticides
- Washing before eating, drinking, smoking, or using the toilet
- Not having food or smoking products on your body when handling pesticides
- Never eating, drinking or smoking when handling pesticides
- Immediately, washing any spilled pesticide off an affected person and removing contaminated clothing
- Showering and washing hair and cleaning under the fingernails at the end of each day

Employee Training

Employers, supervisors, and employees must co-operate to reduce workplace injuries and illnesses. The employer is mainly responsible for workplace health and safety. Supervisors and employees also have a role to play.

Employers must supply personal protective equipment (PPE). They must make sure that supervisors and employees are trained in its proper use. Employers must provide supervisors and employees with information on any pesticide to be handled. Pesticide labels must be on the containers. Material Safety Data Sheets (MSDSs) should be given when available. Supervisors and employees must be trained to work safely when handling pesticides.

Supervisors are responsible for ensuring that all employees wear proper personal protective equipment (PPE), and that they understand and follow correct procedures in order to provide a safe workplace. Employees should request information on the pesticides they will be handling if it is not provided.

In Review

There are basic safety precautions that employers, supervisors, and employees involved in using pesticides must learn and follow if they are to minimize risk to themselves, bystanders, pets and domestic livestock, and the natural environment. In particular, they must:

- **Know safety procedures.**
- **Make sure that proper personal protective equipment (PPE) is used.**
- **Ensure that people handling pesticides avoid all contact with product residues during and after application.**

Selecting and Buying Pesticides

Safe pesticide use begins with choosing and buying a pesticide. To ensure that a pesticide is safe to use, make sure that the:

- Pesticide is registered for the intended use
- Pesticide may be used in available application equipment
- Proper personal protective equipment (PPE)is on hand
- Label shows the pesticide as approved for the intended use
- Pesticide can be used safely under site conditions (Impact on non-target life, people, and the environment should be minimal.)
- Pesticide can be used in an integrated pest management program **(See Chapter 7: Integrated Pest Management)**
- Amount of product needed is calculated accurately
- Label restrictions are known

Amount of Pesticide to Buy

Careful planning of pesticide purchases can reduce the amount and duration of pesticides in storage. This reduces the risk of human or environmental exposure. Minimizing the amount of pesticide on site also minimizes the storage space needed. Order and purchase only the amount of pesticide that can be used within a short period of time, or for one application.

Bulk Containers

Some pesticides are sold in reusable mini-bulk or shuttle containers. These containers hold from 50 to 400 litres of pesticide. When empty, these containers can be returned as a sealed unit to the vendor. This eliminates container disposal problems. Pesticides should be bought in these containers, if possible, when large amounts are required. These containers pose less risk in handling and disposal.

Soluble Packaging

Some pesticides come in water-soluble packaging. These may be referred to as solu-packs. They reduce handling and disposal problems. However, care should be taken with this type of packaging. They must be kept in a dry location at all times to keep packages from leaking.

Total amount of pesticide to buy = Pesticide rate X Size of treatment area

Number of containers to buy = Total amount of pesticide needed ÷ Amount in each container

In Review

The proper selection of a pesticide is based on a number of factors:

- **Pest to be controlled**
- **Application equipment available**
- **Personal protective equipment needed**
- **Compatibility with integrated pest management programs**
- **Environmental conditions**

Personal Protective Equipment

Personal protective equipment (PPE) reduces the applicator's exposure to pesticides. To give effective protection, PPE should be chosen based on the information given on the pesticide label. This equipment should be able to handle the rigours of work and length of pesticide exposure. A pesticide applicator should know how to fit, use, clean, and maintain all PPE. This equipment should not be used for any other kind of work.

The personal protective equipment (PPE) needed for a given pesticide depends on the risk associated with its handling. Risk factors include:

- The pesticide's properties
- Type of exposure
- Length of exposure
- Application method

Pesticide Properties

The toxicity, volatility, formulation, and potential type of exposure to the pesticide determine the PPE that is needed. PPE must protect against all types of possible exposure (oral, ocular, dermal, or inhalation). (**See Chapter 4: Human Health.)**

Highly toxic pesticides pose a high risk of harm to applicators and require the most PPE. The more volatile a pesticide is, the greater the risk of inhalation. This creates a greater need for a respirator. When smaller pesticide particles are created by application equipment, the need for PPE is increased. Smaller particles are more prone to be inhaled into the lungs. The eyes are very sensitive to toxic chemicals. Eye protection should always be used when mixing and applying pesticides with a 'corrosive' warning on the label.

The need for PPE varies with the type of application equipment being used.

Hazard symbols and label information statements are key to determining the toxicity of a pesticide. They may also tell what PPE is needed when handling or applying the pesticide.

Instructions and Warnings on the Label

The pesticide label gives information on the personal protective equipment (PPE) needed for handling a pesticide. This information appears under the precautionary statement on the secondary panel of the label (**See Chapter 3: Labelling.**) Always follow label directions.

A label may not mention each piece of PPE that is needed. It may just state the protection needed. Labels may have statements that indicate a potential problem (e.g., "avoid breathing dust or fumes", "avoid skin contact", or "keep product out of the eyes"). Use these statements to decide which PPE to wear.

Extra information on personal protective equipment (PPE) for a given pesticide can be found on its Material Safety Data Sheet (MSDS), or obtained from a pesticide company representative. Other sources of information on PPE include:

- Pesticide pamphlets
- Safety equipment vendors
- Applicator handbooks
- Training personnel

Dermal Protection

The skin is a major route for pesticides to enter the body.

Gloves

Most exposure of pesticides occurs to the hands. This is especially so during pesticide mixing and loading. By wearing gloves, an applicator can almost eliminate pesticide exposure to the hands. Wear gloves when:

- Handling or applying pesticides
- Rinsing or disposing of pesticide containers
- Repairing contaminated equipment
- Washing contaminated application or personal protective equipment

Gloves should be:

- In good condition (no holes or rips)
- Clean
- Unlined
- Made of proper chemical resistant material for the pesticide
- Long enough to cover the wrist and lower forearm
- Replaced regularly, as some gloves will breakdown over time.

There are several types of materials used to make gloves. No one material is likely to protect against all types of pesticides. Check the label or pesticide supplier for the glove type needed. Some pesticide labels call for certain glove types such as neoprene, nitrile, butyl rubber, or PVC-supported. **Leather or cloth gloves are not suited for handling pesticides.**

Figure 5-1: Proper way to wear gloves when applying a pesticide over your head.

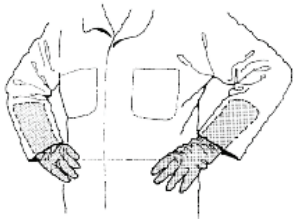


Figure 5-2: Gloves should be under coverall sleeves.

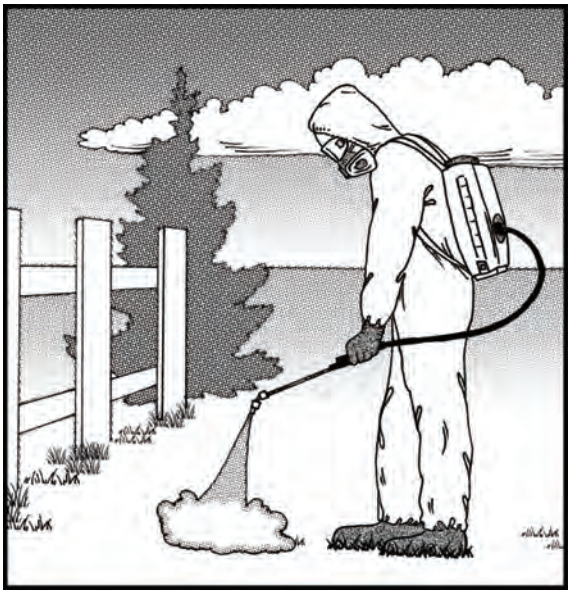
The top of the gloves should be folded to form a cuff. This keeps the pesticide from running down the glove and onto the arm when raised above the head. Sleeves of coveralls or shirts should be worn over the top of the gloves. This keeps pesticides from rolling down the sleeve and into the glove.

- **Gloves are the first piece of PPE to be put on and the last to be removed.**
- **Always use unlined gloves to reduce the risk of absorbing pesticides through the skin.**
- **Always wash gloves before taking them off. That way they will already be clean the next time they are needed. This avoids contaminating other equipment.**

Table 5-1: Minimum Safety equipment required based on the type of formulation and precautionary words on the pesticide label.

FORMULATION	*CAUTION*	*WARNING*	*DANGER*
Granular	Long-legged trousers and long-sleeved shirt, shoes and socks.	Coveralls, shoes and socks, hat, gloves.	Coveralls, boots, hat, gloves, and cartridge or canister respirator if dusts in air or if label says to avoid breathing dust or vapours.
Spray (where little exposure to spray exists)	Coveralls, boots, hat, and gloves.	Coveralls, boots, hat, and gloves. Goggles if advised by label. Cartridge or canister respirator if label says to avoid breathing vapours or spray mists.	Coveralls, boots, hat, gloves, and goggles. Cartridge or canister respirator if label says to avoid breathing vapours or spray mists.
Spray (where coveralls could be wet through or high exposure hazard exists)	Waterproof suit, boots, gloves, hat, and goggles.	Waterproof suit, boots, gloves, hat, goggles, cartridge or canister respirator.	Waterproof suit, boots, gloves, and waterproof hood. Full-face cartridge or canister respirator.

Body Covering



Once on the skin, pesticides can quickly be absorbed into the body. Skin should be covered to reduce the risk of poisoning from dermal exposure. Protective clothing should include:

- A long-sleeved shirt
- Long-legged trousers or coveralls
- Protective footwear
- Socks

Figure 5-3: Disposable coveralls are lightweight and cover regular work clothes. Hood should be up if head protection is required.

Disposable coveralls designed for pesticide use can be used in place of a long-sleeved shirt and long-legged trousers (e.g., TYVEK QC coverall, Saranex 23P coverall, or KleenGuard EP coverall).

Clothes should be pesticide-free and made of tightly woven fabric. They should be waterproof if the pesticides handled are likely to wet clothing. A liquid-proof, chemical-resistant apron should be worn over coveralls when measuring, mixing, or loading pesticides. This should cover the front of the body from chest to boots. It can be made of rubber or synthetic material. This will prevent absorption of any concentrated pesticide spilled.

Individuals are at highest risk when handling concentrated pesticides.

Boots/Protective Footwear

Applicators should wear unlined boots when mixing pesticides or walking through a treated area. These should be made of a chemical-resistant material (e.g., neoprene, nitrile, or polyvinyl chloride). The boots should reach above the ankle and be covered by the pant leg. This prevents liquid pesticides from running down into the boots and being absorbed through the skin.

Figure 5-4: Wear pant legs over boots.

Head Protection

A wide brimmed hat should be worn when handling pesticides. This should be made of a non-absorbent material (e.g., rubber or plastic) for ease of cleaning. The head and neck area can absorb pesticide easier than other parts of the body. Every time cloth or straw hats are worn the head is exposed to the pesticide.

Figure 5-5: Never wear cloth or straw caps!

Cloth baseball caps or straw hats do not provide proper head protection when handling pesticides.

Eye and Face Protection

GOGGLES

The eyes can absorb and be harmed by pesticides. To protect the eyes, wear clean goggles with a rubber or plastic headband. Goggles should fit so that they form a seal around the eyes and have no air vents. Because eyeglasses do not provide complete protection, always wear goggles that fit completely over glasses. Do not wear contact lenses when handling pesticides because they can absorb the pesticide and keep it in contact with the eyes.

FACE SHIELD

A face shield can protect the entire face from spills or splashes when mixing and loading pesticides. Goggles should be worn under the face shield to protect the eyes from mist and volatile pesticides.

Respiratory Protection

A respirator that covers the mouth and nose should be used to prevent pesticide exposure through inhalation. Pesticide spray droplets, particles, and vapours will be kept from entering the lungs when a properly fitted respirator (approved for pesticide use) is worn. Respiratory protection is important because pesticides can enter the bloodstream rapidly and fully through the lungs. If enough is inhaled, pesticides can damage the nose, throat, or lungs, or cause damage to other organs of the body.

Respirators must be approved for pesticide use by the:

- CSA (Canadian Standards Association),
- MSHA-NIOSH (Mines, Safety, Health Association - National Institute of Occupational Safety & Health), or
- BHSE (British Health & Safety Executive)

Respirators should fit properly, be clean, and have cartridges that can remove pesticides from the air that passes through them. The cartridge or canister should be approved for pesticide use.

Respirators must be worn when called for on the label. They should also be worn if there is risk of exposure to harmful levels of pesticides in the air (e.g., during mixing, loading, or cleaning up a spill).

Fitting a Respirator

Respirators come in many shapes and sizes. Select one that fits properly. A proper fit may not be possible if the wearer has a beard, facial hair, scarring or ridges. Hair prevents direct contact between the face and the edge of the respirator.

Follow the manufacturer's guidelines for respirator fit. Use one of the two tests that follow:

1. Place the palm of the hand over the exhalation valve cover and exhale gently. The face piece should bulge slightly with no air leaks between the face and face piece. This indicates a proper fit. If an air leak is detected, reposition the respirator on the face and/or adjust the tension of the elastic straps. Repeat until a proper fit is obtained.

Figure 5-6: Exhalation fit test.

2. Place flat pieces of paper or palms of the hands (lightly) over the open area of the cartridge cap. Inhale gently, and hold your breath for 5 to 10 seconds. The face piece should collapse slightly. This indicates a proper fit. If air leakage is detected, reposition the respirator on the face and/or adjust the tension of the elastic straps. Repeat until a proper fit is obtained.

Figure 5-7: Inhalation fit test.

Do a fit test each time you wear a respirator.

Types of Respiratory Protection

Figure 5-8: Never wear a dust mask when using pesticides.

Types of respirators include:

- Cartridge respirators
- Canister respirators
- Air-powered purifying respirators
- Self-contained breathing equipment

Cartridge, canister, and air-powered purifying respirators do not supply oxygen. These should never be worn in places with little or no oxygen. Dust masks protect only from dust particles. They offer no protection from pesticide vapours. Use an approved respirator when there is a risk of exposure to pesticide vapours.

CARTRIDGE RESPIRATORS

Cartridge respirators are the most common type of respirator used by pesticide applicators. Some of these respirators are now disposable. Cartridge respirators consist of either a half-face or a full-face mask. They provide protection by combining a pre-filter or particle filter to remove dust, small particles, and spray droplets together with one or two cartridges containing activated charcoal to remove hazardous vapours. Special cartridges and pre-filters are needed to protect against pesticide vapours.

Figure 5-9: Half-face cartridge respirator.

When buying or replacing cartridges and pre-filters, be sure they are designed to protect against the type of pesticide you are working with (e.g., organic). Always order cartridges and pre-filters that are designed for use with your respirator. Do not mix and match brands.

Cartridges should be changed at least once a year. Check respirator directions for usage times. If you can smell or taste a chemical when wearing a fitted respirator, you are not protected. Stop work, and leave the area immediately. Cartridge respirators are only good for short-term, outdoor use with low concentrations of pesticide vapour.

CANISTER RESPIRATORS

Canister respirators have a full face-piece and a canister of activated charcoal. The large volume canister allows for use where cartridge respirators may not be suited (e.g., high vapour concentrations). Canister respirators should **not be used** in confined spaces (e.g., fumigated structures) with little oxygen or high gas concentrations. Because air has to be drawn through more activated charcoal, it is sometimes more difficult to breathe comfortably when wearing a canister respirator.

Figure 5-10: Canister respirator.

AIR-POWERED PURIFYING RESPIRATORS

Air-powered purifying respirators use an electric pump to draw air through a charcoal cartridge and particle filter. Purified air is brought to a tightly fitted facemask, or a helmet. These are more comfortable than a half or full facemask respirator. This is especially so on hot days, when respiratory protection is needed for long periods.

Figure 5-11: Air powered respirator.

SELF-CONTAINED BREATHING EQUIPMENT

Self-contained breathing equipment supplies air through a tube on the headpiece. Air comes from a tank of compressed air on the applicator's back. Self-contained breathing equipment is often used when applying fumigants or dealing with emergencies (e.g., fire or major pesticide spill).

In Review

Pesticides can enter the body through skin, eyes, mouth and airways. The personal protective equipment (PPE) that will be needed when handling or applying a pesticide may be described on the pesticide label. PPE should be chosen by the type and formulation of pesticide, so all routes of exposure are blocked. This reduces risk to the applicator. Coveralls, unlined rubber gloves and boots, and certain types of hats will prevent absorption through the skin. Goggles or face shields will protect the eyes. A respirator designed to block pesticide vapours or particles will protect airways. Material Safety Data Sheets also provide information to help an applicator decide what personal protective equipment (PPE) to wear.

Cleanup and Maintenance of Equipment

Care of Personal Protective Equipment

Personal protective equipment protects against pesticide exposure only if it has been:

- Properly fitted
- Properly cleaned after use
- Maintained
- Replaced regularly

All personal protective clothing, (PPE), should be cleaned after each use or at the end of each day. Follow instructions given by the safety equipment manufacturer. Exposure to pesticide residues will be prevented the next time the PPE is handled or used. If specific instructions are not given, the following applies:

Gloves

Clean gloves as follows:

1. Leave gloves on while taking off and cleaning other personal protective equipment.

2. Wash gloves in soap and warm water before taking them off.

3. Check gloves for leaks. Roll the glove from the wrist to trap air in the fingers. Immerse the glove in water.

4. Discard leaky gloves.

5. Replace gloves on a regular basis.

Cleanup of personal protective equipment should be done at the application site, if possible.

Body Covering

Clean body covering as follows:

1. Wash off waterproof clothing before taking it off.
2. Discard heavily contaminated clothing.
3. Use disposable plastic garbage bags for storage of slightly contaminated clothes before washing.
4. Wash clothing after each day of use.

To wash clothes:

- Use chemical resistant gloves to handle contaminated clothing.
- Use a pre-wash treatment on contaminated areas.
- Pre-soak and launder separate from normal laundry.
- Avoid overloading the washing machine.
- Pre-rinse clothing using the pre-soak cycle.
- Use heavy-duty detergent, bleach, OR household ammonia. Do not mix these cleaners.
- Repeat wash cycles as needed for complete cleaning of contaminated clothing.
- Run the empty washing machine through a full cycle after use. Use hot water and detergent to rinse it.
- Set the machine for:
  - A normal wash cycle
  - A full water level
  - Hot water wash and rinse
- Hang clothes to dry. This prevents possible contamination of the dryer.

Throw out clothing that has been heavily contaminated. Place it in a plastic bag and dispose of it with empty pesticide containers.

Always follow the manufacturer's instructions for use/disposal of disposable coveralls.

Boots, Head Protection, Goggles, and Face Shields

Boots, head protection, goggles, and face shields should be washed with soap and warm water after each day of use. They should be checked regularly for leaks or damage. Discard them when they can no longer provide the protection needed.

Respirators

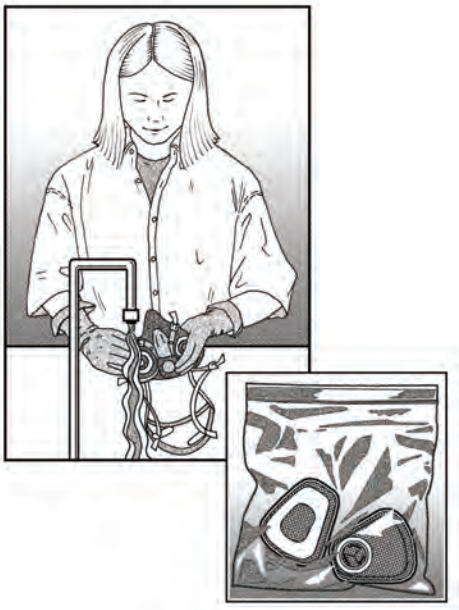


Figure 5-12: Wash face piece separately from cartridges and store cartridges in plastic bag.

Pre-filters and cartridges/canisters should be removed after each day of use. The respirator face piece should be washed in warm water and mild detergent, then rinsed well. Place cartridges in a clean, sealed plastic bag or in a clean, airtight container. This prolongs cartridge life by stopping further uptake of vapours. Even moisture from the air can reduce the ability of a respirator cartridge to work properly.

Respirators should be checked regularly for damage. Make sure that all valves, mechanical pre-filters, and charcoal cartridges are positioned and sealed. Cartridges should be changed:

- At the start of each year (as a minimum)
- If breathing through the respirator becomes difficult
- Immediately if a smell or taste of pesticide is noted while wearing a fitted respirator
- When indicated in the respirator manufacturer's guidelines for changing pre-filters and cartridges/canisters

STORAGE OF PERSONAL PROTECTIVE EQUIPMENT

Do not store personal protective equipment in a pesticide storage area, or with regular clothing. A cool, dry storage area extends the life of personal protective clothing. Keep waterproof clothing (e.g., gloves, boots, splash apron, etc.) away from sunlight to extend its life. Keep charcoal cartridges/canisters in clean airtight containers.

After handling pesticides or washing PPE, take a shower before smoking or eating. Wash the body, hair, and under the fingernails.

Application Equipment

Proper maintenance of application equipment extends its life, saves on replacement costs, and promotes environmental and personal safety. Regularly inspect application equipment for wear and replace all worn or damaged parts. Lack of maintenance can cause accidents, spills, damage to non-target sites, or non-uniform pesticide application rates. Application equipment should be shut off before making repairs or adjustments.

Application equipment should be emptied and cleaned after each day of use, when changing pesticides, and before storage at the end of the use season. Do not leave pesticides in application equipment for a long time. This may:

- Allow pesticide to eat into hoses, gaskets, and plastic
- Cause corrosion
- Reduce pesticide effectiveness
- Allow suspensions to settle out (This can create mechanical problems.)
- Allow granules to absorb moisture and form lumps (often making them unusable)

Proper personal protective equipment (PPE) should be worn when cleaning application equipment. Clean application equipment away from wells, surface water, and groundwater. This avoids contamination.

Follow guidelines for taking off PPE. Shower before eating, drinking or smoking. Wash the body, hair, and under the fingernails. Cleaning under the fingernails removes pesticide residues that can pose a risk.

In Review

Proper care and cleaning of personal protective equipment is important to pesticide safety. Cleaning all PPE (coveralls, gloves, hats, boots, goggles and face shields, and respirators) is a must after each job or at the end of the day. Pre-filters and cartridges/canisters should be stored in containers separate from the respirator. Daily cleaning and proper care of application equipment ensures effective operation.

Transportation

Moving pesticides from one site to another requires care. Containers must be packaged and secured to prevent spillage during transport.

Transportation Guidelines

When transporting pesticides, pack pesticide containers securely to prevent movement or breakage. Follow federal and provincial transportation laws. (**See Chapter 2: Regulations.**) Take care when transporting liquid pesticides because a spill may contaminate other containers and the transport vehicle. Ensure that containers are stacked securely to reduce the chance of breaking or spilling. If a spill does occur, do not use the contaminated packages. Return them to the manufacturer for disposal or repackaging. Clean the vehicle to prevent further contamination.

To avoid cross contamination, never transport pesticides with:

- Human or pet food
- Livestock feed
- Fertilizer
- Clothing
- Household goods

The above commodities must be kept separate from pesticides. Never leave pesticides unattended in a vehicle, unless they are locked in a compartment separated from the passenger area.

Pesticides should be transported in containers that are in good condition, with an approved and intact label. Never buy or off-load broken or leaky containers. Pesticides should be repackaged or disposed of if paper or plastic bags are broken (**See Chapter 9: Emergency Response**).

Figure 5-13: Make sure pesticide containers are secured during transportation.

When transporting liquid formulations, make sure caps and plugs are tightly closed and containers are arranged in an upright position. Protect paper and cardboard containers from moisture (e.g., rain, snow, humidity).

Never transport pesticides in the passenger compartment of a vehicle or let people or animals ride in the same compartment with pesticides (e.g., the back of a truck). Harmful fumes can be released and spills can cause poisoning or vehicle contamination. Do not transport pesticides on a wooden truck bed because wood absorbs spilled pesticide and may contaminate future cargo loads. Pesticide containers should be placed in an enclosed metal or plastic storage box. If this is not possible, place pesticide containers on a waterproof tarp. Storage boxes or bulk pesticide containers must be secured to the transport vehicle. Carry personal protective equipment and spill clean-up equipment (e.g., a shovel and chemical neutralizer) to safely collect pesticide in case of a spill.

In Review

Safe transport of pesticides reduces the risk of spills.

- **Only transport containers that are in good condition.**
- **Check that all caps and plugs are tightly closed and containers are secured to prevent spills.**
- **To prevent theft, never leave pesticides unattended or in an unlocked compartment.**
- **Separate pesticide containers from other goods to prevent cross-contamination.**
- **Never transport pesticides in the same space as passengers.**
- **Prepare for emergency spills by having PPE and spill cleanup equipment on hand.**

Storage

Correct storage of pesticides can reduce the risk to humans, animals, and the environment. Some provinces have laws dealing with pesticide storage. Consult the provincial pesticide regulatory body for requirements in your area.

Storage Location

A storage facility should be:

- Separate from work areas, living areas, and areas where animals are kept
- Away from wells, ditches, or water bodies

- Away from porous soil and areas where flooding can occur
- Away from areas used by the public, children, and animals
- Ideally located 50 metres away from homes, hospitals, schools, and occupied buildings
- Accessible by road to emergency personnel

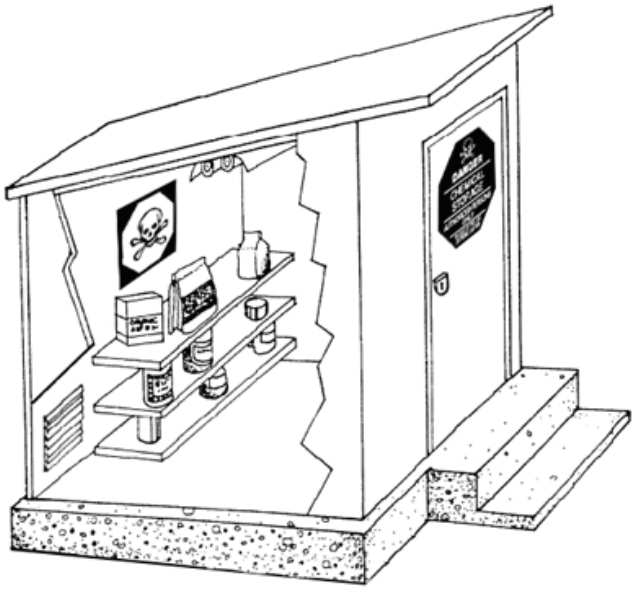


Figure 5-14: Storage facility

Storage Facility

The storage facility should:

- Be used only for storing pesticides
- Be locked to prevent entry by unauthorized persons
- Be built to protect against adverse weather
- Be made of fire resistant materials
- Have a floor that does not allow seepage (with a curb to retain spills)
- Not have floor drains, unless self-contained (e.g., leading to a holding tank)
- Be well ventilated in all weather conditions
- Be well lit
- Have shelves made of materials that do not absorb pesticides
- Have proper electrical wiring
- Have proper fire extinguishers outside the storage facility

- Have easy access to emergency equipment and personal protective clothing outside the storage facility
- Have a warning sign on the entrance that indicates:
  - Pesticides are stored there
  - Flammable materials are present
  - No smoking

Temporary Pesticide Storage

Large weatherproof bulk containers and transport trailers can be used for temporary outdoor storage, but principles that apply to permanent storage still apply. Ensure that security measures are in place and only allow access to authorized persons. Post proper warning signs.

Storage Guidelines

Container Storage

Read and follow label instructions when storing pesticides. Pesticides must be stored in original containers with original labels intact to ensure that the pesticide is used for its intended purpose. Containers should be stored in areas set aside for pesticides. Never store them with other items. Containers should be checked regularly for leaks, tears, rust, or loose lids. Defective containers should be returned to the vendor or disposed of according to provincial laws (*see* section on **Disposal**). Close containers when not in use and store them in a dry area.

Store pesticides ONLY in their original containers.

Good Housekeeping Practices

Store a minimal amount of pesticides. Make careful estimates of amounts needed. This will reduce the need for disposal of excess and unwanted pesticides at the end of the use season. To prevent possible cross-contamination, never store pesticides with or near food, animal feed, seed, veterinary supplies, or in the home. Do not smoke or eat in or around the storage facility.

Storage Area Design

Pesticide storage areas should be located away from wells and water supplies. Store pesticide containers away from direct sunlight to prevent losses to heat or photo degradation. Store combustible materials away from heating systems to prevent fire hazards.

Store herbicides away from insecticides and fungicides. This prevents cross-contamination. Herbicide vapours can be absorbed into other pesticides. This can cause phytotoxicity and unwanted residues.

Keep pesticides separate from other materials that could be hazardous should they contact each other. Pesticides such as dazomet, maneb, and mancozeb produce flammable vapours when wet. Other pesticides, such as difenzoquat, methyl bromide, and paraquat, produce flammable hydrogen gas on contact with aluminum. Glyphosate produces hydrogen gas on contact with galvanized metal.

Keep pesticide containers upright and off the floor. Allow enough space between rows to permit inspection of containers for corrosion and leakage. Follow manufacturer's suggested stacking heights and make sure that tiers are stable and secure.

Keep a list of the quantity, type, and age of pesticides in storage. This allows you to plan purchases. In case of emergencies such as fires or floods it is important to have such a list. This list should be kept handy, but away from the storage site to allow access in case of an emergency.

To minimize handling, only remove the number of containers required for immediate use. Return containers to the storage area when not in use. Inform the local fire department of the location and contents of the storage facility. Keep proper personal protective equipment and a first aid kit near, but not in, the storage facility. Keep pesticide-mixing equipment in the locked pesticide storage. Allow clear access to emergency equipment at all times. Keep a list of emergency telephone numbers (e.g., fire department, medical personnel, and poison control centers) posted in a proper

location. Keep pesticides from freezing if stated on the label. Follow all provincial and/or municipal building, fire, and electrical codes.

In Review

Safe storage of pesticides requires attention to location and features of the storage facility (whether permanent or temporary). The pesticide storage should be located where it will not threaten people, animals, or the environment, and be made of fire-resistant materials. Restrict entry to only authorized persons. Keep the pesticide storage well ventilated, and keep emergency and spill cleanup equipment on hand.

Pesticides should be stored in their original containers. Herbicides should be separated from other pesticides to prevent cross-contamination. Inform the local fire department of the location and contents of a pesticide storage facility. Adhere to all provincial and/or municipal building, fire, and electrical codes.

Mixing and Loading

Mixing and loading pesticides is one of the most hazardous aspects of pesticide use because the mixer or loader will be exposed to concentrated product. Proper personal protective equipment (PPE) must be chosen and used. A site must be chosen for pesticide mixing and loading that will not harm the environment. Care must be taken to prevent pesticide spills and contamination of surface and groundwater.

Wear personal protective equipment when mixing and loading pesticides. Refer to provincial laws.

Personal Protection

Individuals should wear the following PPE when mixing and loading pesticides:

- Long sleeve shirt and pants, or coveralls
- Water repellent head protection
- Unlined chemical resistant gloves and boots
- Face shield and/or goggles
- Chemical resistant apron
- Respirator (for highly toxic or volatile pesticides)

Preparation for Mixing/Loading

Before mixing and loading a pesticide:

- Read the label to confirm that the pesticide is registered for the intended use.

- Review safety precautions, first aid information, mixing directions and pesticide rates. This information will also be found on the pesticide label.

- Ensure that first aid equipment and emergency phone numbers are within reach.
- Calculate how much pesticide is required for each tank or application site.
- Put on personal protective equipment before you begin.
- Prepare only the needed amount of spray mixture.

Figure 5-15: Mixing and loading requires the most PPE. This is the time the pesticide is most concentrated and poses the most risk to the handler, mixer, or loader.

Selection of a Mixing/Loading Site

To protect applicators and the environment, the mixing and loading site should:

- Be outside or well-lit and well-ventilated
- Be close to the application site
- Be away from other people, livestock, and pets
- Be in an area where a spill or overflow will not get into a water supply
- Have an emergency water supply, soap, and spill cleanup equipment nearby

Mixing/Loading of Pesticide

Mix and measure pesticides on a sturdy, level surface. The mixing surface should be made of material that does not absorb pesticides, or it should be covered with heavy-duty plastic. Prevent pesticide contamination by not using this surface for any other purpose. Do not mix pesticides in wind or in situations that can increase the risk of exposure. Hold the pesticide container below eye level when pouring to

prevent pesticide from splashing into the eyes. Do not tear open bags. Cut them carefully with a sharp knife to prevent exposure or spills.

Measure the pesticide accurately to ensure the proper application rate.

When mixing and loading a pesticide in a spray tank, follow label directions. If not stated on the label, the following guidelines should be used:

1. Use clean water.
2. Make sure the spray tank is level while it is being filled. Add roughly half of the required water to the tank.
3. Turn on the agitator (if indicated on the label).
4. Stand on the ground or on a sturdy platform when adding pesticides to application equipment.
5. Add the pesticide slowly, holding the container below eye level.
6. Triple rinse or pressure rinse any empty containers and measuring equipment. Add the rinse water to the spray tank.
7. Add water to the tank until it reaches the required level. Do not overfill.
8. Prevent tank overflow. Never leave a tank unattended while filling.
9. Close and return pesticide containers and measuring equipment to locked storage.
10. Wash gloved hands.

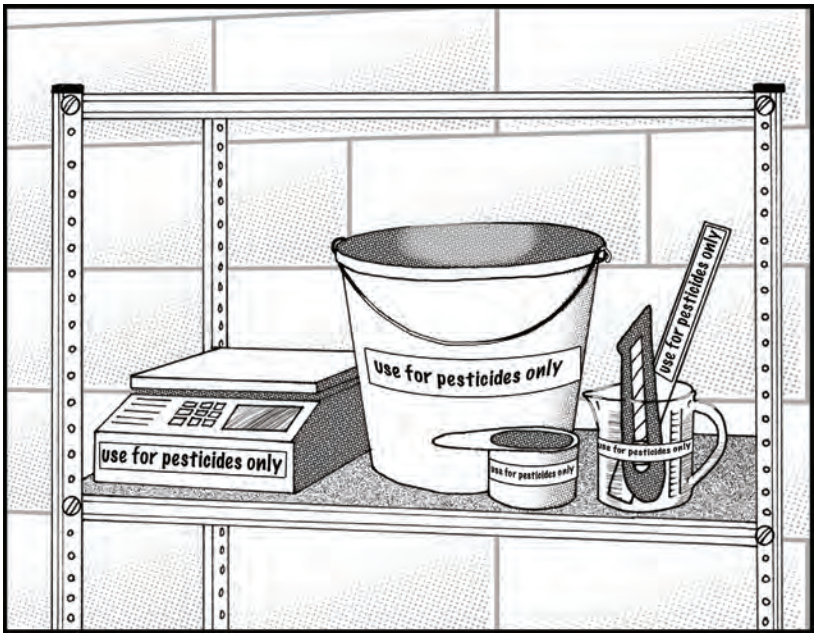


Figure 5-16: Make sure scales, measuring cups, pre-mixing pails, and knives are used only for pesticides. After use, wash these with soap and water, triple rinse, and return them to the locked storage.

Stop and clean up a pesticide at once if it is splashed or spilled.

When working with pesticides, care is required to prevent contamination of surface or groundwater. To reduce the risk of water contamination:

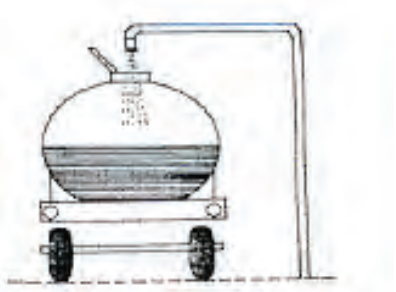


Figure 5-17: An air gap will prevent back-siphoning of a pesticide mix.

- Fill the sprayer away from the water source.
- Use a nurse tank to bring the water to the sprayer.
- Keep the filler hose above the water line in the spray tank to prevent back-siphoning of the spray mixture into the water supply. Use an anti-backflow device.
- Clean application equipment and PPE at the application site, when possible.

Bring the water to the sprayer. Do not bring the sprayer to the water.

In Review

Ensure the safety of applicators, bystanders, and the environment during mixing and loading of pesticides by:

- **Using proper personal protective equipment (PPE) as stated on the pesticide label**
- **Properly locating the mixing and loading site**
- **Adding pesticide properly to the application equipment**
- **Reducing the risk of groundwater and surface water contamination**

Application

The careless or improper application of pesticides may risk exposing people or nearby property. Exceeding label rates or applying pesticides in unsuitable weather can contaminate surface or groundwater. Failure to handle pesticides safely can put the applicator at risk from spills and exposure.

Before and during a pesticide application, applicators should practice the following:

- Read the label
- Wear proper personal protective equipment (PPE)
- Use clean water
- Prevent contamination
- Mix and apply safely
- Never work alone
- Calibrate equipment
- Plan the pesticide application
- Apply granular pesticides correctly
- Repair equipment malfunctions safely

Read the Label

The most important thing to do before applying a pesticide is to read and understand the pesticide's label information.

Wear Proper Personal Protective Equipment (PPE)

Wear proper PPE for the specific pesticide and method of application.

Use Clean Water

Have a supply of clean water at the application site for personal clean up. This water can also be used in an emergency. Clean water tanks should be nearby or attached to application equipment.

Prevent Contamination

Before a pesticide application begins, cover or remove all items that may become contaminated (e.g., animal feed, water containers, toys, food utensils, etc.). Remove livestock and pets from the area if there is a risk of exposure. Make sure that proper warning signs are posted at points of entry to the treatment area. Before application, consult provincial laws/municipal by-laws for specific signage regulations. Prevent contamination by following buffer zones and re-entry times, as indicated on the label and/or provincial laws.

QUIZ # 5-1: PREVENTING CONTAMINATION

Answers are located in Appendix A of this manual.

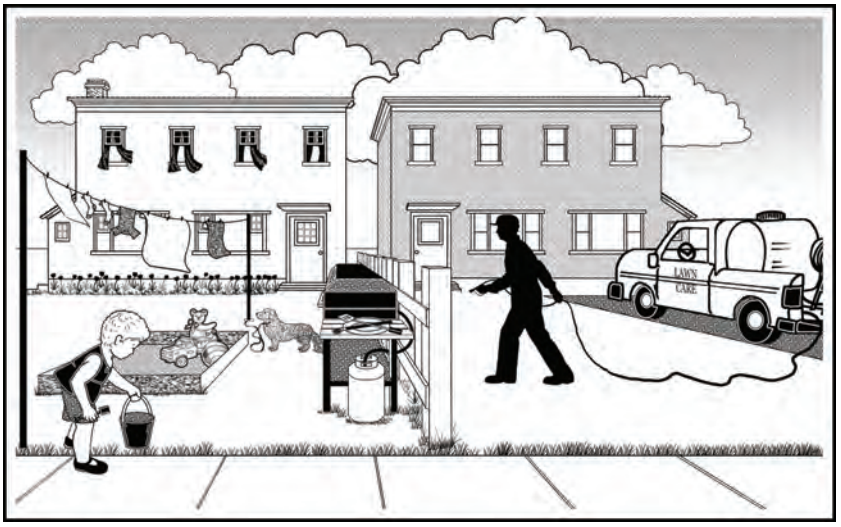


Figure 5-18: List the precautions that should be taken before pesticide application.

Mix and Apply Safely

Pesticides should be mixed and used at rates called for on the pesticide label. Only use outdoor pesticides under favourable weather conditions.

Never Work Alone

Avoid working alone with pesticides. This is especially important when you are working in hazardous conditions. If you must work alone, make sure that someone else knows what pesticide you are using and its *Pest Control Products Act* Registration Number. They should also know where you are working, and when you plan to finish.

Calibrate Equipment

Use calibrated application equipment that is suited to the type of application, as stated on the label. Make sure that the equipment is in good working order. Use and maintain the settings (speed, pressure) chosen during calibration.

Plan the Pesticide Application

Plan a travel route that will avoid passing through airborne spray or freshly treated areas. Stop the pesticide application when passing through an area that does not require treatment. For example, shut off spray nozzles on a boom when turning or crossing a grassed waterway.

Apply Granular Pesticides Correctly

Soil-incorporated granules should be properly mixed into the soil and covered during their application (even at the ends of rows).

Repair Equipment Malfunctions Safely

If application equipment breaks down, shut it off and put on proper personal protective equipment (PPE) before fixing it. When repairs are complete, wash your hands before continuing the application. Wear gloves and goggles when replacing or cleaning plugged nozzles. Use a soft brush and clean water, or compressed air, for blocked nozzles.

Never blow out a nozzle with your mouth. Never use sharp, metal objects or wire to remove a blockage. This can damage the nozzle.

Pesticide Drift

Pesticide drift can damage non-target crops, landscape ornamentals, and lawns. It can pose a health hazard to people and damage the environment (e.g., water, wildlife, aquatic habitat, etc.). To reduce pesticide drift:

- Use the lowest possible application rate.
- Deliver the spray as close to the target area as possible.
- Select the slowest speed possible for motorized application equipment.
- Use nozzles that reduce fine droplets (e.g., large nozzle orifice, low pressure).

When working with sprays:

- Use an anemometer (wind meter) to measure wind speed and direction. Keep a record of this.
- Do not apply when wind speeds exceed provincial regulatory requirements or the label maximum. (**See Chapter 6: Protecting the Environment** and **Chapter 8: Application Technology.**)
- Do not apply pesticides when the temperature exceeds 25^0 C. The release of vapours by pesticides increases as the temperature rises.

In Review

Follow safety guidelines before and during pesticide application. This avoids human exposure and environmental damage. The pesticide label is an important source of information for application rates, acceptable weather conditions for pesticide use, and buffer zone requirements.

In addition, provincial legislation may indicate the type of weather conditions and buffer zone requirements that are permitted for certain types of pesticide use. Choosing and using proper personal protective equipment (PPE) can reduce the risk of exposure to the applicator. Items should be covered or removed to protect them from exposure. Signs can help to notify people of a pesticide application. Application equipment should be calibrated and kept in good working order.

Disposal

Risk of human exposure or environmental contamination must be minimized when cleaning and disposing of empty pesticide containers and excess pesticides.

Container Cleaning and Disposal

Containers should be cleaned when emptied. This removes pesticide residues before they dry. When emptying a pesticide container:

- For liquids, drain the pesticide into the spray tank or mixing tank until no drips are visible.
- For solids, gently shake the bag into the tank or hopper until no loose pesticide remains.
- Triple rinse or pressure rinse metal, plastic, or glass containers, unless otherwise indicated on the label.
- Gently single rinse bags if possible, unless otherwise indicated on the label.

Empty pesticide containers should be properly cleaned and disposed of because:

- Improperly rinsed containers cannot be recycled.
- Pesticide residues can be hazardous to humans. Children playing around containers could be poisoned.
- Pesticide residues can contaminate the environment. For example, rain could wash residues into a stream and kill fish.
- Poor container disposal creates a bad public image. Customers who see poor disposal may refuse future business.
- Poor disposal practices waste pesticides and money.

To Triple Rinse an Empty Pesticide Container:

1. Fill the empty container to at least 10% of its volume with a diluent (usually water) and recap. The amount of rinse water required may vary.

2. Shake or roll the container, and make sure that inside surfaces are well rinsed. Pour the rinse water into the spray tank. Repeat the process twice more. If pressure-rinsing equipment is used, rinse the container for 60 seconds. Pour the rinse water into the spray tank.

3. After cleaning, make the empty container unusable by cutting, puncturing, and/or crushing plastic, metal, or paper containers. Break glass containers in a plastic bag. This prevents future uses such as for water buckets, harvesting containers, or sand pails.

4. Cap and properly dispose of the container. Plastic containers can often be returned to vendors or depots for recycling/disposal. Check the provincial regulatory body to find out how to dispose of paper or plastic bag containers, large drums (refillable and non-refillable) and glass bottles. If you cannot dispose of cleaned, empty containers immediately, return them to locked storage.

Domestic pesticide containers can be discarded with household garbage once they have been cleaned.

Pesticide Disposal

Disposal of Concentrated Product

Planning your pesticide purchases will minimize excess pesticide concentrates left over after an application or use season. Review records of prior applications. Use the pesticide that is on hand before buying more. Contact the pesticide manufacturer or a local vendor to be sure that old stocks are still effective.

The safest way to dispose of pesticide concentrates is to use them according to label directions. If this is not possible, unopened containers may sometimes be returned to the manufacturer or local dealer. Applicators can also contact the provincial pesticide regulatory body for advice on proper disposal of unused pesticides.

Disposal of Surplus Tank Mixture

Applicators can avoid large amounts of surplus tank mixture before mixing by:

- Accurately measuring the area to be treated
- Confirming application rates
- Calibrating application equipment

If there is tank mix remaining at the end of an application, use it according to label directions on another area that requires the same pesticide. If this is not possible, contact the provincial pesticide regulatory body for advice.

Never apply surplus tank mixture a second time to the treatment area.

In Review

You must properly dispose of empty pesticide containers and excess mixed pesticide. This reduces the risk of human exposure or environmental contamination. Empty plastic containers should be triple rinsed and returned for recycling. Dispose of non-plastic containers (glass bottles, paper or plastic bags, drums, etc.) according to label directions or provincial laws. Planning can minimize excess tank mix. If excess pesticide remains, use it on a similar treatment area or dispose of it according to label directions.

Re-Entry

People risk being exposed to pesticides if they enter treated areas too soon after an application without wearing proper personal protective equipment (PPE). Levels of exposure in freshly treated areas can be as high as during application.

Re-entry times are stated on some pesticide labels. If such times are not stated, exposure can be minimized by following provincial re-entry guidelines or waiting until liquid pesticides have dried. Observe the re-entry time before going into a treated area without wearing proper PPE. If you need to re-enter a treated area before the re-entry time has passed, wear appropriate PPE. Make sure that all who may enter a treated area are aware of the re-entry time by posting signs.

Figure 5-19: Wear appropriate PPE if you need to re-enter an area before the re-entry time has passed.

The re-entry time, or re-entry interval, is the minimum time required to stay out of the treated area unless proper PPE is worn.

Application Records

Record keeping provides a history of pest problems and control methods for a given area. Good records are useful for planning pesticide applications, re-entry times, harvest dates, and grazing times. Records provide details on application and equipment settings. Records can answer questions or address problems that arise after application. Problems can include poor applications, crop or property damage, complaints, and lawsuits.

Application records may include:

- Date and time of application
- Location of application
- Pest
- Target site
- Pesticide (product name and P.C.P. Act Registration Number)
- Rate of application
- Applicator's name and license/certificate number
- Type of application equipment and settings (e.g., nozzles used, pressure, acing, speed, boom height, etc.)
- Weather (e.g., rain, wind, temperature)
- Preharvest interval (if it applies)
- Nearby areas (e.g., crops, sensitive areas, such as schools, daycares, water bodies, protected habitat)
- Environmental effects of pesticide use
- Evaluation of the application
- Amount of pesticide used
- Monitoring results (if used)
- Other information that might affect the application

Some provinces require that pesticide application records be kept. Check with the provincial regulatory body for legal requirements.

Summary

Pesticide handlers or applicators should be familiar with safety procedures. This involves:

- **Choosing the most suitable pesticide available**
- **Choosing and using proper personal protective equipment (PPE)**
- **Cleaning and maintaining application equipment**
- **Proper transport, storage, mixing, loading, and application**
- **Proper disposal of excess pesticides and empty pesticide containers**

Choose a pesticide according to:

- **The pest to be controlled**
- **Application equipment available**
- **Personal protective equipment needed**
- **Compatibility with integrated pest management**
- **Environmental conditions**

The pesticide application rate and the size of the treatment area will dictate the amount of pesticide to buy.

PPE should be chosen based on the type and formulation of pesticide and all routes of exposure (skin, eyes, and airways) should be protected. Coveralls, gloves, boots, and hats will minimize skin absorption. Using goggles or face shields can protect the eyes. Cartridge respirators, canister respirators, air-powered purifying respirators, or self-contained breathing equipment can protect airways. This equipment should be chosen based on the type of pesticide being used, the amount of time it will take to complete the pesticide application, and any other hazards associated with the application (such as an application in an enclosed space). PPE must be correctly worn, kept in good order, and replaced regularly.

Good personal hygiene is important to pesticide safety. Proper care and cleaning of PPE and application equipment is a must. All PPE (coveralls, gloves, hats, boots, goggles, face shields, and respirators) must be cleaned after each job or at the end of the day.

Summary, cont'd.

The safe transport of pesticides can help reduce spills. Only transport containers that are in good order. Make sure caps and plugs are tightly closed. Containers should be secured to prevent spills. Vehicles should be locked to prevent theft. Pesticides should be transported separate from non-pesticides and never in the passenger compartment of a vehicle.

Safe storage of pesticides is a must. Pesticides should be stored where they will not threaten people, animals, or the environment. A good storage facility will:

- **Be made of fire-resistant materials**
- **Prevent entry by unauthorized persons**
- **Be well ventilated**
- **Have emergency and spill clean-up equipment nearby**

Applicators, the public, and the environment must be protected during mixing and loading of pesticides. Locate the mixing and loading site to reduce environmental contamination, especially the contamination of surface water or groundwater.

Humans and the environment must be protected before and during pesticide application:

- **Read product labels. Follow label recommendations on pesticide application rates, weather conditions, and buffer zones.**

- **Application equipment must be calibrated and kept in good order.**

- **Applicators must prevent spray drift onto non-target areas.**

Safety is a concern when:

- **Cleaning and disposing of empty pesticide containers**
- **Disposing of excess mixed pesticide**
- **Going back into freshly treated areas**

Self-test Questions

Answers located in Appendix A of this manual.

QUIZ # 5-2

1. List eight (8) safety practices common to all types of pesticide use.

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_____

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2. Given a rate of application, and the size of the treatment areas, how would you calculate the amount of pesticide to buy?

_____

_____

3. What risk factors can affect the type of personal protective equipment needed for handling a pesticide?

_____

_____

4. List the characteristics of a glove that would allow it to provide protection from pesticides.

_____

_____

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_____

5. Why is it important to wear a face shield when mixing and loading pesticides?

_____

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6. List the characteristics of a respirator that is suited to provide protection from pesticides.

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7. List the types of respirators available.

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8. Describe six ways to transport pesticides safely.

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9. List four characteristics of a good site for storing pesticides.

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10. What safety procedures should be followed before mixing and loading pesticides?

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11. List three ways to safely clean a blocked spray nozzle.

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12. Describe the process for washing pesticide-contaminated clothes.

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13. Name four steps for safe pesticide container disposal.

_____

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_____

14. What should you do with excess tank mixture?

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_____

15. What should never be done with excess tank mix?

_____

16. Define re-entry time.

_____

_____

17. List three reasons why it is important to record pesticide applications.

_____

_____

_____

Chapter 6

ENVIRONMENT

A healthy environment provides natural resources for industries like fishing, farming, and forestry. Prosperity in the Atlantic Provinces depends on the natural environment (fishing waters, farming soils, and forests). Pesticides can contaminate or damage these environments if they move from target sites. Those using pesticides must know the effects their actions can have on the environment. They must take precautions to reduce the risk of environmental damage.

Learning Objectives

Completing this chapter will help you to:

- **Know what happens to pesticides in the environment**
- **Know how to prevent pesticide contamination of water**
- **Know how to prevent pesticide contamination on land**

Fate of Pesticides in the Environment

A number of factors decide the fate of pesticides in the environment. They also affect the impact that a pesticide will have when applied or released by accident. These factors include:

- Adsorption
- Desorption
- Absorption
- Volatilization
- Spray drift
- Runoff
- Leaching
- Degradation

Adsorption

Adsorption is the binding of chemicals to soil or some other substance. The amount that a pesticide binds to soil depends on:

- Pesticide type
- Pesticide concentration
- Moisture content
- pH
- Soil texture

Organic soils or those with a fine clay texture are most adsorptive. Pesticides that are tightly bound or adsorbed to soil are less likely to:

- Move down through the soil layers (leach)
- Break down by microorganisms in the soil

Pesticides adsorbed to soil can be moved from exposed fields into waterways by wind or water erosion. This can contaminate water, kill fish and damage fish habitat. Careful use of pesticides near water, and respect for provincial laws on setbacks (buffers) from watercourses, can help to reduce contamination of water.

Desorption

Desorption occurs when a pesticide bound or adsorbed to soil or another substance is released. For example, soil particles contaminated with a pesticide can move into a watercourse. The adsorbed pesticide may be released on contact with water. Animals and plants in the water can then take up pesticide residues. This can harm the aquatic environment.

Figure 6-1: Absorption

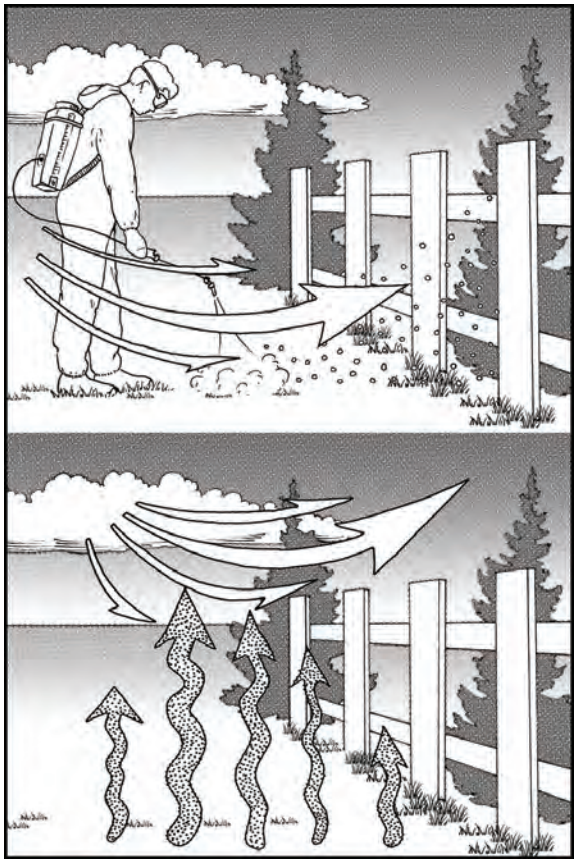
Absorption

Absorption refers to the movement of pesticides into organisms (plants or animals) or structures (soil or wood). Absorption into an organism is not always bad, since many of these organisms can break pesticides down into non-toxic compounds. In most cases, a pesticide will not be absorbed if it has adsorbed to the soil. Some pesticides need to be absorbed by an organism for the pesticide to be effective.

Volatilization

Volatilization is the process where solids or liquids become vapour (gas). The evaporation rate depends on the chemical makeup of the pesticide and environmental factors. Some pesticides can volatilize readily from sandy and wet soils. Hot, dry, windy weather also promotes volatilization. Small drops of spray

are easier to volatilize than larger ones. Pesticide vapours in the air can readily move from the application site (vapour drift). This movement is more likely to occur after, rather than during an application. Vapour drift of pesticides can contaminate nearby crops, property, or the environment.



Vapour drift can be reduced by:

- Using low spray pressures with large droplet sizes
- Not spraying when it is hot
- Following temperature application limit guidelines given by the label or provincial law
- Using low volatility formulations

Figure 6-2: In the top figure spray drift happens as a result of wind at the time of application. Vapour drift can happen after the application has been completed as in the bottom figure.

Vapour drift is the movement of vapours from the site of application. It is more likely to occur following a pesticide application.

Spray Drift

Spray drift refers to airborne movement of spray drops or particles away from a treatment site during application. Damage caused by spray drift can be similar to

that of vapour drift. However, the timing and factors that cause spray drift are different from vapour drift. Neither type of drift is good because they can:

- Damage or cause the deposit of unwanted residues on nearby crops
- Result in human or animal poisonings
- Contaminate waterways and damage aquatic organisms
- Reduce the amount of pesticide that is delivered to the target area
- Reduce pest control

Spray drift is airborne movement of spray or particles away from a treatment site <u>during</u> a pesticide application.

Spray drift is affected by:

- Size of the droplets
- Weather
- Set-up of application equipment

Spray droplet size is important in pesticide drift. Smaller droplets are more likely to drift. The factors that decrease droplet size include:

- High air temperature
- Low humidity
- Poor nozzle selection
- High application pressure

Weather also plays a role in off-target movement of pesticides. The higher the wind speed, the more likely an applied pesticide will drift. Stable air or atmospheric inversions occur when wind is calm and the air temperature at ground level is lower than that of the air above it. This can cause spray droplets to stay in the air. When the wind picks up, the droplets can then move with the air from the target. This is a factor if pesticides are to be applied using aircraft.

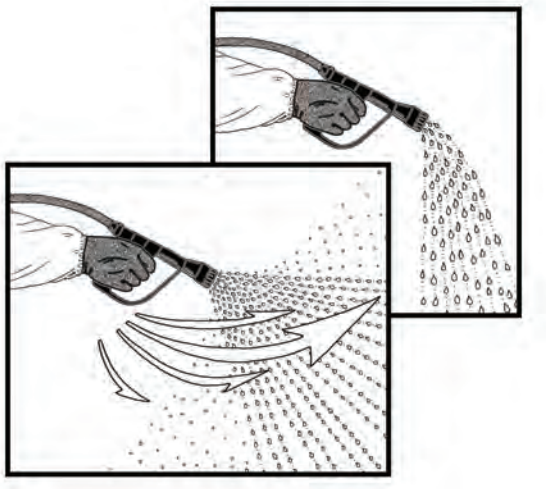


Figure 6-3: Higher pressure makes smaller droplets. These droplets are more likely to drift.

Application equipment plays a role in pesticide drift. The greater the distance between the nozzle and target, the greater the chance of drift.

To reduce spray drift, pesticide applicators should:

- Avoid using high spray pressures. These can cause small droplets, depending on the type of nozzle being used.
- Avoid applying pesticides when winds are high enough to blow spray droplets from the target area. Follow wind speed guidelines on the pesticide label or as required by provincial law. Observe the lower of the two when both are present.
- Select nozzle types to produce droplet sizes that are just small enough to give good coverage.
- Decrease the distance between nozzles and the target.
- Add adjuvants to the spray tank to decrease drift.
- Consider using a granular pesticide if you need to apply pesticides in windy areas.

Runoff

Runoff refers to the movement of water down a slope. The risk of environmental contamination or damage from runoff increases if water contains pesticide residues. Pesticides can be mixed (dissolved) in water or bound (adsorbed) to soil particles that move with the water.

The amount of pesticide in runoff is affected by its formulation, concentration, and solubility.

The extent of runoff depends on:

- Surface slope
- Texture and type of surface
- Adsorptive ability of the soil
- Moisture in the surface material
- Amount of added moisture (rainfall, irrigation, etc.)
- Type and amount of surface vegetation and root development

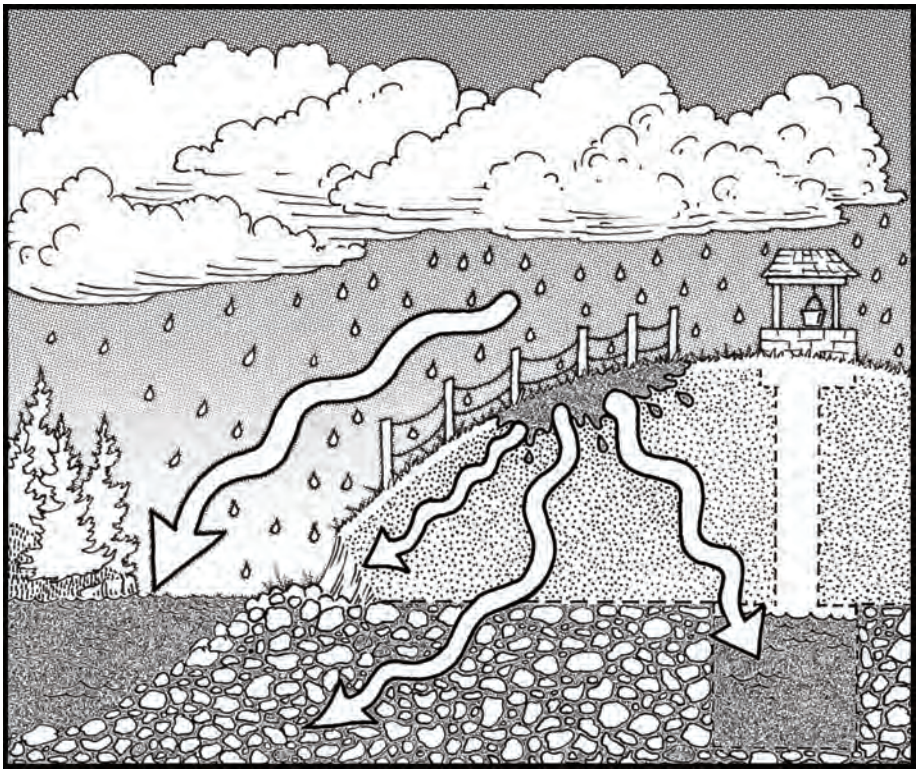


Figure 6-4: Runoff is affected by a number of factors, for example slope, soil texture, and rainfall.

Runoff from pesticide treated areas or areas where a pesticide spill has occurred can pollute streams, rivers, ponds and lakes. Pesticide residues in surface water can harm aquatic plants and animals, and make water unfit for human use. This can cause serious long-term damage **(See Prevention of Water Contamination)**. To reduce runoff, pesticide applicators should:

- Respect provincial laws or guidelines related to soil erosion control.
- Select adjuvants (if needed), so that the pesticide will better adhere to plants.
- Quickly incorporate the pesticide into the soil (if required).
- Respect weather conditions. If rain is expected, delay application.
- Avoid pesticide applications on highly sloped lands.

Leaching

Leaching refers to the movement of pesticides (or other chemicals) with water through the soil. Leaching can occur downward, upward, or sideways. Preservatives can leach from treated wood. Leaching is not good because it can move pesticides away from the target. This results in a waste of pesticides, poor pest control, and can contaminate or damage other sites.

Leaching occurs when:

- Pesticide solubility increases
- The soil has a low water holding capacity (gravel or sandy texture)
- Adsorption of the pesticide to soil is low or desorption is high
- Water is added (rain or irrigation)
- The soil becomes coarse

To reduce leaching and groundwater contamination:

- Use alternatives to chemical pesticides
- Use as low an application rate as the pesticide label allows
- Use a pesticide that readily adsorbs to soil and does not leach
- Do not irrigate for at least 24 hours after application
- Do not apply pesticides within 24 hours of expected precipitation

Degradation

The breakdown of pesticides into other compounds is known as degradation. Degradation of the active ingredient can occur through microbial activity, chemical activity, or photo-degradation. The rate of pesticide breakdown is referred to as its half-life. The half-life for a pesticide is determined by measuring the amount of time it takes for the initial concentration to degrade by one-half in the environment. The longer a pesticide takes to break down, the longer its half-life or persistence. Pesticides that do not readily break down are referred to as being persistent in the environment.

Pesticides can be grouped on the basis of half-life. A "typical soil half-life" value is an estimate and can vary because persistence depends on the site, soil, and climate. Pesticides that persist in the environment can pose a high risk since they have

more time to accumulate in plant or animal tissues. Sometimes, the degradation products can be more toxic than the original pesticide.

Some processes of degradation can have both good and bad effects. Generally pesticides should be less persistent in the environment; however, some pesticides can be broken down so quickly that the pest control effectiveness is greatly reduced.

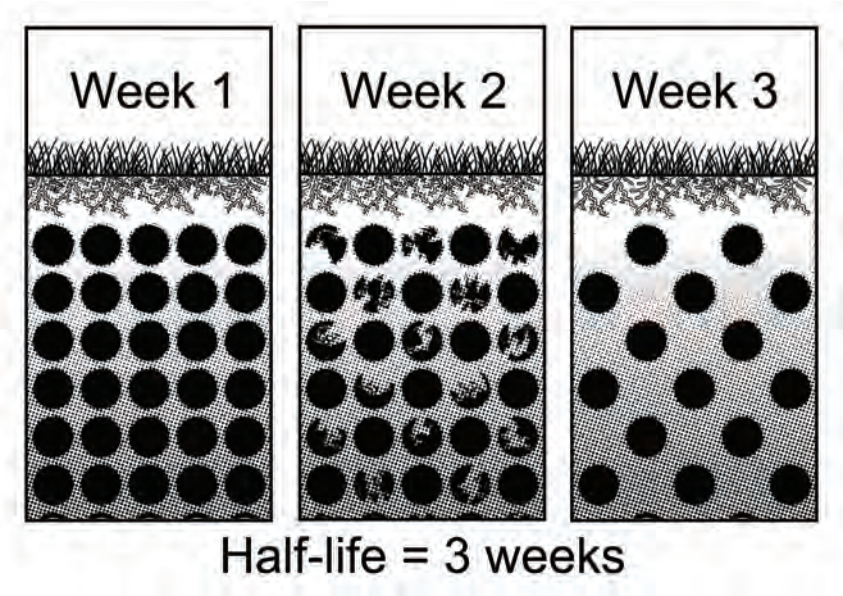


Figure 6-5: The rate of pesticide breakdown is referred to as half-life.

Microbial Degradation

Microbial degradation is the most common form of breakdown. This refers to the use of a pesticide as an energy or food source by soil microorganisms.

Microbial breakdown is affected by:

- Temperature
- pH
- Soil moisture
- Presence or absence of oxygen
- Soil fertility
- Chemical/physical properties of the pesticide

Chemical Degradation

Chemical degradation refers to the breakdown of pesticides by chemical reactions. This occurs between the pesticide and other materials in the soil, such as water. This type of degradation usually changes the pesticide into less harmful components. The rate of chemical reaction depends on:

- Temperature
- pH
- Soil moisture
- Pesticide qualities or properties

Photodegradation

Photodegradation refers to the breakdown of pesticides by sunlight into simpler parts. Pesticides that photodegrade quickly must often be incorporated into the soil to provide effective pest control.

Contamination Sources

When an area is contaminated, the pesticide source is classed as point source or non-point source. Point source contamination occurs when a large amount of pesticide is released in a small area (e.g., accidental spill, pesticide fire, or poor disposal). Non-point source contamination occurs when a pesticide is first applied over a large area and later moves to a non-target area.

In Review

Pesticides can go through a number of processes once they have been released into the environment. When they are applied, pesticides can act in unexpected ways and greatly affect the environment. Pesticides can:

Become bound to the soil (adsorption)

- **Move from target site (runoff)**
- **Evaporate (vapour drift)**
- **Break down (degradation)**

Events like these determine whether a pesticide stays where it has been applied or causes contamination of the environment.

Aquatic Impact of Pesticides

Pesticides can contaminate both surface and groundwater. When water is contaminated, it can become toxic to humans, wildlife (on land and water), domestic animals, or plants (including sensitive crops).

Surface water is water that you can see, such as ditches, streams, ponds, rivers, lakes and oceans. **Ground water** is found below the surface of the earth, in zones of rock, sand, or gravel saturated with water. These zones are called **aquifers**. The **Water table** is the level below which all the space between soil particles is filled with water. The water table can vary in depth. In Atlantic Canada, much of the water used by humans and livestock comes from groundwater. Once an aquifer has been contaminated, it can remain so for a long time.

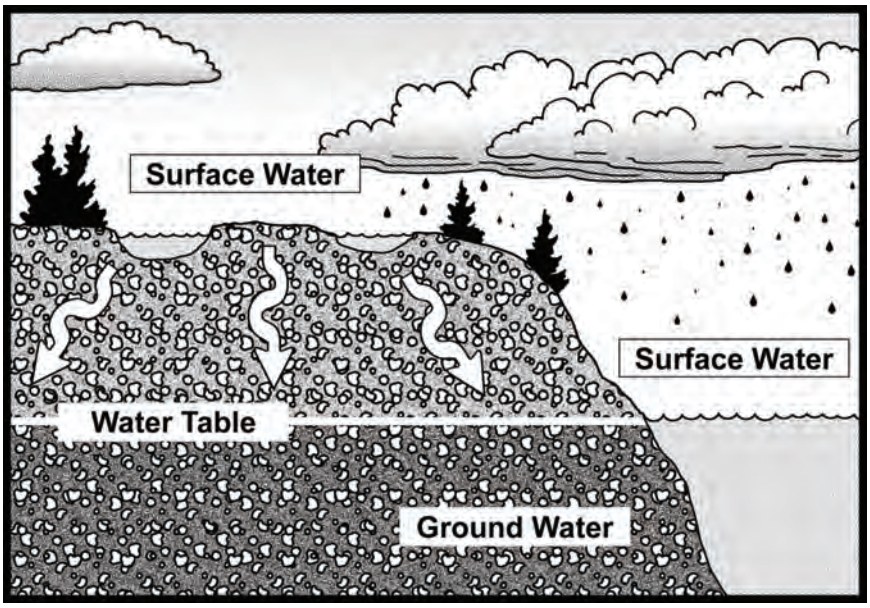


Figure 6-6: Surface water is water you can see while ground water is below the surface of the earth.

Pesticides can enter surface or groundwater due to:

- Natural processes (runoff, leaching, and erosion of soil that has adsorbed pesticides).

- Poor cleanup of spills during mixing, loading, or transporting.
- Poor disposal of excess spray mix, unwanted pesticides, or rinsate from empty containers.
- Poor handling or application of pesticides resulting in:
    - Spray drift
    - Vapour drift
    - Application rates above the label rate
- Poor handling or application of pesticides including:
    - Failure to clean up spills
    - Back-siphoning of pesticides from the spray tank to the water source
    - Overflow of the spray tank during filling
    - Careless washing of spray equipment

Prevention of Water Contamination

When surface water is contaminated, any animal or plant living in or using the water can be affected. These include humans, domestic animals, wildlife, beneficial insects, and plants. Contamination can affect them directly (by contact or drinking), or indirectly (by impacting food supplies or recreational activities). It is very expensive, sometimes impossible, to decontaminate surface or groundwater. It is best to make every effort to prevent contamination.

The best solution to water contamination is prevention.

To prevent water contamination:

- Never apply pesticides near a body of water. Leave a buffer zone (an area not treated) next to a water body. Follow label buffer statements or provincial laws regarding aquatic setbacks or buffers.

- Apply pesticides using label guidelines.
- Make sure that sprayers are calibrated and all equipment is maintained.
- Spray only in proper environmental conditions.
- Never wash application equipment close to a well, lake, river, or other water body. Wash water can contaminate.
- Prevent back siphoning of tank contents when filling spray application equipment. Tank contents can flow back through the filler hose into the water supply. This will cause direct water contamination. Prevent contamination of the original water source from backflow by:
    - Filling the sprayer away from water bodies
    - Using a nurse tank
    - Keeping the end of the filler hose above the water level in the spray tank at all times
    - Using an anti-backflow device (e.g., spring-loaded check valve) when taking water directly from a source

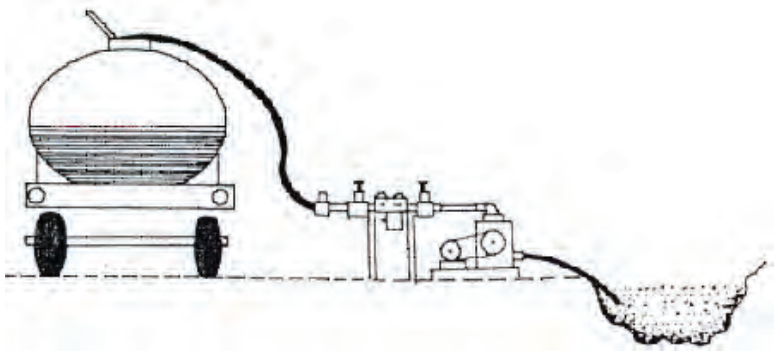


Figure 6-7: Anti-backflow device.

Impact of Water Contamination on Fish and Aquatic Organisms

Pesticides that contaminate water can harm the aquatic ecosystem (fish, insect larvae, and plant life). Most pesticides will harm aquatic communities. Take great care near water bodies. Check the pesticide label for warnings that the pesticide is toxic to fish.

Some pesticides are more toxic to aquatic life than they are to humans and land animals.

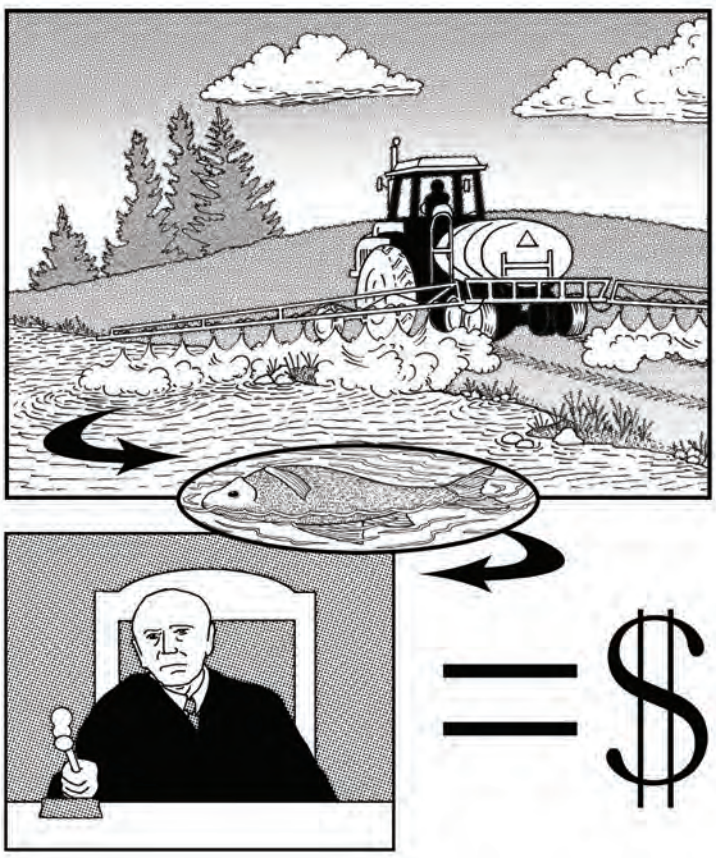


Figure 6-8: Those who damage fish or fish habitat using pesticides may be prosecuted under provincial law or the federal *Fisheries Act*.

Aquatic life can be **directly** harmed or killed if pesticides get into water. This happens through:

- Spray or vapour drift
- Runoff
- Soil erosion
- Leaching
- Improper release of pesticides (e.g., spills or over-spray)

Aquatic life can be harmed **indirectly** when low-level pesticide contamination:

- Kills food organisms
- Removes water or streamside plants
- Disrupts mating or feeding

Pesticide applicators can help prevent contamination of water and destruction of aquatic food sources by:

- Applying pesticides safely.
- Reading the label and using the correct pesticide application rate.
- Avoiding the use of pesticides that are highly toxic to fish, near water or shallow aquifers.
- Keeping buffer zones (as directed by provincial laws or label warnings) when mixing, loading, or applying pesticides.
- Showing care and restraint when using pesticides near fish habitat or areas that drain into fish habitat.
- Avoiding pesticides that:
    - Tend to leach to shallow aquifers
    - Have high runoff potential
    - Have high aquatic toxicity

Impact of Water Contamination on Other Forms of Life

Pesticide contaminated water can affect all life. It can harm humans, domestic animals, wildlife, or plants. Any animal that drinks contaminated water can be affected. Sometimes birds and mammals may not be affected, but can transfer pesticide residues to offspring. These offspring may die or suffer long-term damage.

In Review

Pesticide contamination of surface or groundwater can have a major impact on aquatic life, humans, and animals. Toxic impacts include direct effects on organisms or indirect effects on the food supply, habitat, or mating. When surface water is contaminated, it is always expensive, and often impossible, to decontaminate. The best way to reduce the chance of contamination is to prevent it. Following safety measures when transporting, loading, mixing, or applying pesticides can prevent contamination.

Terrestrial Impact of Pesticides

Pesticide use can impact many aspects of the land environment. This includes animals, beneficial insects, plants, soil and air.

Soil Contamination

There are many ways that pesticides can contaminate soil. These include:

- Spills during mixing and loading
- Overflow from application equipment
- Poor container or pesticide disposal
- Exceeding the proper application rate

Soil contamination can:

- Damage or leave residues in plants
- Harm soil bacteria and earthworms
- Contaminate drinking and irrigation water

Pesticide spills are affected by soil textures. A spill on sandy or coarse-textured soils can leach and lead to contamination of groundwater. Pesticide spilled on clay or fine-textured soils can remain on the surface. This is likely to move away over time through surface runoff.

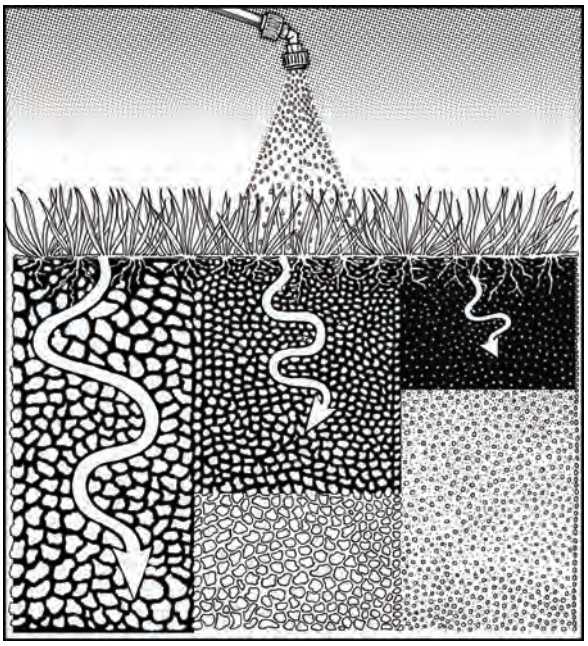


Figure 6-9: Pesticides can move through sandy soil faster than clay soil.

Reduce the chance of soil contamination by:

- Following all label directions and precautions
- Complying with federal and provincial laws
- Using care when mixing and loading (e.g., not overfilling equipment)
- Reducing pesticide drift
- Disposing of excess pesticide mixtures and empty containers
- Cleaning up all spills at once

Air Contamination

Air can be contaminated by pesticide as spray droplets, mists, dusts, or vapours. Once in the air, pesticides can move to water bodies, non-target organisms, nearby crops, or soil. This can cause direct or indirect damage. Vapours from a herbicide application can drift to a sensitive crop hundreds of metres downwind. This can leave residues or cause phytotoxic effects. Contaminated air can also concentrate in enclosed spaces (like a greenhouse) and harm applicators, crop workers, customers, or non-target organisms.

Air contamination can be reduced by using safety guidelines designed to control pesticide drift**. (See Chapter 8: Application Technology.)**

Animals (wildlife, birds, domestic animals, and other land animals)

When directly or indirectly exposed to toxic pesticides, animals can suffer:

- Adverse affects (e.g., weight loss, reproductive failure)
- Long-term damage
- Death

Animals can be harmed **directly** by exposure during application (contact or inhalation). They can suffer **indirectly** by contacting contaminated:

- Water
- Vegetation (e.g., brushing against it)
- Soil
- Food (e.g., treated seed, poisoned animals, or contaminated vegetation)

Animal and bird populations can be harmed through:

- Destruction of wildlife habitat
- Contamination of nests, dens, or burrows
- Destruction of food supply

Pesticides in animal tissues can make them unfit for humans to eat. Because of their generally higher toxicity to mammals, insecticides and rodenticides tend to be more poisonous to wildlife than other forms of pesticides.

Pesticide applicators can help protect animals from ill effects of pesticide exposure by:

- Respecting wildlife
- Reading and following all pesticide label information
- Following safety guidelines described in this manual
- Using pesticides only when needed
- Selecting less toxic and less persistent pesticides
- Using target-specific pesticides to reduce the impact on other organisms
- Knowing the effects that granular pesticides and treated seed can have on wildlife
- Ensuring that pesticides are properly used and stored
- Removing poisoned rodents in a proper manner (These can cause secondary poisonings of pets or other animals.)
- Avoiding pesticides that are likely to move away from the area of application through drift or runoff
- Leaving buffer zones around sensitive areas

Beneficial Insects

Pollinators (bees), insect predators, and decomposers are beneficial insects. People need them to perform many useful functions such as:

- Pollinating fruit trees
- Controlling nuisance insects (e.g., aphids)
- Breaking down waste vegetation

Beneficial insects are a major part of the natural ecosystem. Many insects are a benefit to Integrated Pest Management (IPM) programs. They help to control insect pest populations. Some growers buy beneficial insects solely for this purpose. Applicators must understand that beneficial insects can also be killed when pesticides are used to control insects. If the natural population of beneficial insects is decreased, the natural balance may be upset. Insect pests may quickly increase in numbers.

Applicators can protect beneficial insects by:

- Minimizing pesticide use
- Choosing pesticides that are least harmful to beneficial insects
- Leaving edges of treatment areas untreated to provide shelters for insect predators
- Reducing spray and vapour drift onto areas with beneficial insects

Pollinators such as bees are a special group of beneficial insects. Many plants need them in order to survive. Pesticide applicators can protect bees by:

- Telling nearby beekeepers and beekeeper associations when hazardous pesticides are going to be applied outdoors
- Not applying toxic pesticides to blooming crops
- Mowing cover crops and weeds to remove blooms before pesticide applications
- Choosing pesticides that are least harmful to bees
- Timing pesticide applications for when bees are not active (e.g., early morning or late evening)
- Reducing spray or vapour drift

Plants

Pesticides can injure target and non-target plants. Pesticides that damage or injure plants are said to be phytotoxic. Herbicides cause the most damage to non-target plants.

Applicators should refer to warnings on pesticide labels for non-target plant concerns.

Pesticides can affect non-target plants by:

- Drifting
- Runoff
- Leaching from treated areas or mixing, disposal, or storage sites

Applicators can protect non-target plants by preventing the movement of pesticides onto non-target areas.

Damage to streamside vegetation can affect bank stability and remove a food source and shelter area for wildlife. Loss of shade plants next to watercourses can increase water temperature and cause a loss of fish food. Increased water temperature may cause stress to fish, or result in their death. Damage to non-target vegetation can harm wildlife by affecting food sources or habitat.

In Review

Pesticide use can impact many parts of the land environment. This includes animals, beneficial insects, plants, soil and air. When using pest control products, applicators must respect and care for all aspects of the natural environment.

Contamination of soil and air by pesticides can be reduced by:

- **Complying with label directions and provincial laws**
- **Mixing and loading the pesticide with care**
- **Reducing drift**

Pesticides can directly or indirectly affect plants through:

- **Drift**
- **Runoff**
- **Leaching from treated areas, or mixing, disposal, or storage sites**

Animals can suffer adverse affects from direct exposure during a pesticide application. They can suffer indirectly when they consume or contact contaminated water, vegetation, soil, or food. Beneficial insects such as pollinators, insect predators, and decomposers can be killed, or their habitats affected, by exposure to pesticides.

Summary

Misuse or improper application of pesticides can contaminate or damage many parts of the natural environment. To reduce the risk of a pesticide, applicators must know how pesticides behave in the environment. They must know how, once released, pesticides can act to damage soil, water, air, plants and wildlife. When pesticides are applied, they can behave in a number of ways. Pesticides can be adsorbed, desorbed, or volatilized. They can also drift, run-off, degrade, or leach. This can harm non-target aspects of the environment.

Pesticide contamination of surface or groundwater can have a major impact on aquatic life. This can include:

- **Direct toxic effects on organisms**
- **Indirect effects on food supply, habitat, feeding, or mating**

Prevention is key to reduce the chance of contamination. Care must be taken to prevent pesticide from getting into waterways during transport, loading, mixing, or application.

Pesticide spray or vapour drift can contaminate the air and make it poisonous to humans, wildlife, and plants. A pesticide applicator who pays attention to weather and wind conditions can reduce the risk of air contamination.

Plants, beneficial insects, and wildlife can also be harmed by pesticides when they:

- **Drift**
- **Runoff**
- **Leach from treated areas or mixing, disposal, or storage sites**
- **Contaminate water, vegetation, soil, or food**

Following label recommendations, precautions, and buffer zones can reduce the chance of pesticides harming vital parts of the natural environment.

Self-test Questions

Answers are located in Appendix A of this manual.

1. Adsorption is the binding of chemicals to soil or other materials. List three (3) other processes that affect pesticides once they are released into the environment. Define each.

2. Explain how pesticides can contaminate water.

3. List three (3) ways to reduce contamination of watercourses and protect aquatic life.

4. List four (4) ways that pesticides can contaminate soil.

_____

_____

_____

_____

5. List four (4) ways of keeping animals from being harmed by pesticides.

_____

_____

_____

_____

6. What can happen if streamside vegetation is damaged?

_____

_____

_____

7. Which of the following is **False?**

   a. Aquatic organisms can be harmed <u>indirectly</u> when low-level contamination kills food organisms, removes aquatic or streamside vegetation, or disrupts mating or feeding.

   b. Once the pesticide is in the air, it can move to water bodies, non-target organisms, nearby crops, or soil.

   c. Non-point source contamination occurs when a large amount of pesticide is released in a small area (e.g., spill, pesticide fire, or poor disposal).

d. When surface water is contaminated, any animal or plant living in the water or using it can be affected.

8. Spray drift is the movement of vapours from the area of application. **True or False**?

9. The smaller the droplets, the more likely they are to drift. **True or False**?

10. To reduce the likelihood of spray drift, applicators should select nozzle types that produce small droplets. **True or False**?

Chapter 7

INTEGRATED PEST MANAGEMENT

The goal of pest management is to manage pests effectively, economically, and safely. Insects, weeds, plant diseases, slugs, birds, and mammal pests can be managed using Integrated Pest Management (IPM). With IPM, you only need to reduce pest numbers below a damaging level. It is not necessary to eliminate all pests.

The IPM approach was first developed for agricultural pests. Since the 1980s, it has been successfully applied to:

- Landscape pests
- Forestry pests
- Structural pests
- Home and garden pests
- Agricultural pests

IPM helps decrease the need for chemical pesticides. This reduces costs and environmental risks.

Learning Objectives

Completing this chapter will help you to:

- **Define Integrated Pest Management and describe the parts of an IPM program.**
- **Know why correct identification and knowledge of pest biology is crucial when managing pests.**
- **Know the role of monitoring in pest management and give examples of common methods.**

Learning Objectives, cont'd.

- **Describe injury and action thresholds and know the difference between them.**
- **Describe five categories of pest treatments and give examples.**
- **Know the factors to consider when choosing pest treatments.**
- **Know the importance of evaluating pest management results.**

Principles of Integrated Pest Management

IPM is a decision-making process that helps to prevent pest problems. With IPM programs, all information and treatment methods are considered in order to manage pests. This should be effective, affordable, and safe for the environment. Elements of any IPM program include:

1. **Prevention**: Organisms are kept from becoming problems by planning and managing ecosystems.

2. **Identification**: Pests and beneficial organisms are identified.

3. **Monitoring**: Pest and beneficial organism's populations are watched, as well as pest damage, and the environment.

4. **Injury and Action Decision**: Injury and action thresholds are used to know when to treat pests.

5. **Treatments**: Treatments (or a combination) are used, including cultural, biological, physical, mechanical, behavioural, or chemical methods. The goal is to control pests with little impact on the environment.

6. **Evaluation**: The effectiveness of pest management plans are considered.

Advantages of IPM include:

- Long-term answers to pest problems
- Protecting environmental and human health by reducing pesticide use
- Reducing harm to beneficial organisms
- Preventing creation of pesticide resistant pests
- Providing a way to manage pests when pesticides cannot be used

Elements of an IPM Program

Prevention

Prevention is a key step in IPM. IPM prevents problems by changing the way crops, ornamentals, buildings, or other sites are managed. Avoiding pests is often cheaper and gives better results in the long run. Waiting until problems occur can create a reliance on treatments. Preventing pest problems protects plants with no treatment cost. If prevention does not eliminate pests, their numbers are at least lower. This makes them easier to control.

Cultural or physical controls (described later) can be considered preventive. You might choose disease resistant plant species to avoid some disease problems. Sanitation is a big part of prevention. An example would be cleaning a warehouse to deny food and water to rodents.

Identification

Not all plant damage or decline is caused by a pest. Crops, ornamentals, lawns, and other plants can be damaged by extreme heat, cold, or wind. They can also be damaged by physical injuries from equipment, lack of nutrients, human activity, or pet urine. Many types of pest damage look the same, but controls for individual pests can vary. You must know what the problem is before choosing a treatment. When a pest is identified, you must find information on its biology and life cycle.

To plan an IPM program, find out:

- When pests will be present
- What they eat
- Where they hide
- The stages of life that are easiest to control
- What natural enemies exist

Figure 7-1: It is important to identify beneficial insects.

Beneficial organisms (e.g., insects) are often mistaken for pests when found on damaged plants. They are actually there to prey on the pests that cause damage. You must be able to recognize beneficial organisms before deciding if treatments are required. For example, if enough lady beetles are present in aphid colonies, a pesticide may not be needed to control the aphids.

Understanding the biology of pests and beneficial organisms can help in making pest management decisions:

- Knowing the life cycle and growth stages of a pest allows you to target treatments to times when the pest is most exposed. This is important if the treatment only works for a short time, or during certain stages of the pest's life.

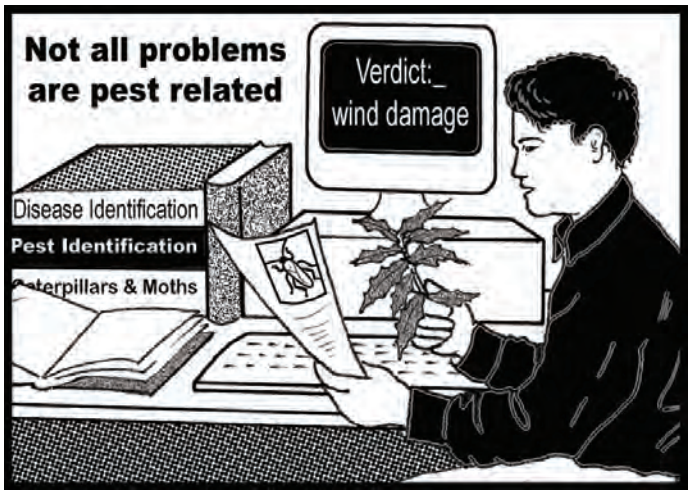
- Knowing the rate of reproduction for a pest can help when choosing the time and number of treatments. Pest species that have only one generation a year tend to grow more slowly than species with many generations each season.

- Knowing the rate of reproduction for beneficial organisms helps in deciding if the beneficial organisms will be able to control the pest population naturally, or if a different treatment will be needed. Some species have one generation per year. Others have many.

- Understanding pest behavior can help in choosing the time and place of treatment. Some pests are only active at certain times of the day or in certain places. Knowing this allows you to target pest management efforts.

Identify Pests and Beneficial Species

Applicators can learn to identify common weeds, insects, vertebrate pests, and plant diseases. It is ideal to have a sample of the pest, to make sure that it is identified correctly. This may not always be possible. Some pests (e.g., plant diseases) are often identified by the damage or symptoms they cause.



If a pest cannot be identified you can seek the help of someone with more experience, or a professional.

Some provinces have government or private diagnostic laboratory services to identify pests. This usually involves a fee.

Figure 7-2: Not all plant damage is caused by a pest.

Identification and biology of pests and beneficial organisms can be learned from:

- Identification guides, reference books, and government or scientific publications
- Government or private pest monitoring services
- Representatives or technicians from pest management or pesticide companies
- Government pest management specialists
- Universities and colleges
- The Internet and other electronic resources

Monitoring

Crops, ornamentals, buildings or other sites can be checked, or monitored, for the presence of pests. Monitoring gives the information needed to make sound decisions on managing pests. Regular monitoring makes it possible to tell where pests are, the size of the population, and if it is increasing or decreasing. This helps when deciding whether treatments are needed, and the most effective time and place.

A pest-monitoring program consists of:

- A series of regular inspections and counts, or estimates, of the size of the pest population
- Written records of observations and the counts found during each inspection

Monitoring can be as simple as keeping regular notes of monthly visual inspections. It can be as complex as performing detailed, weekly count in which the size of the pest population is estimated.

It is important to do a good job when monitoring pests. A good monitoring program can reduce the need for pest treatments and save money. It may also provide early warning that problems are beginning. The earlier the problems are found, the easier they are to address.

Monitoring can be used to:

- Tell if pests are present and in what numbers
- Find pest damage or symptoms of disease
- Look for weather conditions (temperature or humidity) that favour the development of the pest (including plant diseases)
- Look for the life stages of the pest that are most responsive to treatment
- Tell the growth stage or health of a host plant or animal
- Tell if beneficial organisms are present and in what numbers
- Identify what can be changed to improve the effectiveness of the treatment or prevent future pest problems

There are many types of monitoring methods and tools. Methods include visual inspections and counting and measuring methods.

Visual Inspections

A visual inspection is the most basic way to monitor for pests. Visual inspections are:

- Close and careful examinations to see what pests are present
- Done when and where they are needed
- Recorded in writing

Visual inspections take less time than counts, but the information that is found can be limited. There are no numbers that can be compared from one inspection to the next. The same person should be responsible for doing visual inspections of a site each time. The value of the notes taken during this time depends on the experience and judgment of the monitor.

Visual inspections are useful to:

- Check for the presence of pests or pest damage.
- Check for the presence or absence of beneficial organisms.
- Find large problem sites (e.g., weedy patches or infected crop areas).
- Find conditions that promote pest problems (e.g., entry points for rats in warehouses).
- Check plant health and other site characteristics.

Counting and Measuring Methods

Counting and measuring pest populations provide more detailed information than visual inspections. Counts can be compared from week-to-week or year-to-year. The value of the results does not depend on the judgment of the person doing the monitoring. The monitor needs to be trained in taking samples and doing counts. The compiled information can then be used to make pest management decisions.

Common methods to monitor include counting:

- Insects or damaged areas on samples of plant parts
- Pests found in a measured area (e.g., the number of weeds or insects in a square metre of turf)
- Insects, rodents, or fungus spores caught in traps
- Crop insect pests caught in sweep nets
- Pests knocked into beating traps from tapping tree trunks or limbs
- Days or hours with weather conditions that favour plant disease

Counting is useful to:

- Estimate the size and spread of a pest population
- Compare records between sites or dates
- Establish injury levels and action thresholds
- Evaluate the effect of treatments on pest populations

Sampling Theory

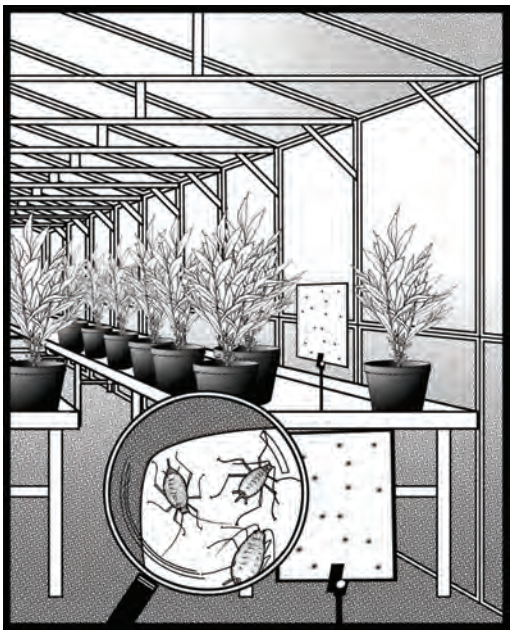


Figure 7-3: The counting of pests is a common sampling procedure.

Counting methods often involve taking samples (e.g., using sticky traps in a greenhouse and counting the number of pest insects found on them, or selecting measured areas of turf and counting the number and types of weeds present). The goal is to take enough samples to get a good estimate of pest numbers in the whole area. Estimate quality depends on **sample size** and **sample randomness**.

SAMPLE SIZE

The greater the number of samples counted, the more likely it is that the results will give a good estimate. Ten to fifty samples are often required. There is a limit to how many samples can be taken. Before monitoring, you must decide how many samples are needed for accuracy.

To determine the number of samples needed:

1. Take 10 samples. Count the number of pests (or signs of damage, or beneficial organisms, etc.). Add up the total and divide by 10 to get the average.

2. Take 40 samples, count the same way, and calculate the average.

3. Compare the two averages. If they are within 10–20% of one another, it is likely that taking 10 samples will be enough. This shows that the results did not change that much when more samples were taken.

4. If there is a large difference (greater than 20%) between the two averages, it means that 10 samples are not enough. Try the average of 15, 20, or more samples until a number is found that gives a result similar to that of 40 samples.

This method of estimation is more useful in situations (e.g., landscapes) where a rough estimate of a pest population will do. It may not be accurate enough to monitor some crop pests. In that case, injury and action thresholds may need to be determined. (See Ch. 7: Injury and Action Thresholds).

SAMPLE RANDOMNESS

It is necessary to take random samples. This ensures that results reflect the entire site and are not influenced by the person doing the sampling. Random sampling means picking samples by chance. You do not look first and decide which samples to collect. Random sampling is just as important as getting enough samples. This allows a more accurate estimate of the pest situation. If samples are not random, the pest situation can appear better or worse than it really is.

A sampling plan is used to ensure that samples are random. Decide on a sample plan ahead of time and stick to it. Sampling plans include:

- Laying a grid pattern on a map and choosing where samples will be taken on the grid
- Taking samples at points that have been planned in advance (e.g., every fifth plant in a row) or at one-metre intervals along a line drawn between two points

A visual inspection is not random. It is focused on places where pests are most likely to be. This does not reflect the whole pest situation. It is not possible to compare counts from non-random sampling with those of random sampling. The same methods must be used each time to compare results.

Frequency of Monitoring

The way in which you monitor should depend on the pest and type of site. Monitoring for insects is often done weekly. It should be done during a time when damage is expected. Weeds in turf might be counted only once or twice a year. Checks for fungal diseases on plants may be needed every few days during warm, humid weather. If records are kept, the information can be used in the future to pinpoint the best time to look for specific pests. This keeps costs down by not monitoring when pests are not likely to be present.

Injury and Action Thresholds

With IPM, a few pests can be tolerated. It is only necessary to take action when pest numbers reach a certain level. This level is called a threshold.

Injury Threshold

The injury threshold is the level at which pest numbers are high enough to cause unacceptable injury or damage. The injury level is the maximum number of pests that can be tolerated.

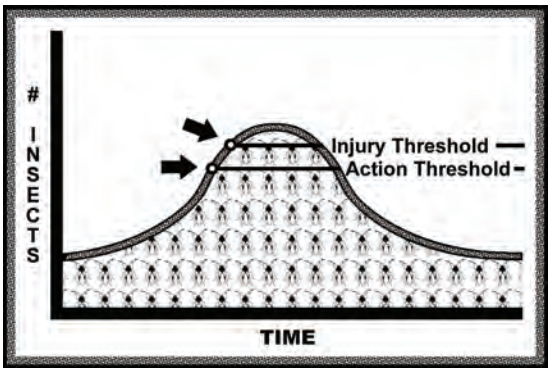


Figure 7-4: Action and injury thresholds.

Action Threshold

The action threshold is the point at which treatment should take place to prevent the pest population from reaching injury threshold. The action threshold will differ with the type of treatment. It depends on how the treatment works.

For pesticides that act quickly, the action threshold might be just before a pest population reaches the injury threshold level. For slower treatments such as the use of biological controls, the action threshold should occur earlier when pest numbers are lower. The action threshold can also be determined for a time when most of the pests are in a treatable stage (e.g., larval stage for insects).

With aphids, for example, the action threshold for bringing in aphid predators (biological control) would be when the aphid population is low. This is because predators need time to reproduce and control the aphids. The action threshold for chemical control using a pesticide would occur when the aphid population is higher. A pesticide acts immediately, and a larger population of aphids can be controlled more quickly than if a biological control option was chosen.

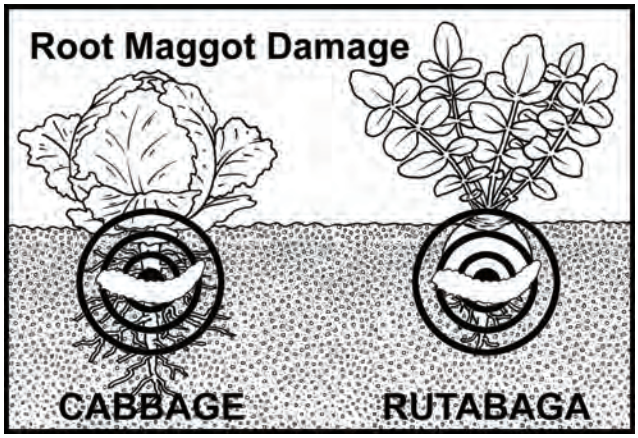


Figure 7-5: Thresholds may be different for some pests based on the type of crop damage it causes. Because the root is the marketable portion of the rutabaga, it has a lower action threshold for cabbage root maggot damage than cabbage, where the root is not marketed.

Injury and action thresholds have been well studied and established for some crops. These take the cost of treatments and crop value (both yield and quality) into account. This is used to determine if the cost of treatment is justified. Few injury thresholds have been established for landscape ornamentals. For these, injury thresholds depend on how easy it is to see the damage. Injury thresholds also depend on how much damage people are willing to accept. For some structural pests, such as rodents in food processing plants, there is no tolerable level of pest population. Injury and action threshold are not as important for these situations as prevention and monitoring.

To help in defining injury and action thresholds, information may be available from:

- Government and scientific texts
- Pest management experts
- Universities or colleges
- Grower organizations

Threshold information may not always be available. It may be necessary to begin by estimating damage based on previous experience or on the expectations of clients or site users. By keeping good records and evaluating the IPM program each year, it is possible to refine and improve thresholds over time.

Treatments

All available information is used in an IPM program to select the best treatments. Two or more treatments are often used together. Most treatments fall into one of the following groups:

- Cultural
- Mechanical/Physical
- Biological
- Behavioural
- Chemical

Figure 7-6: Customers have a different tolerance level for pests. They are not always willing to accept the treatments that best fit an IPM program.

Cultural Control

Cultural controls disrupt the pest or host life cycle. This makes the environment less suited to support the pest. Some of these treatments are also considered preventive. Cultural controls keep pests from developing or spreading.

Cultural controls include:

- Rotating crops to stop or slow the growth of a pest's population, such as avoid nematodes and soil-borne plant diseases
- Using optimum growing conditions to produce healthy plants
- Using sanitation (for example, alternate hosts for pests can be removed; breeding and overwintering sites can be cleaned up)
- Choosing pest resistant cultivars or species

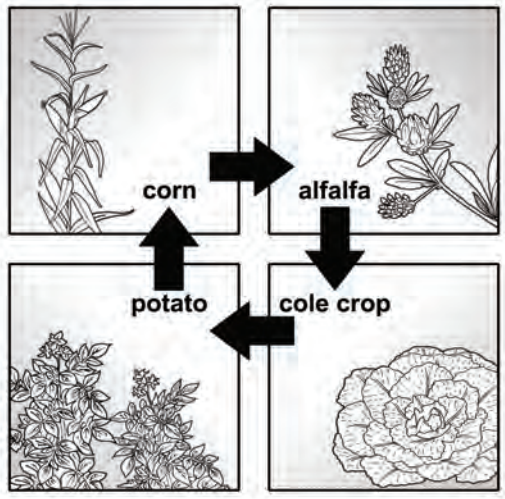


Figure 7-7: Crop rotation over a number of years can reduce pest problems for some or all of the crops being grown.

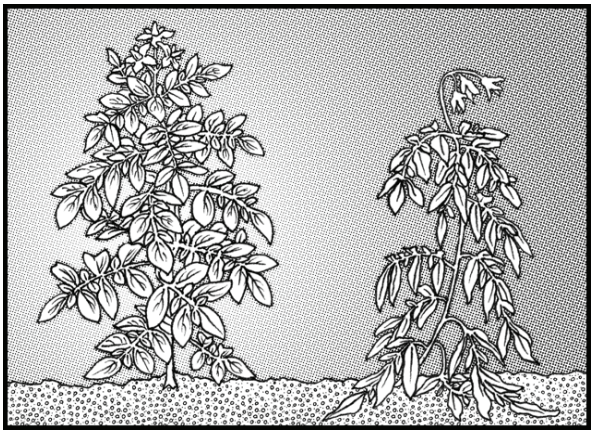


Figure 7-8: Pest resistant and pest susceptible cultivars. On the left a potato plant that is resistant to the disease affecting the potato plant on the right.

Mechanical/Physical Control

Figure 7-9: Agricultural tilling kills weeds either in a crop or before a crop is planted.

Although some textbooks may separate physical and mechanical controls, there are many similarities. These treatments use equipment, devices, barriers, or extreme temperatures to reduce pests. Mechanical/physical controls include:

- Mechanical cultivation of soil to kill weeds or over-wintering insects
- Mowers and brushing equipment for plant control
- Traps for insects, rodents, molluscs, or other pests
- Screens, plants collars, netting, or other barriers
- Vacuum equipment for pests in field crops or buildings
- Freezers to control pests in stored products
- Flame, hot water, or infrared light for weed control
- Noisemakers or other pest-repelling devices

Biological Control

Biological control involves the use of a living natural enemy of a pest. Some are sold commercially for release in large numbers. Beneficial insects are used to control pests in greenhouse vegetables and outdoor crops. There are many kinds of organisms used as biological controls. These include disease organisms, mites, birds, and animals.

Biological controls include:

- Releasing predatory or parasitic insects to attack insect or weed pests
- Conserving natural predators and parasites

- Using grazing animals to control weeds
- Using disease organisms to control insects or weeds

Figure 7-10: The cinnabar moth is used to control tansy ragwort, a weed in pastures, rangelands, and along roadsides.

Biological controls are registered as pesticides in Canada by the Pest Management Regulatory Agency.

The use of parasite and predator insects (and all biological controls) requires a good understanding of biology. Release must be planned for the right time. Most biological controls are highly perishable, so they need to be handled with care and must be released soon after being received. Most species are effective on one or a few species of pests. They may only provide good control under certain conditions (temperature, humidity, length of day) or on certain crops.

Behavioural Control

For this type of treatment, a pest's natural behaviour is used to suppress the population. Behavioural controls include:

- Releasing insect pheromones. (These are chemicals produced by insects to send signals to others over a large area. Sex pheromones can be used to confuse male insects and disrupt mating.)
- Using pheromones, plant attractants, or other lures to attract pests to traps or toxic baits
- Releasing sterile male insects to prevent pests from reproducing (e.g., codling moth)

Chemical Control

A pesticide is designed to kill, control, repel, attract, or manage pests. Any product that claims to do this is a pesticide under the *Pest Control Products Act* and Regulations. Chemicals that act as plant growth regulators, plant defoliants, or plant desiccants are also pesticides.

Pesticides are grouped by their properties. They can be:

- Selective
- Non-selective
- Residual
- Persistent in the environment
- Quick to break down (non-persistent)

Selective pesticides are toxic to some species, with little or no effect on other species.

Non-selective pesticides are toxic to a range of species. Beneficial organisms and non-target life can be harmed.

Residual pesticides remain effective on a treated surface or area for some time after application.

Persistent pesticides remain active for months or years before breaking down. Some persistent pesticides can build up in animal or plant tissues.

Non-persistent pesticides do not remain active in the environment for more than a year. They often break down into inactive compounds within days or weeks.

Pesticide Resistance

Overuse of some pesticides can result in pest populations that are resistant to them. This is often noticed when the usual application rate or timing of a pesticide fails to provide control.

Resistant pest populations develop when a few individuals survive a pesticide application because of a genetic difference. When these pests reproduce, they pass on resistant genes to their offspring. When the same pesticide is used over and over, it kills the susceptible insects, leaving the resistant insects behind to breed. The entire population is soon made up of pesticide resistant individuals.

When a pesticide application does not work, some applicators may then try maximum label rates. This increased selection pressure can speed up the development of resistance.

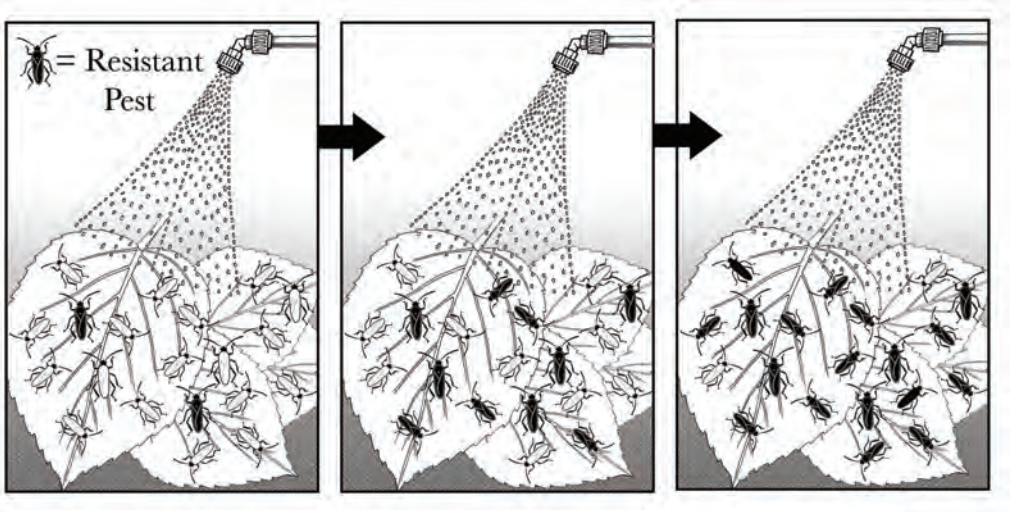


Figure 7-11: Pesticide resistance increases with repeated applications.

A pest population that becomes resistant may not be able to be controlled with pesticides. Pest populations that have developed resistance to one pesticide may also resist other pesticides with similar chemical properties. The use of registered pesticides should be managed to prevent or slow pest resistance. This will allow pesticides to remain effective as pest control agents for a longer time.

Pest populations that have developed resistance to one pesticide may also be resistant to other related pesticides.

Pesticide resistance can be avoided or slowed by:

- Using pest prevention methods when possible
- Using a number of treatments (particularly non-chemical)
- Using pesticides only when monitoring shows they are needed (e.g., waiting until action thresholds have been reached)
- Alternating pesticides from different chemical groups so that no single group of pesticide is used over and over

Environmental Considerations for Treatments

Figure 7-12: Consider all environmental conditions before spraying.

Observing environmental conditions at, or near, a proposed treatment site can help when making decisions. Environmental conditions can affect the safety and effectiveness of a treatment. Wind speed and temperature are important when using chemical (pesticide) treatments. Weather can also affect biological or other non-chemical treatments.

Environmental conditions include:

- **Temperature** - A beneficial organism such as a parasite may require a certain temperature to reproduce quickly and control a pest. Some pesticides lose their effectiveness or break down quickly at extreme temperatures.

- **Relative humidity** - Some plant diseases do not develop when relative humidity is low. Other plant diseases do not develop when relative humidity is high. Some herbicides are less effectiveness when relative humidity is high; others, when it is low.

- **Precipitation** - Rain can reduce pesticide effectiveness by washing it off a treated surface. Wet conditions can increase the effectiveness of parasitic nematodes used to control root pests.

- **Air movement** - Winds can spread pests. They can also carry pesticides or biological control insects away from the application site.

- **Sensitive areas** - A chemical control may not be advised or allowed if there are fish-bearing waters nearby.

- **Topography** - Steep land can discourage the use of some types of application equipment as well as physical or mechanical equipment. Valleys can have wind patterns that interfere with the use of insect pheromones as behavioural controls.

Treatment Selection

The aim of IPM is to prevent unacceptable damage and treatments that are not needed. Choosing the right treatment (or combination) requires some thought. Treatments should only be used if experience and monitoring information shows that pest numbers are likely to increase to the injury threshold.

Always check pesticide labels for precautionary statements on environmental conditions that will affect how a pesticide works. Package labels on biological controls usually have information on conditions that will harm the organisms. Environmental conditions needed for the best effect are also stated.

Applying the same treatment over and over can stop pests from causing damage. However, it:

- Is expensive
- Promotes pesticide resistance
- Harms non-target species
- Can cause environmental damage

To decide if a treatment is wise, benefits must be weighed against costs and potential problems. Information is needed to select the best treatment. This can include:

- Information on the pest's biology, natural enemies, and preferred hosts
- Monitoring records
- Injury and action thresholds
- Local environmental conditions
- Treatment characteristics

Monitoring records are used with injury and action thresholds to determine timing of treatments. Selected treatments should:

- Be less hazardous to humans
- Be less toxic or damaging to non-target life and the environment
- Produce long-term results
- Prove to be cost-effective over time

In an IPM program, it is common to use several treatments together to control pests. Combined treatment methods are often more effective than using only one method. Even if the effect of each method is small, they can add up to adequate control. If a pesticide is to be used, it must be compatible with other treatments. Some less toxic or non-residual pesticides can be used shortly before using biological controls.

Information on pest treatment methods includes:

- Books and periodicals (government and scientific texts, pest management industry journals, and trade magazines)
- Pest management representatives (pest management firms, technicians and industry associations, product suppliers, and pest monitoring service firms)
- Government pest experts
- Universities and colleges
- The Internet and other electronic resources

Keeping Treatment Records

You must keep detailed records of all treatments, including the type of treatments chosen, dates of treatment and weather conditions at the time of the treatment as well as shortly after it. Records should provide a detailed history of pest problems encountered and treatment results.

Records are useful for:

- Evaluating different treatments
- Comparing pesticides
- Fine-tuning equipment settings (e.g. pump pressure, nozzle types and travel speed of application equipment)
- Planning pesticide re-entry times and harvest dates
- Solving problems that come up after treatment (e.g., failed treatments, crop or property damage, and liability issues)
- Planning future treatments

Figure 7-13: Good record keeping is important in any IPM program.

Treatment records for pesticide applications should include the following:

- Applicator's name (license or certificate number, if it applies)
- Date, time, and location of application
- Target pest(s)
- Pesticide (Product name and PCP Act number)
- Rate of application and amount used
- Type of application equipment and settings
- Weather and other conditions that can affect the application
- Preharvest interval (where applicable)
- Environmental effects, problems, or safety issues that arise
- Evaluation of treatment effect

Information on insects, diseases, weeds, and vertebrate pests can be found in specific study manuals.

Evaluation of Pest Management Results

The effectiveness of any IPM program must be evaluated. You should note whether pest management results were achieved, and how the program could be improved.

An IPM program can be evaluated using

- Noting any changes, including preventive actions that can avoid future problem
- Changing injury and action thresholds in light of experience
- Planning for seasonal pest infestations
- Tracking the costs and benefits of a pest management program
- Visual inspections or counts of pests and non-target organisms before and after treatments.
- Post-treatment data versus pre-treatment monitoring records.
- Treatment records (methods, dates, times, rates, costs, etc.).
- Feedback from clients or site users.
- Possible pest management improvements and preventive actions that can be taken.

Communication

Communication is important when developing and putting an IPM program in place. A large amount of information must be taken into account and applied to solve a pest problem.

Local pest experts, government employees, trade associations, and other IPM practitioners work to gather local experience and information.

Workers on farms or workers in businesses involved in pest management must communicate with each other. As well details of the IPM program and its goals should be made clear to these workers. There should also be some method to relay needs and observations to employers or supervisors. Everyone should clearly understand his/her role if an IPM program is to succeed.

Figure 7-14: Communication is important for an effective IPM program.

It is important to pass along IPM information to customers and to promote the benefits of an IPM program to potential or future clients, and the general public.

Clients should know what needs to be done, and why. This will help to address their concerns and promote customer satisfaction.

Summary

Integrated Pest Management (IPM) programs use all available information and treatment methods to manage pest populations. This should be effective, inexpensive, and environmentally sound. IPM is based on the idea that it is often only necessary to keep pest numbers at acceptable levels. The entire population need not be eliminated. An IPM approach improves long-term pest management. Pesticide use and costs are often reduced. IPM includes:

- **Prevention**
- **Identification**
- **Monitoring**
- **Injury and action thresholds**
- **Treatments**
- **Evaluation**

Prevention is the key because it keeps pests from causing problems. This avoids damage and saves money.

Correct identification is needed for choosing proper monitoring and treatment. You must know what the problem is before choosing methods to monitor and treat it.

Monitoring provides information needed to make sound decisions on pest management. This information comes from visual inspections or counting and measuring methods. Regular counts or measurements provide numbers that can be compared over time, regardless of who does the monitoring. Enough random samples must be taken to get a good estimate of the pest population.

In IPM programs, it is often only necessary to act when pest numbers reach a high level (threshold). This involves:

- **The injury threshold - The maximum tolerable pest population**
- **The action threshold - When treatment should take place to prevent the pest population from reaching injury threshold**

Treatments are needed when experience and monitoring results show that pest numbers are likely to reach the injury threshold.

Summary, cont'd.

In an IPM program, two or more treatments can be used in a coordinated approach. Treatments can be grouped as follows:

- **Cultural controls disrupt pest life cycles or make the environment less suited for survival.**
- **Mechanical and physical controls use equipment or devices, barriers, or temperatures to reduce pest populations.**
- **Biological controls are living natural enemies of a pest. These include insects, disease organisms, birds, and other animals.**
- **Behavioural controls use a pest's natural behaviour to suppress the population.**
- **Chemical controls include most pesticides. Active ingredients are naturally derived or synthesized. They are used to kill, attract, repel, or alter the growth of pests.**

Pesticides are often grouped as selective or non-selective. They can be residual, persistent, or quick to break down. A major problem with overuse of pesticides is the development of resistant populations. Careful management of pesticides slows the development of resistance. This allows pesticides to remain effective if needed.

Treatments should be:

- **Least hazardous**
- **Likely to produce long-term results**
- **Cost-effective over time**

Environmental conditions should be taken into account before applying treatments. These can affect safety and effectiveness. Detailed treatment records must be kept. These provide a record of pest problems and treatments. Treatment records can be used to plan improvements and answer questions after treatment.

An IPM program must be evaluated for effectiveness. Ways to prevent pest problems and improve the program should be identified. Communication between all involved in an IPM program is important.

Self-test Questions

Answers are located in Appendix A of this manual.

1. What are the advantages of using an IPM program?

   a. _____

   b. _____

   c. _____

   d. _____

2. Why is prevention key to an IPM program?

   _____

   _____

   _____

3. Monitoring is used in an IPM program to:

   a. Discover if pests are present and in what numbers
   b. Find pest damage or symptoms of disease
   c. Determine if beneficial organisms are present
   d. All of the above
   e. a and b only

4. Explain the difference between injury threshold and action threshold.

   _____

   _____

   _____

5. List five treatments used for pest control. Give one example of each.

_____

_____

_____

_____

_____

6. Why is communication important in an IPM program?

_____

_____

_____

_____

_____

7. A monitoring program should take enough samples to get the most accurate estimate of the pest population. **True or False?**

8. Visual inspections include counting the number of pests on plants. **True or False**?

9. In an IPM program, only one treatment is used for a given pest problem. **True or False**?

References for Further Reading

Books:
Common Sense Pest Control. 1991. W. Olkowski, S. Daar and H. Olkowski. The Taunton Press.715 pp. Bio-Integral Resource Center, P.O. Box 7414, Berkeley, CA 94707 Tel: 510-524-2567 Fax: 510-524-1758 www.birc.org

IPM Journal:
IPM Practitioner. Bio-Integral Resource Center, P.O. Box 7414, Berkeley, CA 94707 Tel: 510-524-2567 Fax: 510-524-1758 www.birc.org

IPM Training:
Nova Scotia Agricultural College, Centre for Continuing and Distance Education, PO Box 550, Truro, NS B2N 5E3 Tel: 902 893-6666 Fax: 902-895-5528 www.nsac.ns.ca/cde/coursedes.htm

Pest Identification and Disease Diagnosis Services:
Wildwood Labs, 53 Blossom Drive, Kentville, Nova Scotia B4N 3Z1 Tel: 902-679-2818 Fax: 902-679-0637 Email: info@wildwoodlabs.com Web: http://www.wildwoodlabs.com

Chapter

8

APPLICATION TECHNOLOGY

First, a pest is identified. Next, the best pest control option is chosen. If that option is to apply a pesticide, then one should be chosen that will have the least impact on human health and the environment. Focus must then be placed on how to properly apply the chosen pesticide. This chapter covers how to choose, calibrate, use and take care of application equipment. Label terms common to application equipment are reviewed. Some aspects of pesticide drift are noted. The need to observe and respect environmental conditions when using pesticides is also dealt with**.**

Learning Objectives

Completing this chapter will help you to:

- **Describe the goals of pesticide application and how to achieve them.**
- **Know the importance of proper application and care of application equipment.**
- **Know where to find information on pesticide application rates and the importance of using them correctly.**
- **Know the importance of calibrating application equipment.**
- **Know the effect of weather on pesticide application.**
- **Describe vapour and spray drift and know how to avoid them.**

The two main goals of pesticide application are:

1. Bringing a pesticide to a target
2. Preventing the contamination of non-target sites

Using the proper application equipment for the target and pest type promotes effective pest control. The proper maintenance and use of equipment ensures that the pesticide is applied as per label directions. Application rates and sprayer outputs given on pesticide labels must be followed. To do this, application equipment must be calibrated.

Application Equipment

Pesticide application equipment is a key element in the transfer of an active ingredient (a.i.) from a storage container to the final target. The target can be an insect, disease organism, or weed. Many types of application equipment are available to apply pesticides. Some types can be used in a wide range of situations. Some are highly specialized and are only used for a few specific pesticides (e.g., equipment used to apply soil fumigants). The most common equipment is designed for use with either liquid or dry pesticides.

The product transfer process for liquid pesticides is as follows:

1. The pesticide is mixed in the spray tank at the recommended label rate.

2. The mixture moves through the nozzles, forming spray droplets.

3. Calibrated equipment (speed, nozzles, and pressure) delivers the active ingredient evenly as droplets to the target.

For solid pesticides, the product is transferred as follows:

1. The pre-mixed granules or dust particles move through openings in the spreader equipment.

2. Calibrated equipment (speed and openings) delivers the active ingredient evenly to the target as granules or dust.

Pesticides must be applied evenly to a given target and at the given label rate. The contamination of non-target sites must also be prevented. To do this, the application equipment must be:

- Appropriate for the job
- Set up with the proper parts
- Calibrated
- Used according to manufacturer specifications
- Maintained
- Designed to minimize applicator exposure during loading and application

Selection of Application Equipment

As stated before, a whole range of equipment has been designed to apply pesticides. To choose the right equipment for a given application, the operator must have a good knowledge of what is available. Only the most efficient equipment should be used. Knowledge is also needed to calibrate and maintain application equipment. Applicators must also know the target pest and treatment area.

To select pesticide application equipment that is suited to the type and size of the job, the applicator must assess:

- The type of application (spray, fog, dust, fumigation, etc.)
- The location (outdoors or indoors)
- The pesticide formulation to be used (liquid, granular, etc.)
- Environmental factors (especially wind and rain)
- The size, shape, and terrain of the site
- The target site or pest
- Time available for application

Components of Application Equipment

Application equipment is usually constructed of a number of components or parts. These work together to apply the pesticide. Each part has a specific function (e.g., holding the pesticide, metering it, or moving it within the system). Applicators must know all of the parts, their purpose, their adjustments, and what is required to maintain them.

Operation of Application Equipment

Applicators must use pesticide application equipment in a safe and proper manner. To do this, they must:

- Know how the equipment works.
- Follow manufacturer instructions.
- Comply with all use instructions on the pesticide label.
- Calibrate equipment for uniformity and rate of application.

Operation of equipment can vary with the type that is used and the nature of the pesticide. The skills required to use a gun sprayer, for example, differ from those needed to operate a granular spreader or air-blast sprayer. Equipment must be used in a way that avoids misapplication, human poisoning, and environmental contamination. Causes of concern include:

- High winds
- Nearby sensitive areas (e.g., fish spawning beds)
- The location of a pest (e.g., in soil or tall trees)
- The presence of bystanders (e.g., children in a schoolyard)

Use of Appropriate Label Rates

The 'Directions for Use' section is found on the secondary panel of a pesticide label **(See Chapter 3: Labeling)**. This provides the applicator with information on the amount of pesticide to use on a given pest or application site.

The label shows the amount of formulated pesticide that is to be applied per area or volume (the recommended pesticide application rate). For formulations that are to be diluted, the label also states the amount of diluent or carrier that is to be applied per area or volume (the recommended sprayer output). The wording used to describe pesticide application rate and sprayer output varies from one pesticide label to another.

Pesticide labels can also provide a range of pesticide application rates and sprayer outputs. This is done so that the applicator can choose the best rate for the situation. For example, if the pest pressure is light, the lowest recommended rate should be used. If the pest pressure is heavy, or if soil or weather conditions, or the pest's life cycle

make it more difficult to control the pest, the applicator would choose a higher application rate. Pest management specialists are available to give advice to applicators on how to choose the best pesticide application rate. As well, one can consult a licensed pesticide vendor, or the pesticide manufacturer, to determine which rate would be best in a given situation.

Pesticide application rate can be stated on the label using terms such as:

- **Application rate**
- **Rate**
- **Dose**
- **Dosage**

Sprayer output can be stated using terms such as:

- **Application rate**
- **Spray volume required**
- **Volume**
- **Apply in**
- **Add to use**

Equipment Calibration

Calibration is the setting and adjusting of the proper output for the application equipment. Calibrated equipment delivers the required amount of pesticide to the treatment area in an accurate and uniform pattern. Output of the sprayer is referred to as 'calibrated sprayer output'. To ensure that application equipment is delivering the proper amount of pesticide, it should be calibrated before use.

Figure 8-1: Keep travel speed constant to ensure an even product distribution.

There are many procedures for calibrating equipment. To determine which to use for a specific type of application equipment, refer to its operating manual.

Calibration must be correct and suited to the type of application equipment being used. Poor calibration can result in an improper rate of application or non-uniform distribution of pesticide. The result may be crop/plant damage or poor pest control.

Over-application of pesticides:

- Is an unnecessary use of pesticide
- Drives up costs
- Can contaminate human food, livestock feed and crops with residues
- Increases the risk of applicator or bystander exposure
- Increases the risk of harm to the environment

It is against the law to use pesticides in excess of label rates.

Under-application of a pesticide can result in failure to control the target pests. A re-treatment of the area may be required. This costs time and money. Under-application can also help to create pesticide-resistant pests.

Maintenance of Application Equipment

Application equipment will only work well if it is well maintained. Good maintenance guards against:

- Loss of pesticide to the surrounding area
- Damage to nearby plants or animals
- Contamination of air or water

Application equipment in good working order:

- Ensures that the calibrated application rate is achieved at all times
- Prevents breakdowns that can result in exposure to people, or costly downtime
- Prevents contamination of the environment
- Increases the lifespan of equipment

A proper equipment maintenance program should include daily cleaning and checking of hoses, hose connectors, hopper or spray tanks, pumps, and all moving parts. Damaged or worn parts should be replaced or serviced immediately. Equipment should also receive a complete check and overhaul at the start and end of each application season.

In Review

The two main goals of pesticide application are:

1. **Bringing a pesticide to a target**
2. **Preventing the contamination of non-target sites**

Using the proper application equipment for the target and pest type promotes effective pest control. The proper maintenance and use of equipment ensures that the pesticide is applied as per label direction. Application rates and sprayer outputs given on pesticide labels must be followed. To do this, application equipment must be calibrated.

Environmental Conditions and Pesticide Drift

Weather can affect the pattern of pesticide placement or the effectiveness of the active ingredient(s). This includes air movement or wind patterns, relative humidity, and temperature. Applicators must take present and forecasted weather into account before applying any pesticide. Sometimes either the application equipment or the operation can be changed to adapt to less than ideal weather. Sometimes, an application must be delayed until better conditions exist.

High wind speeds or air temperatures increase the chance of a pesticide moving from the application site to off-target areas. This is referred to as pesticide drift. Off-target pesticides can harm people, wildlife, beneficial organisms, and nearby plants and crops. To avoid this, maximum wind speeds or temperatures may be stated on the pesticide label or governed under provincial law.

Types of Pesticide Drift

Vapour Drift

Vapour drift occurs when a pesticide evaporates or turns from a solid or a liquid into a gas. These vapours can then move away from the treatment area. Vapour drift can also occur when a fumigant is not properly sealed under cover.

Vapour drift occurs when pesticide vapours move away from the target site during or after application.

To reduce vapour drift, applicators should:

- Select a less volatile pesticide formulation (e.g., select a formulation that does not easily go from a solid or a liquid into a gas).

- Refrain from using pesticides when weather conditions promote excessive evaporation or volatilization (e.g., high temperatures and wind speeds or low relative humidity).
- Seal an area being fumigated. This will contain the fumigant or any volatile pesticide.
- Do not apply pesticides during atmospheric, or temperature, inversions.

A temperature inversion occurs when the layers of air closest to the earth are colder than those above it. The air does not rise and mix with the warmer air and a stagnant air mass is created. Pesticide vapours can remain trapped in this air mass, close to the earth, for longer than normal periods.

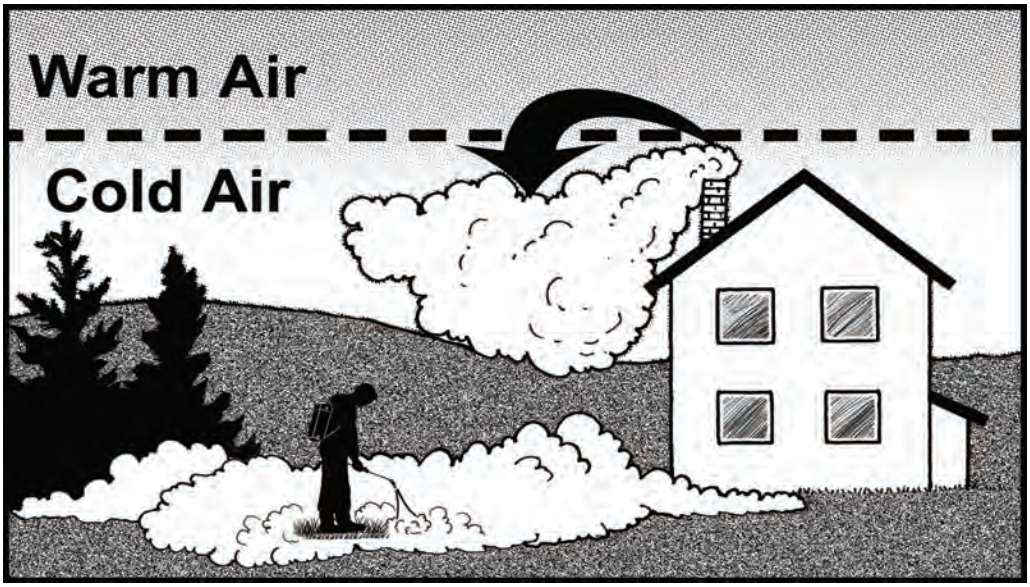


Figure 8-2: Temperature inversion.

Spray Drift

Spray drift occurs when pesticide droplets or particles move away from the treatment site during an application. The smaller the droplets generated, the more likely they are to drift.

Figure 8-3: Spray drift during application *(top photo).* Vapour drift after application *(bottom photo)*.

To reduce spray drift, pesticides should only be applied under certain weather conditions. You should avoid:

- High winds
- Unstable weather
- Very hot weather
- Low relative humidity
- Atmospheric, or temperature, inversions

Application equipment can also be set to reduce fine droplets by:

- Reducing pressure at the nozzle
- Reducing the distance between the nozzle and the crop
- Aiming nozzles to reduce wind shear
- Reducing the travel speed of the sprayer

Some product labels also advise that drift control agents be added to the pesticide mixture.

In Review

Environmental conditions such as high winds, low relative humidity, and high air temperature may prevent the uniform distribution of pesticides over a treatment area. Some weather factors can cause drift of pesticide vapours (vapour drift) or fine spray droplets (spray drift) over short or long distances. When a pesticide moves from a target area, it can damage the environment.

Summary

Pesticide application equipment is designed to apply the pesticide:

- **Uniformly to a desired target**
- **At a specified rate**
- **Without contaminating non-target areas**

It is necessary for applicators to choose the right equipment for the job. They must also have a good understanding of how it works. Equipment must be calibrated, well maintained, and properly operated. To avoid pesticide drift, weather conditions must be taken into account when applying any pest control product.

Self-test Questions

Answers are located in Appendix A of this manual.

1. List three (3) reasons why it is important to correctly use and maintain pesticide application equipment.

2. Why is the calibration of application equipment important?

3. Where would you look to find information on how to calibrate a sprayer?

4. List three weather conditions that could affect pesticide application.

5. Describe vapour drift and give three ways to prevent it.

Chapter 9

EMERGENCY RESPONSE

Accidents are unplanned and they can happen even when proper care is taken. Spills, equipment failures, or fires can occur when handling, moving, storing, or applying pesticides. Serious harm to human health, livestock, wildlife, or the environment can result.

Accidents are often sudden and without warning. Correct and timely response to an accident with pesticides is crucial. This is often the key to reducing the extent of injury or damage. Steps can be taken to prepare a response to accidents or emergencies. These include:

- Knowing all areas of risk
- Knowing how to respond to different types of accidents
- Taking necessary steps to reduce risk
- Making and using emergency response plans and kits

Learning Objectives

Completing this chapter will help you to:

- **Know why pesticide spills are a hazard.**
- **Know how to prepare and safely respond to pesticide spills.**
- **Know the importance of a well-equipped decontamination kit and what it should contain.**
- **Understand why fires involving pesticides are hazards and know how to prepare for, respond to, and prevent them.**

Learning Objectives, cont'd.

- **Know how to reduce the theft of pesticides and what to do if product is stolen.**
- **Know first aid steps.**
- **Know what items should be in an emergency response kit and their use.**
- **Know the function of an Emergency Response Plan and which emergencies to prepare for.**
- **Understand why any accident should be reviewed.**
- **Know the kinds of emergencies that can occur.**

Pesticide Spills

Pesticide spills can poison people, animals, or plants. A spill can also directly or indirectly contaminate soil, surface water, ground water, or food/feed. The cleanup costs from a pesticide spill can be very high. Spill prevention and a plan to respond are a must. Certain actions can decrease the chance of a pesticide spill. Planning and preparing a proper response for minor and major spills can reduce damage.

Preparing for an Accidental Pesticide Spill

Pesticide spills are never planned. The risk of an accidental spill is always present when a pesticide is being handled. Key preventative actions can reduce the damage, and the cost of cleanup can be reduced. A plan of action will better prepare pesticide applicators to respond to a spill. The plan should include the following:

- Know the hazards of any pesticide used and what to do should a spill occur.

- Have knowledge of provincial laws on proper spill response, notification, and disposal.

- Keep emergency phone numbers handy. These should include:

    - The local environmental emergencies number
    - Police
    - Fire department
    - Ambulance
    - Poison control centre
    - Doctor
    - Canutec[1] (613-996-6666)

- Have near the telephone the label or MSDS information on 24-hr emergency phone numbers and procedures for first aid, cleanup, decontamination, or disposal.

- Have proper personal protective equipment (PPE) and cleanup equipment in a spill response kit.

Human Safety Concerns

Human safety is the most important concern when a spill occurs. Safety concerns must extend to those who might be contaminated directly, and indirectly during the containment and cleanup process. Following basic guidelines will reduce the hazard to human health when responding to a pesticide spill. Basic safety guidelines are as follows:

- Always wear proper PPE before going into a contaminated area or handling someone who has been exposed to a spilled pesticide.

- Evacuate the spill area and remove all contaminated clothing. Wash contaminated skin with soap and water to prevent further exposure. Provide first aid if needed, and get medical help at once.

- Control access to the spill area by keeping people and animals away.

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[1] Canutec can provide information for major transportation spills.

- Cover liquid spills with absorbent material. Keep them from moving off site. Check pesticide MSDSs for instructions on containment including the use of earth (or other materials) to contain a spill and prevent it from entering storm drains, wells, water systems, and waterways.

- Do not smoke, eat, or drink during cleanup. Wash thoroughly after cleanup activity.

- Open all windows and doors. Turn on the electric ventilation system if the spill is in a confined space or storage area.

Certain pesticides are very flammable. Use an electric ventilation system ONLY if it is explosion-proof.

Spill Response Procedures

Risk to humans can be reduced by a quick and orderly response to a spill. This can also reduce damage to the environment by minimizing the area of contamination. This will reduce the cost of cleanup and decontamination. Always respond to a spill in this order:

1. Put on proper PPE before going into a contaminated area or handling someone exposed to a spilled pesticide.

2. Attend to any victims.

3. Try to contain or reduce the spill.

4. Clean up the spill.

5. Decontaminate the site.

Clean up pesticides only after putting on the proper PPE and attending to any victims.

Sometimes the process for dealing with a pesticide spill is given on the pesticide label or MSDS. If this is not provided, use the following as a guide for cleaning up small and large spills.

Cleanup of a Small Spill

Less than 20 L or 20 kg of concentrated product or less than 200 L of pesticide mix

These steps should be taken when cleaning up a small amount of spilled liquid or dry pesticide:

1. Contain or reduce further spillage.
2. Put down absorbent material such as activated charcoal, peat moss or 'kitty litter'. Commercial absorbents for soaking up liquids are also available. Dampen a dry substance very slightly with a little water.
3. Sweep or shovel contaminated soil and absorbent material into a container (drum) lined with a heavy-duty plastic bag.
4. Seal and label the container. Record on the container the pesticide's product name, the P.C.P. Act Registration Number, approximate amount of pesticide, and date of accident.
5. Contact a provincial pesticide regulatory body for proper disposal procedures.
6. Decontaminate the spill area (as will be discussed later) or consult the product MSDS or manufacturer for directions to neutralize any residues that remain.

Never use large amounts of water to wash down a pesticide spill. The contaminated water may move off site and contaminate a wider area, nearby surface water or groundwater.

Clean up spilled pesticide only after putting on the proper PPE and attending to any victims.

Cleanup of a Large Spill

More than 20 L or 20 kg of concentrated product or more than 200 L of pesticide mix

A spill of more than 20 L or 20 kg of concentrated pesticide can occur if containers are damaged. This can result from a vehicle accident while transporting pesticide or moving a pesticide in storage. A spill of more than 200L of pesticide mix can also occur as the result of a malfunction or accident with the application equipment.

When cleaning up a large amount of spilled liquid or dry pesticide:

1. Contain large spills of liquid to a storage confinement area by building an earthen dam. This keeps pesticide from getting into water supplies and drainage systems. Keep the containment area small. Pump large spills into drums.

2. Put down absorbent material such as activated charcoal, peat moss or 'kitty litter'. Commercial absorbents for soaking up liquids are also available.

3. Sweep or shovel contaminated soil and absorbent material into a container lined with a heavy-duty plastic bag. The container should have a tight lid.

4. Seal and label the container. Record on the container the pesticide's product name, PCP Act Registration Number, approximate amount of pesticide, and date of accident.

5. Arrange for disposal by a licensed, hazardous waste handling company.

6. If required, notify a provincial pesticide regulatory body of the spill and the steps taken to clean it up.

7. Decontaminate the spill area. Follow the required steps (as will be discussed later) or consult the product MSDS or manufacturer for directions to neutralize any remaining residues.

Contact a provincial pesticide regulatory body for help if a pesticide spill is likely to cause harm to the environment, affect the safety of the area, or damage property, livestock, or people.

Decontamination of the Spill Area

Spilled pesticide can be hard to remove if it has dried. In some cases, bleach or lime placed on the area after cleanup will help break down any pesticide that remains. Use only small amounts of bleach or lime, and only when they are called for on the pesticide label.

If a spill occurs on soil, remove any soil that appears contaminated. Depending on the pesticide, residue that remains in the soil may have to be neutralized. Consult a provincial pesticide regulatory body, the pesticide MSDS, or manufacturer to receive information on decontamination of pesticide-saturated soil.

Never wash down a pesticide spill with large amounts of water. The pesticide / water mix may leach into the soil and contaminate groundwater.

Decontamination of Cleanup Equipment and Personal Protective Equipment

Spilled pesticide and other contaminated materials must be safely placed in containers. Cleanup equipment, such as shovels, brooms, etc. must be washed and decontaminated. To decontaminate cleanup equipment:

1. Put on proper PPE.
2. Wash any shovels, brooms, and equipment used to clean up the spill. The wash water or residue should be added to the material in the drums if practical.
3. Wash any contaminated PPE before taking it off.
4. Remove clothing and equipment **(See Chapter 5: Pesticide Safety**). Always wear gloves when removing and washing PPE.

5. Gloves are the last piece of PPE to be removed. Wash gloves before taking them off.

6. Wash your hands and face with soap and water.

Personal Hygiene

Shower and change immediately if clothing becomes heavily contaminated during cleanup of a spilled pesticide. Do not wait to finish the cleanup.

After cleanup, wash your hands and face with warm soapy water. Do this before eating, drinking, smoking, or changing into regular clothing. Take a full shower as soon as possible.

If any person involved in the spill or cleanup begins to feel sick (e.g., nausea, headache, etc.), take him/her to the nearest hospital at once. Take along:

- A clean pesticide label (if possible)
- The PCP Act Registration Number (on the front panel of the label)
- All medical treatment information on the label or MSDS

Medical personnel can use the PCP Act Registration Number to get treatment information, if needed.

Spill Response Kit

A fully equipped spill response and decontamination kit should be kept on hand when storing, moving, or handling pesticides. Proper PPE, nearby in a spill response kit, will reduce the risk to human health. This also allows quick and safe containment and cleanup. Quick response to a pesticide spill can reduce contamination to soil, surface water, groundwater or the environment. The smaller the area contaminated, the lower the cost of cleanup. The spill response kit should be labelled, checked regularly, and stored in a safe place with easy access in case of an emergency.

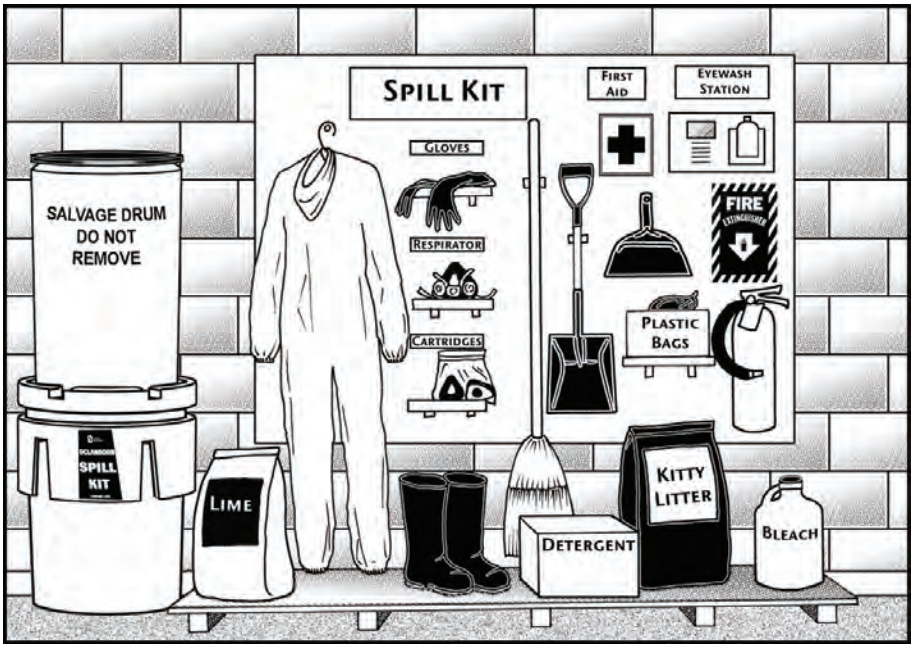

Figure 9-1: Keep spill response materials readily available.

A spill response kit should contain:

- A box of heavy-duty detergent
- Sufficient absorbent material to clean up any size liquid spill
- Sodium hypochlorite (laundry bleach)
- Hydrated lime (do not mix bleach and lime)
- A square-mouthed aluminum shovel or spade
- Yard brooms
- Drums with tight-fitting lids
- Heavy plastic bags
- Cartridge type respirators (keep cartridges in a sealed bag)
- Safety goggles
- Unlined chemical resistant gloves and boots
- Coveralls

The most important step to take after a pesticide spill is to protect yourself. You are no help in an emergency if you become a victim of poisoning.

In Review

A pesticide spill can occur at any time and place. Those who handle or apply pesticides must be prepared to deal safely and quickly with small and large spills. A quick and safe response can reduce the extent of a spill and reduce risk to humans and the environment. A response plan for dealing with spills should be prepared. A fully equipped spill response kit should be positioned where spills might occur.

In case of a pesticide spill:

1. **Protect yourself. Never enter an area where pesticides have been spilled without proper personal protective equipment.**
2. **Attend to any victims.**
3. **Contain the spill. Never flush the spill area with large amounts of water. This can move off-site and cause further environmental contamination.**
4. **Clean up the spill. Place all pesticide and contaminated material into a container with a sealed lid and the contents listed.**
5. **Contact the provincial pesticide regulatory body for safe disposal.**
6. **Decontaminate the site.**

Pesticide Fires

Fires involving pesticides are extreme hazards. Some pesticides are flammable. Some are explosive. All pesticides are likely to produce highly toxic fumes when burned. These fumes may be harmful to people (including firefighters), animals, or plants. Runoff water from fighting a fire is likely to contain pesticide residue. This may contaminate soil, sewers, streams, lakes, wells, or other water sources.

Fire Prevention

Pesticides are hazardous materials. Many pest control products contain oil or highly flammable petroleum solvents. When pesticides are involved in a fire, damage can result from fumes, runoff water, or direct contact. Because of the potential harm of pesticide fires, steps should be taken to reduce or prevent them. Prevention is the cheapest way to reduce the potential risk and cost of a pesticide fire.

To prevent a pesticide fire, or reduce the effects if one occurs in a storage area:

1. Store pesticides away from other buildings and homes.
2. Secure doors and windows to prevent unwanted access.
3. Ensure that the storage structure adheres to the National Fire Code, National Building Code, National Electrical Code, provincial laws, municipal by-laws, etc.
4. Post signs on all storage entrances to show that pesticides are present.
5. Install fire and smoke detectors in the storage area.
6. Do not use open flames for welding, burning, cutting, or heating in the pesticide storage site.
7. Keep a fire extinguisher near the storage area.
8. Inform the local fire department as to the exact location and estimated quantity of pesticide stored.

9. Keep a list of stored pesticides in an easy to reach location away from the storage area.

10. Keep emergency phone numbers handy.

11. Develop a plan in the event of a fire.

Developing a Contingency Action Plan

A plan of action is key in being prepared to deal with a fire. This can be quickly acted on once a fire is reported. A plan of action saves time and lives. **This plan should be prepared in advance, rehearsed, and updated (at least yearly).** A good plan should include the following:

1. Call the fire department at once. Have the number posted for quick response.

2. Make sure all workers are accounted for. The plan should give a location for all to meet. Firefighters will want to know if all are accounted for. This will allow them to know if they need to rescue, or just fight the fire.

3. Keep people and animals away and upwind. This will keep them from being exposed to toxic fumes, runoff, or explosions.

4. When firefighters arrive, tell them if all personnel are accounted for. Remind them that pesticides are stored in the building.
5. Tell firefighters what pesticides are involved.

6. Tell firefighters of any well or water source that may become contaminated.

7. Report any fire with pesticides to the provincial pesticide regulatory body.

In Review

A fire with pesticides can be sudden and unexpected. The fire and contamination may affect human health and the environment. This can also be expensive to clean up. The cheapest way to deal with pesticide fires is to prevent them. Those who handle or apply pesticides should know what fire hazards exist. They should do all they can to reduce the chance of a fire.

Fires will still occur. Applicators need to be ready to immediately respond with a good plan of action. This will save time, and reduce harm to humans and the environment.

Pesticide Theft and Vandalism

Keep pesticides secure and contained during transport and storage to reduce theft and vandalism. Theft can be costly. Vandalism can cause human or environmental contamination. A pesticide owner or applicator may be subject to legal action if stolen pesticides harm human health or the environment. If pesticides are vandalized or stolen, call the police at once so they can put it on record. Also, report the incident to the provincial pesticide regulatory body.

First Aid

First aid is the means to help stabilize a sick or injured person until medical help arrives. First aid can prevent further injury and save lives. First aid is only a first response. It cannot take the place of medical help. Always call for medical help right away.

A quick and proper response to a poisoning is crucial. To provide first aid, employers, workers, and family members should know:

- Where to find a list of emergency phone numbers
- Signs and symptoms of poisoning for the pesticides being handled
- The first aid treatment for pesticide poisoning for the pesticides being handled
- Where the pesticide application is taking place and what time the applicator should return
- Where to find a first aid kit

First Aid Kit

An emergency first aid kit should be kept where it can be easily accessed. Kit contents should be based on:

- The number of people working on site
- The type of work
- The location of the work

Table 9-1 lists the contents of a first aid kit for responding to pesticide accidents or poisonings. This kit should be kept **near** an application or pesticide storage area.

Table 9-1: Contents of a first aid kit

ITEM	*PURPOSE*
Clean water	Drinking, washing skin, or flushing the eyes
Soap	Washing pesticide off skin
Chemical impermeable gloves	Protecting person administering first aid
Cup or glass	For drinking
Face mask with one way valve	Protecting person giving mouth to mouth resuscitation
Bandages	Preventing pesticides entering wounds
Blanket	Covering patient and minimizing the risk of shock
Emergency phone numbers	To get help
Paper towel	Cleaning
Plastic bag	Collecting vomit for later analysis by the medical personnel if required
Syrup of ipecac	Inducing vomiting. **This is only to be administered upon instruction of a poison control centre or doctor, and only if the patient is alert**
Activated charcoal	Absorbing pesticide in stomach. This is only to be administered upon instruction of a poison control centre or doctor, and only if the patient is alert

General Procedures for any Pesticide Poisoning

When handling patients who have been poisoned by pesticides:

1. Call a doctor or poison control centre if the patient is unconscious, heavily contaminated, or appears to have swallowed a pesticide.

2. Put on proper personal protective equipment and assess any hazards.

3. Remove the patient from any contamination. **(Note: NEVER move a person if spinal cord injury is suspected.)**

4. Confirm that the patient is breathing. If not, give artificial respiration if you are trained to do so. Wear a facemask with a one-way valve to prevent pesticide exposure from the patient's mouth.

5. Cardiopulmonary resuscitation (CPR) may be needed if the victim has no pulse. **Administer CPR ONLY if you are trained to do so**.

6. Keep the patient quiet, warm, comfortable, and reassured to minimize shock.

7. If the patient is conscious and breathing, place him/her on their side. The head should be lower than the rest of the body and turned to one side (in case of vomiting). This is the recovery position.

8. If the patient is not conscious, keep the chin pulled forward and head back to allow breathing. (An unconscious patient should never be transported flat on their back.)

9. Wait for medical help.

General First Aid

If the patient is having a seizure or convulsion, lay him/her down in a safe area. Do not try to restrain.

A person can be exposed to pesticides in four different ways:

1. Exposure to the lungs (respiratory exposure)
2. Exposure to the eyes (ocular exposure)
3. Exposure to the skin (dermal exposure)
4. Exposure through eating or drinking (oral exposure)

Responses to respiratory exposure, ocular exposure, dermal exposure, and oral exposure are noted below.

Treatment for Respiratory Exposure

Pesticide vapours and fine droplets can be inhaled into the lungs. This can cause respiratory exposure. If this occurs, act quickly and:

1. Put on proper personal protective equipment. Assess any hazards.
2. Move the patient to fresh air. Loosen any tight clothing.
3. If qualified, apply first aid to treat the patient's symptoms until help arrives. Place a blanket beneath the patient's shoulder. Tilt the head back with chin forward to promote breathing.
4. Minimize the onset of shock by keeping the patient quiet and preventing chilling or overheating.
5. Call for medical assistance.

Treatment for Exposure to the Eyes (Ocular Exposure)

Pesticides may splash into the eyes during mixing and loading, or during application. It can then be quickly absorbed into the bloodstream and cause poisoning. Some pesticides are also very corrosive. These can cause short and long-term eye damage. Pesticide label information will provide a warning if the pesticide is corrosive. Always wear proper eye protection when handling or using pesticides.

Treat pesticide contamination of the eyes as follows:

1. Hold the eyelid open and flush with clean running water for 15 minutes or more.
2. Read and follow first aid instructions given on the pesticide label.
3. Call for medical help or take the patient to a hospital.

Treatment for Exposure to the Skin (Dermal Exposure)

The skin (particularly the hands) is the most likely site of pesticide exposure. This can occur at any point in the handling process. It can result from:

- Touching a contaminated container or application equipment
- A splash during mixing and loading
- Brushing against treated vegetation or surfaces during or after an application

In all cases, quick response is required to reduce toxic effects.

Treat pesticide contamination of the skin as follows:

1. Remove the patient's contaminated clothing and footwear at once.

2. Drench the patient's skin with water. Cold water is best. Hot water opens skin pores and increases pesticide absorption.

3. Call for medical help if there is extensive exposure or the patient becomes unconscious.

4. Wash the patient's skin and hair with soap and water. Clean under fingernails and toenails.

5. Give first aid as required until help arrives.

TREATMENT FOR CHEMICAL BURNS

Some pesticides are corrosive. They can cause chemical burns when they contact skin. Care must be taken when handling pesticides that are known or suspected to be corrosive.

Treat skin contamination with a corrosive pesticide as follows:

1. Have the patient enter a shower at once, if available. Remove all contaminated clothing.

2. If no shower is available, remove contaminated clothing and wash the skin with lots of cold running water.

3. Cover any burned area with a loose, wet, clean cloth. **Do not apply anything to the burned area**. Never use salves or ointments on a chemical burn.

4. Call for medical help and give first aid as required.

Treatment for Ingestion of Pesticides (Oral Exposure)

Poisoning due to the ingestion of pesticides often occurs when people store pesticides in something other than original pesticide containers (e.g., soda bottles, cans, coffee mugs, etc.). Another person may accidentally swallow the pesticide and poisoning can result. Quick action is required.

Treat oral ingestion (swallowing) of a pesticide as follows:

1. Call for medical help at once.

2. Read and follow first aid instruction given on the pesticide label.

3. Induce vomiting by giving the patient water and placing him/her in a sitting or standing position. Have him/her gently tickle the back of the throat with a finger or a blunt object.

4. Collect some of the vomitus for medical examination.

5. Provide first aid as required until help arrives.

Induce vomiting only if:

- **The patient is alert**
- **The label tells you to do so**
- **Ordered by the poison control center or medical personnel**

Do not induce vomiting if:

- **The patient is unconscious**
- **The patient is having convulsions**
- **A corrosive pesticide was swallowed**
- **A petroleum-based pesticide was swallowed**

Never give anything by mouth to an unconscious or drowsy patient.

Recording Medical Information

Knowledge of the pesticide involved in an actual or suspected pesticide poisoning can assist medical personnel in their diagnosis and treatment. In the case of a poisoning emergency, provide medical personnel with:

- The name of the pesticide(s) (or active ingredient)
- The PCP Act Registration Number (from the front panel of the pesticide label)
- The type and extent of exposure (ingestion, dermal, etc.)
- Symptoms observed and their sequence
- The length of exposure or amount of pesticide ingested
- The age and weight of the exposed patient
- The medical history of the exposed patient
- The first aid performed

Follow up to an Exposure

Once a patient has been exposed to a pesticide, he/she may become sensitive to other pesticides in the same chemical family. If so, a much milder second exposure may cause poisoning symptoms identical to or worse than the first. Anyone who has been poisoned by a pesticide should have a full medical assessment before resuming normal activities or work. This assessment should be done, even if there is a full recovery after first aid. Family members and other workers should watch the victim(s) for recurring poisoning symptoms.

First aid is not a substitute for professional medical treatment.

In Review

Pesticide poisonings often occur from accidental contact. The best way to reduce the chance of poisoning is to prevent the accident. Still, accidents will happen. Making and practicing plans of action will allow for quick, proper, and safe responses by rescuers.

When a pesticide poisoning occurs, those attending to the patient(s) must be kept safe. A rescue should not occur until all hazards have been assessed. Rescue personnel must put on proper personal protective equipment. Timely first aid can reduce the effects of a pesticide poisoning. Those handling or applying pesticides should know the symptoms of poisoning and first aid practices for the pesticides they are working with. The pesticide label is the most important source of information for first aid.

A first aid kit will allow treatment to be given while waiting for medical help to arrive. When medical help does arrive, they should be given all relevant details and the PCP Act Registration Number of the pesticide(s) involved.

Any pesticide exposure that results in poisoning symptoms should be reported to medical professionals.

Developing an Emergency Response Plan (ERP)

An accident can occur suddenly and without warning. Those who handle or apply pesticides must be prepared to respond to such events. Prepare by making an Emergency Response Plan (ERP). This can be quickly and effectively used if an emergency occurs. The ERP should give instructions to respond to and deal with all pesticide-related emergencies. These include fires, spills, and vandalism. The ERP should also be designed to prevent a simple emergency from turning into a major disaster. The ERP should contain steps to limit the harm to individuals, the community, and the environment.

The first step in making an Emergency Response Plan is to identify any emergency that can happen. The process of making an ERP may prevent some emergencies. People may spot and control hazards before they cause harm. Emergency Response Plans should prepare for:

- Accidents causing injury
- Gas and odour release
- Pesticide spills
- Fires or explosions
- Natural disasters (floods, ice storms)
- Vehicle transport accidents
- Threats (phone calls)

Ensure that the facility and emergency response services are equipped to handle the kinds of emergencies common to the storage, handling, and transport of pesticides. Make sure that all involved in the plan (including new workers) are aware of what is expected of them in carrying out the ERP. Practice with different emergency scenarios will help people come to know the plan. It is good to review the ERP before the start of each use season. Perform a complete update annually. Copies of the plan should be kept off site and available to emergency responders.

Summary

There is always a chance of an emergency when handling or applying pesticides. All who work with pesticides should be prepared to respond to poisonings, accidents, spills, fires, and theft.

There should be a plan with actions to take in case of an emergency. The plan should include information on what to do in case of poisoning or exposure. There should be ready access to safety equipment. Safety equipment should include personal protective equipment, fire extinguishers, and a spill response kit.

Put on the proper personal protective equipment before responding to an accident, and assess the area for danger.

Self–test Questions

Answers are located in Appendix A of this manual.

1. List 7 general phone numbers that should be available for quick response to an emergency.

   _____ _____

   _____ _____

   _____ _____

   _____

2. The first action when cleaning up a pesticide spill is to contain the spilled pesticide. **True or False**?

3. What volume of liquid is considered a small spill?

   _____

4. Why is it wrong to wash down a spill with large amounts of water?

   _____

   _____

5. What should happen if a person involved in the spill or its cleanup begins to feel sick (e.g., nausea, headache, etc.)?

   _____

   _____

   _____

6. Why are fires involving pesticides considered to be extremely hazardous?

_____

_____

7. Fire prevention is important. List 11 actions that can be taken to prevent or reduce the chance of a fire involving pesticides.

_____

_____

_____

_____

_____

8. First aid is meant to stabilize a sick or injured person until medical help arrives. **True or False?**

9. What is the treatment when the eyes are exposed to a pesticide?

_____

_____

_____

10. Which of the following is False?

    a. Do not induce vomiting unless told to do so on the pesticide label or on instruction from the poison control center or other medical personnel. Only do it if the patient is alert.
    b. Small amounts of water may be given to an unconscious or drowsy patient.

c. Do not induce vomiting if the patient is unconscious or having convulsions.
d. Do not induce vomiting if a corrosive material or petroleum-based product was swallowed.

11. Having an emergency response plan (ERP) allows for quick and proper action when pesticides are involved. Why is it important to act quickly?

_____

_____

12. List 7 emergencies for which an ERP should be prepared.

_____

_____

_____

_____

_____

_____

_____

Chapter 10

PROFESSIONALISM

The use of pesticides is often a source of public controversy and anxiety. This is even so when good integrated pest management programs are used. Public opinion is becoming more opposed to pesticide use. This is particularly so in urban areas or areas used by children (e.g., schools, playgrounds, recreation areas). In these areas, even the most careful use of pesticides can stir up conflict of opinions. Applicators now find themselves under increasing scrutiny from the public, clients, and the media. Today's pesticide applicators must do their work in a professional manner. They must also 'appear' to be working as professionals in the eyes of the public.

Learning Objectives

Completing this chapter will help you to:

- **Know why it is important for a pesticide applicator to deal professionally with the public and how to do so.**
- **Know what is needed to have a positive professional image.**
- **Know the importance of public relations to pesticide managers.**

Pest control is becoming a complex industry. There is a call for less toxic pesticides and integrated pest management. The public expects applicators to show skill and professionalism in their work. Pesticide applicators can show their skill and ability by the following factors:

- Professionalism - Showing a professional image
- Knowledge - Having a knowledge of pest management
- Communication - Communicating with the public

- Attitude - Having a good attitude
- Work habits - Working professionally

These factors will be discussed in more detail below.

Professionalism

Public relations are interactions between the applicator and others (bystanders, clients, and other concerned people or groups). Each group has its own interests, concerns, priorities, and perceptions. A professional applicator should listen and consider the concerns of others when conducting pest management.

Good public relations have many benefits. These include:

- Professional credibility
- Improved public trust and confidence
- Enhanced client confidence
- An informed public that is involved, interested, and supportive
- A better knowledge of public concerns that can arise from pest management

Knowledge

Applicators with a good working knowledge of pesticides and their use are able to make good pest management choices. They are also better able to tell others about pesticides they use and their profession. Applicators should know:

- Information required for provincial pesticide applicator certification/licensing
- Public concerns on pesticide use, human health, and the environment
- Where to get good resource material (publications, organizations, etc.)
- Current information on the control of specific pests

- The relations between the pest, the host, and the environment
- The values and risks of the pest and pest control methods
- Related federal, provincial, and municipal laws

Those who work with pesticides must continually upgrade their knowledge. Pest management decisions will then be based on the best available practices. This can be done through government or industry training programs, seminars, or trade shows. You can also study written materials (e.g., training manuals, journals, industry newsletters, etc.). If you are asked a question about a pesticide or pest, do not guess the answer. Obtain the answer, and get back to the person.

Never guess the answer to a question. Find out the correct answer, and get back to the person.

Communication

Effective communication with clients and the public is key to a well-informed community. Without this, vital pest management programs, such those which deal with public health pest problems, may be threatened. Pesticide applicators can better communicate with the public when they:

- Listen to public concerns
- Try to understand conflicting viewpoints
- Involve the public and their clients in decisions that can affect them

- Take part in public forums
- Plan and review communications
- Are honest and cooperative with the public and government
- Speak clearly and sincerely
- Respond to the media
- Avoid poorly chosen or less than honest statements
- Provide the facts

Figure 10-1: Notify neighbors of planned pesticide applications.

Attitude

A positive attitude supports the profession and earns respect from clients, colleagues, and the public. It can also help to reduce fear and discomfort around the use of pesticides. Pesticide applicators can show a positive attitude by doing the following:

- Limit pesticide use. For example, never perform a whole lawn treatment when a spot treatment will do.
- Keep a safe work environment for applicators.
- Show concern for the environment.
- Refuse unsafe work.

- Respond quickly and effectively to requests for information, complaints, concerns, or emergencies.
- Stay within your skill area.
- Make recommendations based on facts.
- Take the concerns of bystanders and neighbours into account.
- Spend time with the client or public to explain the operation.

Work Habits/Activities

An applicator can also demonstrate professionalism through good work habits. This will assure clients and the public that pest control is being performed properly. Good daily work habits include the following:

- Use pesticides responsibly, and follow the pesticide label.
- Notify neighbours or possible bystanders before any pesticide application.
- Do not use pesticides when bystanders are present.
- Use integrated pest management (IPM).
- Use only pesticide application rates as stated on the label.
- Keep a record of each application.
- Avoid applications during unsuitable weather.
- Identify yourself to clients/public verbally, and use signs on vehicles and application equipment.
- Check to be sure it is the correct site for the application (for example, that you are at 123 Birch Street and not 123 Birch Road).

There are many ways to show good work habits. For example, open communication within the business (e.g., supervisors and employees) will demonstrate a sharing of important information.

Schedule daily and weekly preventative maintenance inspections. This will ensure that application equipment is clean and well maintained. Applicators should be familiar with equipment before using it. Equipment/vehicles should be used in a safe and proper manner. Applicators should give thought to ground, weather, and road conditions. They should plan ahead to avoid problems that can arise during the application.

An emergency response plan must be in place to address spills. A spill cleanup kit should be on hand at each operation site. When moving between application sites, equipment and PPE should be cleaned to prevent the spread of pests and pesticide residues. Professional applicators should keep records. They should perform follow up inspections to ensure that treatments have been effective. An applicator must remain visible. Verbally introduce yourself to clients. Use marked vehicles and application equipment. Post all treated areas.

Summary

Because of concerns from the public, clients, and the media, pesticide applicators must work as professionals. This includes:

- **Projecting a professional image**
- **Having knowledge of pest management**
- **Communicating effectively with the public**
- **Having a positive attitude**
- **Acting in a professional manner**

Self-test Questions

Answers are located in Appendix A of this manual.

1. As a pesticide professional, you must consider the interests and concerns of others. **True or false**?

2. List 5 factors that can support professionalism.

   _____

   _____

   _____

   _____

   _____

3. Which of the following is **not** an advantage of conducting yourself as a professional?

   a) Improves credibility and client confidence
   b) Improves public trust
   c) Helps to deal with complaints or problems from pest control work
   d) Improves control of persistent pests

4. As a pesticide applicator, which item of information do you **not** need to know?

   a) Information required for pesticide applicator certification/licensing
   b) Relationship between EPA Registration Number and the PCP Registration Number
   c) The relationship between the pest, host, and the environment
   d) Relative federal, provincial, and municipal laws

5. List nine (9) ways that a pesticide applicator can show a good attitude.

6. List fourteen (14) ways that a pesticide applicator can display good work habits.

_____

_____

_____

7. List eight (8) ways that a pesticide applicator can communicate effectively with the public.

_____

_____

_____

_____

_____

_____

_____

_____

8. An applicator should be concerned about bystanders and neighbours**. True or false**?

9. An emergency response plan is a hallmark of a professional applicator. **True or false**?

APPENDIX A

ANSWERS TO SELF-TEST QUESTIONS

ANSWERS TO SELF-TEST QUESTIONS

Chapter 1: General Information

1. An active ingredient is the part of a formulation that controls the pest.

2. Adjuvant

3. a) Rodents (mice, rats, rabbits)
   b) Fungi
   c) Plants (mostly weeds)

4. a) GR means 'granular'. Granular pesticides are often ready to use. These show little, if any, drift during application.
   b) F means 'flowable'. These seldom clog sprayer nozzles. They are less
   c) PE means 'pellet'. These are easy to handle. They can be used to treat small areas. They will not drift.

5. Two or more pesticides may be "tank mixed" when the labels of each indicate that they can be mixed.

6. A contact herbicide controls weeds by damaging the surface of a plant (often the leaves).

7. Systemic insecticides are absorbed into plants or animals. Insect pests are killed when they chew or suck on the treated plant or animal.

8. **False** Phenoxy herbicides are selective. Grasses and most grain crops are resistant to and not harmed by them.

9. **True**

Chapter 2: Regulations

1. The *Pest Control Products Act* and Regulations (PCP Act)

2. Pesticides are classed as Domestic, Commercial, Restricted, or Manufacturing. Domestic class pesticides are sold in small containers. They are registered for home use. Commercial class pesticides are designed for use in agriculture, forestry, industry, or other commercial outfits. Restricted class pesticides are Commercial class pesticides with limits. Manufacturing class pesticides are used in manufacturing, formulating, or repackaging.

3. **False**

4. The terms 'Agricultural' or 'Industrial' are often used in place of the term 'Commercial' on the label of Commercial class pesticides.

5. MRL stands for the maximum residue limit. This is the maximum amount of pesticide that may be safely contained in food products.

6. **False** Provincial pesticide laws are more specific than the federal *Pest Control Products Act*.

7. **True**

8. **True** The Workplace Hazardous Materials Information System (WHMIS) has been developed to provide employers and employees with information on the safe use, storage, handling, and disposal of <u>all</u> hazardous material used in the workplace. This includes training related to pesticides.

Chapter 3: Labeling

Quiz # 3-1

1. Control Plus brand 70 WP Insecticide
2. 95,000
3. triochemical
4. 70.35%
5. Wettable powder
6. The Pesticide Company
7. 340 grams
8. Commercial or Agricultural
9. Moderately Poisonous

Quiz # 3-2

1. No
2. 500 L/ha
3. 12 days
4. Wheat/Wheat Moth x
   Cranberries/Cranberry Girdler
   Rutabagas/Aphids
   Broccoli/Cabbage/Looper
   Broccoli/Aphids x

Rape Greens/Diamondback Moths
Wheat/Grasshopper x

5. Broccoli 7
Wheat 15
Barley 7

6. Cabbage/Aphids 56-86 grams/ha
Barley/Leafhoppers 80-120 grams/ha
Wheat/Wheat moth 120-240 grams/ha
Barley/Grasshopper 67-240 grams/ha

7. There is no specific antidote.

8. Long sleeved shirt, long pants, and chemical resistant gloves

9. 12 hours

10. No

11. Upon advise of a physician or doctor, drink 1-2 glasses of water & induce vomiting.

12. No

13. 30 meters between the last spray swath and the edge of aquatic systems such as rivers, lakes, ponds, streams and other bodies of water.

Quiz # 3-3 Principle Display Panel

1. 1: C; 2:D; 3:A; and 4:B.
2. Octagon shape
3. **True**
4. **True**

5. Domestic, Commercial (Agricultural or Industrial), Restricted, and Manufacturing

6. **False** Products with "Agricultural" on the principal display panel are classed as Commercial pesticides.

7. **True**

8. (1) By the weight of active ingredient per unit volume
   (2) As a percentage by weight

9. **True**

10. **False** It is **illegal to sell and use** products in Canada with only U.S. Environmental Protection Agency (E.P.A.) numbers. The PCP Act Registration Number must be on all labels.

Quiz # 3-4 Secondary Display Panel

1. **False** The maximum number of applications in the Number of Applications Statement **cannot be exceeded.**

2. **False** The **most strict buffer zone** statement of either the provincial regulatory requirement or the label must be followed.

3. P.C.P. Act Registration Number and information from the Toxicological Information Statement.

Quiz # 3-5 MSDSs

1. Material Safety Data Sheet

2. Product information section
   Hazardous ingredients section
   Physical data section
   Occupational procedures and prevention measures section

First aid and emergency procedures section
Fire and explosion hazard section
Toxicity and health effects section
Reactivity data section
Preparation date and group section

Chapter 4: Human Health

1. **True**

2. Acute toxicity

3. Danger Poison

4. **False** The smaller the number, the more toxic the pesticide.

5. **False** Effects of chronic toxicity are often hard to detect and permanent.

6. Inhalation (into the lungs), dermal absorption (through the skin), and ocular absorption (through the eye)

7. **False** Most prescription eyeglasses do not provide proper protection from product drift or splash.

8. **True**

Chapter 5: Pesticide Safety

Quiz # 5-1

1. Precautions to consider:

   - Remove children
   - Remove pets
   - Remove/cover sandbox/play toys
   - Remove barbeque
   - Remove clothes on line
   - Close windows

Quiz # 5-2

1. Read and follow all label information.
   Wear clean personal protective equipment (PPE).
   Remove contact lenses before handling pesticides.
   Wash before eating, drinking, smoking, or using the toilet.
   Do not carry food or smoking products on your body when handling pesticides.
   Never eat, drink or smoke when handling pesticides.
   Wash any spillage off the affected person and remove contaminated clothing.
   Shower, wash body, hair, and scrub under fingernails at the end of each day.

2. Total amount of pesticide required to buy = Pesticide rate x Treatment area

3. Some factors that can affect risk during pesticide use or handling include:

   - The pesticide
   - The type of exposure
   - The length of exposure
   - The application method
   - Location i.e., an enclosed space

4. Gloves should be:

   - In good condition (no holes, rips)
   - Clean
   - Made of a proper chemical resistant material for the pesticide such as neoprene, nitrile, butyl rubber or PVC-supported (not leather or cloth)
   - Unlined
   - Long enough to cover the wrist and lower forearm when cuffed.

5. Face shields give protection to the full face from spills or splashes that can occur during the mixing and loading of pesticides.

6. Respirators must:

   - Have either/or 1 of the 3
     - Have a CSA (Canadian Standards Association),
     - MSHA-NIOSH (Mines, Safety, Health Association - National Institute of Occupational Safety & Health)
     - Have a BHSE (British Health & Safety Executive) approval for pesticide use
   - Have a proper cartridge or canister designed for pesticide use
   - Fit properly
   - Be clean
   - Contain cartridges that are not over-saturated

7. Types of respirators include:

   - Cartridge respirators
   - Canister respirators
   - Air-powered purifying respirators
   - Self-contained breathing equipment

8. When transporting pesticides:

   - Pack containers securely to prevent movement or breakage during transit.

   - Take extra care with liquid pesticides.

   - Make sure that containers are stacked securely to reduce the risk of breaking or spilling.

- If a spill occurs, clean it up.
- Do not transport leaking or damaged containers.
- Never transport pesticides with food, feed, fertilizer, clothing, or household goods. They must be kept separate.
- Only use containers (with labels) that are in good condition.
- Never leave pesticides unattended in a vehicle, unless they are locked in a compartment outside the passenger area.
- Only transport pesticide containers that are intact.
- Make sure caps and plugs are tightly closed. Transport liquid pesticide containers in an upright position.
- Protect paper and cardboard containers from moisture (e.g., rain, snow, humidity).
- Never transport pesticides in the passenger compartment of a vehicle. Never let people or animals ride in the same compartment with the pesticides (e.g., back of truck).
- Do not transport pesticides on a wooden truck bed.

9. The location of a storage facility should be:

- Separate from work areas, living areas, and areas where animals are kept
- Away from wells, ditches, or water bodies
- Away from areas where flooding can occur
- Away from highly porous soil
- Away from areas used by the public, children, and animals
- Sited at least 50 meters from residences, hospitals, schools, and buildings with high occupancy
- Accessible to emergency personnel

10. Before mixing and loading:

- Read the label to confirm that the pesticide is registered for the intended use.
- Check on safety precautions, review poisoning and first aid information.
- Check mixing directions, pesticide rates, and limitations.
- Determine how much pesticide is needed in each tank/application.
- Put on personal protective equipment.
- Prepare only the amount of spray mixture needed.
- Make sure clean-up and first aid equipment, and emergency phone numbers are within reach.

11. To clean a blocked nozzle:

- Use a soft brush and clean water or compressed air.
- Never blow out a nozzle using the mouth.
- Never use sharp metal objects or wire to remove a blockage. This can damage the nozzle.

12. To wash clothes:

- Use chemical resistant gloves to handle contaminated clothing.
- Use a pre-wash additive on contaminated areas.
- Pre-soak and wash separate from normal laundry.
- Do not overload the washing machine.
- Pre-rinse clothing using the pre-soak cycle.

- Set the machine for a normal wash cycle, a full water level, and use hot water during the wash and rinse cycles.

- Use either a heavy-duty detergent, bleach, or household ammonia (do not mix these cleaners).

- Repeat wash cycles if necessary.

- Run the empty washing machine through a full cycle after use. Use hot water, on the highest-level setting, and detergent.

- Hang clothes to dry. This prevents contamination of the dryer.

13. Steps for container disposal include:

    - Drain the container into the spray tank or mixing tank. Do this until there are no visible drips. If the pesticide is a dry formulation, shake the bag into the tank or hopper.
    - Triple rinse or pressure rinse metal, plastic, or glass containers; gently single rinse bags when possible.
    - Make the empty container unusable by cutting, puncturing, and/or crushing plastic, metal, or paper containers. Break glass containers in a plastic bag. This does not apply to refillable containers.
    - Cap and dispose of the container according to provincial laws. Return containers to collection depots for recycling/disposal when available.

14. If there is an excess of spray mixture, use it according to label directions on another field that requires an application. If this is not possible, contact your provincial pesticide regulatory body for guidance.

15. Never apply surplus tank mixture as a second application to a treatment area without first diluting it.

16. Re-entry time is the minimum time required to stay out of a treated area without personal protective equipment.

17. It is important to keep good records because:
    - Record keeping gives a history of pest problems and control methods used for an area.

- They can be useful for planning applications, re-entry times, harvest dates, and grazing times.
- Records provide details on the application and equipment settings.
- They answer questions or address problems that come up after
- application (e.g., poor applications, crop or property damage, complaints, lawsuits).

Chapter 6: Environment

1. **Desorption** occurs when a pesticide bound or adsorbed to soil or other material is released.

   Volatilization is the process where solids or liquids become vapour (gas).

   Spray drift refers to the airborne movement of spray from a treatment site during application.

   Runoff is the movement of water down a slope.

   Leaching is the movement of pesticides with water through the soil.

   Absorption is the movement of pesticides into organisms (plants or animals) or structures (e.g., soil, wood).

   Degradation is the breakdown of pesticides into other compounds.

2. Pesticides can contaminate water through:

   - Natural processes such as runoff, leaching, and erosion of soil that has adsorbed pesticides
   - Improper clean up of spills during mixing, loading, or transport
   - Poor disposal of excess spray mix, unwanted pesticides, or rinsate from containers
   - Poor handling or applications including or resulting in:

     i. Particle drift

ii. Vapour drift
iii. Higher than called for application rates
iv. Failure to clean up spills
v. Back siphoning of pesticides from the spray tank into the water source
vi. Overflow of the spray tank during filling
vii. Improper washing down of spray equipment

3. Contamination of watercourses can be reduced, and aquatic life protected by:

- Applying pesticides properly
- Using correct pesticide application rate
- Choosing pesticides with care when applying them near water or shallow aquifers
- Avoiding pesticides with a:
    - tendency to leach to shallow aquifers
    - high runoff potential or
    - high aquatic toxicity

- Using buffer zones (as directed by provincial law or label precautions) when mixing, loading or applying pesticides
- Showing extra care and restraint when applying pesticides near fish habitat or areas that drain into fish habitat

4. Soil can be contaminated by pesticides when:

- Spills occur during mixing and loading
- Application equipment is left unattended and allowed to overflow during a mixing and loading operation
- Pesticides or pesticide containers are improperly disposed
- Pesticide label rates are exceeded

5. Animals can be protected from pesticides by:

- Being mindful to the presence of wildlife
- Reading and following all pesticide label information
- Following safety guidelines described in this standard
- Only using pesticides when needed

- Using the least toxic and least persistent pesticide registered
- Using target-specific pesticides to reduce the impact on non-target organisms
- Knowing the effects that granular pesticides and treated seed can have on wildlife (Make sure that such pesticides are properly used and stored. Poisoned rodents can cause secondary poisoning of pets or other animals. These should be removed in a proper manner.)
- Avoiding pesticides that are likely to move away from the area of application through drift or runoff
- Leaving buffer zones around sensitive areas

6. Damage of streamside plant life can affect bank stability. This can remove a food source and shelter area for some wildlife and aquatic organisms. Loss of shade plants next to watercourses can also cause an increase in water temperature or a loss of fish food.
7. **c.** Contamination that occurs when a large amount of pesticide is released in a small area (e.g., spill, pesticide fire, or poor disposal) is known as **point source contamination**.

8. **False**. Vapour drift is the movement of vapours from the area of application. Spray drift refers to airborne movement of spray or particles from a treatment site during application.

9. **True**

10. **False**. Selecting nozzle types that produce large droplets (and still give good coverage) will reduce spray drift.

Chapter 7 Integrated Pest Management

1. Advantages of using an IPM approach are that it:

- Provides long-term solutions to pest problems
- Protects the environment and human health by reducing pesticide use
- Reduces harm to beneficial organisms
- Reduces development of resistance in pests

- Provides a way to manage pests when pesticides cannot be used

2. Prevention of pest problems is usually cheaper. It also provides better long-term results than waiting for problems to appear and then treating.

3. d

4. The injury threshold is the level at which pest numbers are high enough to cause unacceptable injury or damage. The action threshold is the point at which treatment should take place to prevent the pest population from reaching injury threshold.

5. Cultural; biological; mechanical/physical; behavioural; and chemical controls (need to give examples of each)

6. Communicating is important because a large amount of information needs to be taken into account and used when solving any pest problem. Information comes from a variety of sources. This also has to be done to educate customers, future clients and the general public.

7. **True**

8. **False** Counting the number of pests on plants is referred to as counting and measuring. Visual inspection involves checking for the presence of pests, beneficial organisms, signs of damage, etc. This information is recorded in writing.

9. **False** An IPM program often uses a number of coordinated treatment methods. This combination tends to be more effective than using only one method.

Chapter 8: Application Technology

1. It is important to correctly use and maintain pesticide application equipment:

- To apply the pesticide uniformly on the desired target at the calibrated label rate
- To extend the life of the equipment
- To avoid contamination of non-target sites

2. Calibrate application equipment so that it can deliver the right amount of pesticide, in a uniform pattern to the treatment area and the pest.

3. Refer to the operator manual or consult industry / government experts.

4. Weather conditions include:

- Air movement or wind patterns
- Relative humidity
- Temperature.

5. Vapour drift occurs when pesticide vapours move away from the target site during or after an application. To reduce the amount of vapour drift

- Select less volatile pesticides.
- Do not apply pesticides when weather conditions (e.g., high temperatures) would be prone to cause evaporation or volatilization.
- Properly seal an area being fumigated to contain the fumigant or any volatile pesticide.

Chapter 9: Emergency Response

1. The numbers should include the local environmental emergencies number, police, fire, ambulance, poison control centre, doctor, and Canutec.

2. **False** PPE should always be put on before going into a contaminated area or handling someone who has been exposed to a spilled pesticide.

3. A spill is considered to be small if it is less than 20 L or 20 kg of concentrated product or less than 200 L of pesticide mix.

4. It is wrong to put large amounts of water on a spill because the pesticide/water mix may leach into the soil and cause groundwater contamination.

5. A person involved in the spill or cleanup who feels sick should be taken to hospital immediately. A clean pesticide label or the PCP Act Registration Number should be sent along with him/her.

6. Fires involving pesticides are extreme hazards because some pesticides are flammable, a few are explosive, and all can produce toxic fumes when burned.

7. Actions that can prevent or reduce the chance of a fire involving pesticides include:

   - Not using open flames for welding, burning, cutting, or heating in the pesticide storage site
   - Making sure that the pesticide storage structure adheres to the National Fire Code, National Building Code, National Electrical Code, provincial laws, Municipal By-laws, etc.
   - Securing doors and windows to prevent unauthorized people from entering

8. **True**

9. The treatment for pesticide in the eye is to hold the eyelid open and flush immediately with clean running water. Do this for at least 15 minutes. Read and follow the first aid instruction on the product label. Call for medical help or transport the patient to hospital.

10. b) Small amounts of water may be given to an unconscious or drowsy patient.

11. Quick action is important to reduce impact and prevent an emergency from turning into a major disaster. It can also reduce liability for damages.

12. An ERP should prepare for:

- Accidents causing injury
- Gas and odour release
- Pesticide spills
- Fires or explosions
- Natural disasters (floods, ice storms, etc.)
- Vehicle transport accidents
- Threats (phone calls)

Chapter 10: Professionalism

1. **True**

2. Qualities of professionalism of the following:

   - Professionalism
   - Having a good attitude
   - Having knowledge of the profession
   - Communicating with the public
   - Working in a professional manner

3. d

4. b

5. A pesticide applicator can show a good attitude by:

   - Limiting applications (Never do a whole lawn treatment if a spot treatment will do.)
   - Keeping a safe work environment for applicators
   - Showing concern for the environment
   - Refusing unsafe work
   - Being quick and responsive to requests for information, complaints, concerns, or emergencies
   - Staying within your skill area
   - Making recommendations based on facts
   - Taking the concerns of bystanders and neighbours into account
   - Spending time with the client or public to explain the operation

6. Any of the following 14 ways:

- Use pesticides responsibly, and in keeping with the label.
- Notify neighbours, or people who can be affected, before any pesticide application.
- Do not use pesticides when bystanders are present.
- Use integrated pest management (IPM) techniques.
- Use proper pesticide rates.
- Keep a record of each application.
- Avoid applications during adverse weather.
- Communicate within the business (e.g., supervisors, head office).
- Equipment should be clean and well maintained. Schedule daily and weekly preventative maintenance inspections.
- The operator should prepare and be familiar with equipment before the application. Equipment/vehicles should be used in a safe and proper manner.
- Before any application, give thought to ground, weather, and road conditions. Follow all road laws while in transit.
- Confirm that the application is being made at the correct site.
- Plan ahead to avoid problems during the application. Have a copy of an emergency response plan for spills. Keep a spill clean up kit on hand.
- After the application, clean application equipment and boots between sites. This prevents the spread of pests. Keep records. Perform any follow up inspections.

7. Any of the following eight (8) ways.

- Listen to public concerns. Try to understand their point of view.
- Involve the public and the client in decisions that may affect them.
- Take part in public forums.
- Plan and evaluate communication.
- Be honest, frank, open, and cooperate with the public and government.
- Speak clearly and be sincere.
- Meet the needs of the media.
- Avoid damaging or less than honest statements. Provide the facts.

8. **True**

9. **True**

APPENDIX B

GLOSSARY

Glossary

Absorption	The movement of pesticides into plants, animals or structures (soil or wood).
Action threshold	The point at which treatment should take place to prevent a pest from causing harm. Timing depends on the type of treatment.
Active ingredient	The substance in the pesticide that controls the pest.
Acute toxicity:	An adverse effect or response seen in a person within a few hours to days after exposure.
Adjuvant	A substance added to a pesticide solution to improve product effectiveness. Examples include emulsifiers, wetting agents, and surfactants.
Adsorption	The binding of a pesticide to the surface of a plant or soil particle
Air gap	Physical separation of a water system from a pesticide mixture by a vertical air space.
Antifoaming agents	A substance used to reduce foaming of spray mixtures that require vigorous agitation.
Behavioural controls	Use a pest's natural behaviour to suppress population.
Beneficial	Useful or helpful to people (i.e., beneficial insect that feeds on aphids).
Buffer zone	Areas or strips of land left untreated to protect a nearby area (i.e. a sensitive water body, habitation).
Buffering agents	Increase stability of pesticides in water.
Calibration	Checking and adjusting sprayer output of pesticide by application equipment.

Carrier	Material that is added to a pesticide formulation to dilute it and to make the formulation less toxic so it can be evenly applied.
Cartridge	The part of a respirator that absorbs fumes and vapours from the air before it is breathed in. It contains activated charcoal.
Chemical degradation	The breakdown of pesticides by chemical reactions with other materials in the soil. (i.e., water).
Chemical name	The chemical name of the active ingredient.
Chronic toxicity	Adverse responses that occur and persist over time after exposure(s). Chronic effects are often permanent. These may result from a single or repeated exposure.
Commercial class (Agricultural or Industrial) pesticide	Meant for use in commercial agriculture, forestry, or industry (not the general public). They have low to medium toxicity.
Contaminate	When a chemical alters or renders a material or food unfit to use.
Degradation	A complex chemical is reduced into a less complex form. This may be the result of microbes, water, air, sunlight or other agents.
Dermal	Relates to the skin.
Dermal absorption	The intake of a substance through skin. It results from direct contact to unprotected areas.
Desorption	When a pesticide bound (adsorbed) to soil particles or other material is released.
Diluent	A substance, often water, mixed with a pesticide to make the proper concentration for application.
Domestic class pesticide	Intended for home use. They contain active ingredients with low toxicity, or the concentration of the formulated product is low.

Drift	Movement of pesticide droplets or dust, by wind or air currents, from the target area. Drift is a major hazard of pesticide application.
Drift retardants/thickeners	Increase droplet size of spray material and reduce particle drift.
Ecosystem	A community of organisms that interact with one another and their environment.
Emulsifiers	Allow oil-based pesticides to mix with water.
Environment	The surroundings (water, air, soil, plants, and animals).
Face shield:	A see-through piece of protective equipment used to protect the face from exposure.
Fire point	The lowest temperature at which a substance will ignite and burn for at least 5 seconds.
First aid	A series of actions taken immediately to help stabilize a patient and sustain life until medical help arrives.
Flash point	The lowest temperature at which an ignition source will cause liquid vapours to ignite near the surface of a liquid.
Forest or Forest management category- restricted	Applies to wooded areas or sites to be planted to forest of more than 500 hectares.
Fume	A smoke, gas or vapour
Granular	A pesticide in the form of coarse particles that are applied dry with a spreader, seeder, or special applicator.
Habitat	An environment in which organisms live.
Hazard	The danger of exposure when working with pesticides.
Host	A living plant or animal that a pest depends on for survival.

Incompatible	When pesticides cannot be mixed or used together. When incompatible pesticides are mixed together, one or more may precipitate from the mixture, the effectiveness of one or more may be reduced, or injury to plants or animals may result.
Ingestion or Oral exposure	The intake of a substance by mouth (accidental ingestion, suicide attempts, or eating of contaminated food).
Inhalation exposure	The breathing in of airborne particles of a substance. Fine powders, spray droplets, vapours, or gases may be inhaled into the lungs.
Injury threshold	The level at which pest numbers are high enough to cause unacceptable injury or damage.
Integrated Pest Management (IPM)	A decision-making process based on preventing pest problems. All available information and treatment methods are considered in order to act in an economically and environmentally sound manner.
Invert emulsifiers	Allow water-based pesticides to mix with oil-based carriers
IPM	See: Integrated Pest Management
Large spill	More than 20 L or 20 kg of concentrated pesticide or more than 200 L of pesticide mix.
LC_{50}: (lethal concentration 50%)	The concentration (in parts per million) of a pesticide in the air or water that is needed to kill half of the test animals exposed to it.
Leaching	The movement of chemicals through soil or water.
Manufacturing class pesticide	Products used only to make or formulate end-use products.
Material Safety Data Sheet (MSDS)	Legislated under WHMIS. Provide information on health hazards, personal safety, and environmental protection for hazardous products.

Maximum Residue Limits (MRLs)	The maximum amount of pesticide residue permitted to be in food products.
Microbe	Tiny organisms (i.e., bacteria, fungi, and viruses)
Microbial degradation	The most common form of breakdown. It is the use of a pesticide product as an energy or food source by soil microorganisms. (Microbes)
Non-selective herbicide	A herbicide that affects all plants that contact it.
Ocular exposure	The intake of a substance through the eyes. Eyes absorb pesticides easily through their many blood vessels.
Parasite	An organism that lives in or on the body of another and obtains nourishment from it.
Particle drift	Pesticide particles that remain in the air after application and move away from the treatment site.
Penetrants	Allow a pesticide to get through the outer layer of a treated surface.
Persistence	The ability of a pesticide to remain in the environment for a long time without changing.
Personal protective equipment or clothing (PPE)	Clothes, materials, or devices that offer protection from pesticides; especially important when handling or applying toxic pesticides (i.e., gloves, apron, boots, coveralls, hat, respirator, splash apron, goggles, and face shield).
Pest	Any harmful, noxious, or trouble organism that may cause an undesirable effect. Pests include fungi, bacteria, viruses, weeds, insects, mites, rodents, and birds. Wildlife (raccoons, wolves, deer) may be named as pests.

Pesticide	Designed to kill, control, repel, attract, or manage pests. Any product that claims to do this is a pesticide under the *Pest Control Product Act and Regulations*. Chemicals that regulate plant growth, defoliants, and plant desiccants are also considered to be pesticides.
Pesticide label	As defined in the *Pest Control Product Act*: "Any legend, word, mark, symbol, or design applied or attached to, included in, belonging to, or accompanying any control product". A pesticide label is a legal document in Canada.
Pesticide residue	A deposit that remains in or on a crop or other substance after the application of a pesticide.
Pesticide resistance	Occurs when a pest population is exposed to the same, or a similar, pesticide a number of times. A few individuals may have a genetic difference that enables them to survive a pesticide application. These reproduce and generate a new population that is resistant to the pesticide.
Pheromone	A chemical produced by insects to communicate to other insects. These are used as signals, alarms, or to attract mates.
Photodegradation	The breakdown of pesticides by sunlight into simpler compounds.
Phytotoxic	Poisonous or injurious to plants
Predator	An organism that preys on another. A predator kills its prey to feed on it.
Residue	Pesticide that remains on or in the crop (or other substance)
Respiration	Breathing. This is also the physical and chemical processes by which an organism supplies cells and tissues with oxygen. It is the use of oxygen to produce energy to sustain life.

Respirator	A device to protect the wearer from breathing hazardous air.
Restricted class pesticide	May have safety concerns related to human health, plants, animals, or the environment. They often have special, detailed labels to show how to handle them safely. Only certified applicators may use them.
Risk	The chance that someone or something will be harmed by the toxicity of and exposure to the pesticide.
Rodenticide	A pesticide used to control rodents.
Runoff	Movement of water down a sloping surface.
Small spill	Less than 20 L or 20 kg of pesticide concentrate or less than 200 L of pesticide mix.
Spray drift	The airborne movement of spray droplets from a treatment site during the application.
Spreaders	Allow a pesticide to form a uniform coating over a treated surface.
Stickers	Allow a pesticide to stay on the treated surface.
Surface runoff	Movement of pesticide from the treated area over the soil surface.
Surfactant	A substance used in a pesticide to make mixing easier. It reduces surface tension of a liquid to spread it out over a surface (rather than "beading-up" in small droplets). This allows it to adhere to the surface being treated. Examples include: emulsifiers, soaps, wetting agents, detergents and spreader-stickers.
Tank mix	The blending of pesticides in the same spray tank. Pesticides should not be “tank mixed” unless approved on the label of each pesticide to be mixed.

Toxicity	The harm a particular pesticide may cause to an organism. Toxic effects may vary with sex, health, age, weight, or prior exposure to other pesticides.
Vapour	Gas produced by a substance that is a solid or liquid at room temperature. A gas or vapour is not an aerosol or mist (composed of tiny droplets of liquid suspended in air).
Vapour drift	Movement of vapours (fumigant or volatile pesticide) from the area of application. It usually occurs after an application.
Volatilization	The process where solids or liquids become vapour (gas).
Wetting agents	Allow wettable powders and dry flowables to mix with water and stick or spread on target surfaces.
WHMIS:	Workplace Hazardous Materials Information System.
Woodlands management category - commercial	Applies to wooded areas of 500 hectares or less planted as tree nurseries, rights-of-way, and seed orchards.
Woodlands management category- restricted	Applies to wooded areas of 500 hectares or less or sites to be planted to forest.