PESTICIDE DEALER TRAINING MANUAL

Based on the *Pesticide Applicator Training Manual*, 2nd Edition, Core Manual, Northeastern Regional Pesticide Coordinators

modified April 2023

Pesticide Dealer Training Manual
Table of Contents

Introduction

All Class "A" and Class "B" pesticide dealers are required to know about the proper storage, handling and sale of pesticides in order to obtain a pesticide dealer's license. You need to have an adequate knowledge of: pesticide control regulations; pesticide classification; safe pesticide handling; hazards; and, proper storage and disposal of pesticides that will be sold or recommended for use. The purpose of this manual is to help you learn the facts and skills you need to obtain your pesticide dealer's license. By reading each chapter and then testing yourself with the questions at the end, you can teach yourself what you need to know to pass the Dealer's exam.

This manual has been adapted from the core training manual that is used by private, non-commercial and commercial applicators in preparation for their licensing exams. Although you will not actually be making pesticide applications, you need to be knowledgeable about the pesticide products you supply to certified applicators and other customers, like homeowners. Many homeowners use pesticides every day, yet are not required to demonstrate their competence in the use of these products. As a pesticide dealer, you are a particularly important source of information for homeowners on the selection and safe use of pesticides.

This core manual has been divided into two sections. The first section covers background information that every pesticide dealer and applicator should know. For example: laws; regulations; and pesticide toxicity and safety. The second section describes the steps and decisions which every applicator has to make in his/her daily routine on the job. Again, although you will not be making actual pesticide applications, you can serve your customers best if you familiarize yourself with their needs and challenges.

Pesticide Dealer Licensing

Chapter I

Pesticide application has become more complex over the past several years. The number of different kinds of pesticides available for use has increased. Effects on wildlife and the environment are now known to be important considerations. Highly toxic pesticides require special equipment and safety measures.

While you, as a pesticide dealer, will not be making actual pesticide applications, there are many things you need to know about the storage, handling and sale of pesticides in order to remain in compliance with federal and state pesticide regulations. When you understand and act in accordance with your legal responsibilities, you will contribute to the safe and effective use of pesticides.

Some day-to-day questions you may encounter as a pesticide dealer include: What classes of pesticide am I entitled to sell with my license? Who can purchase restricted use pesticides? Can restricted use pesticides be displayed for self-service? Can any class of pesticide be displayed in food areas? What should you do if you have a pesticide accident in your store? What do I need to do to be able to transport pesticides? How do I dispose of obsolete pesticides?

In Vermont, those people wishing to become a dealer of Class "A" or Class "B" pesticides must take an exam to demonstrate that they understand their legal responsibilities regarding the storage, handling and sale of pesticides, long with other topics such as pesticide safety, pesticide formulations, first aid for pesticide poisoning, and environmental effects of pesticide use. This chapter is intended to familiarize you with your legal requirements under the Vermont Rule for the Control of Pesticides, in accordance with 6 V.S.A, Chapter 87.

Goals of This Chapter

- Know who needs to be licensed to sell pesticides.
- Know the Vermont classification system for pesticides.
- Know the legal responsibilities of the pesticide dealer.
- Be familiar with how to properly store pesticides, display pesticides for sale, and manage pesticide spills.
- Be familiar with the categories of pesticide applicator

NOTE: Most of the information provided in this chapter is based on the regulatory requirements put forth in the *Vermont Rule for Control of Pesticides*, in accordance with 6 V.S.A., Chapter 87. There is also additional non-regulatory information provided as "guidance". Such information will always be preceded by "☞ **The following are practical suggestions...**" and will be enclosed in a text box. i

As a licensed pesticide dealer, you are legally responsible for being thoroughly familiar with the Rule, in its entirety, and your responsibilities under the law.

Who Needs to be Licensed to Sell Pesticides?

Any store or other retail sales outlet wishing to sell Class "A" (restricted use), or Class "B" pesticides must have at least one full-time employee that is licensed with the Vermont Agency of Agriculture as a pesticide dealer. A full-time employee shall be a person who works at least 32 hours per week on a year-round basis.

Licensing Requirements

Prior to the issuance of a license, Class "A" and Class "B" pesticide dealers must: apply to the Secretary of Agriculture for a license; pass a written examination to demonstrate that the applicant has a working knowledge of pesticide regulations, classification of pesticides, safe handling, hazards, label interpretation, and pesticide disposal; and, pay the required fee. Class "C" dealers do not need to take a written examination, but must pay a fee.

The license year extends from January 1 through December 31. The license must be renewed annually by January 1 of each year. A license not renewed within 365 days shall be considered lapsed and shall require re-examination prior to any re-isuuance.

Licenses may be renewed without examination if the conditions under which the original license was issued have not changed.

Pesticide Classifications

Class "A" - Restricted Use - Federal and State

• Restricted Use - Federal: Those federally restricted use pesticides identified by the Environmental Protection Agency (EPA) designation "Restricted Use Pesticide" on the product label.

• Restricted Use - State: Those pesticides classified as general use by the EPA, and reclassified as restricted use by the State of Vermont based on factors such as: toxicological profile, environmental effects, potential for misuse, and method of application. The product label will *not* indicate that the product has been classified as restricted use by the State. You must refer to the Vermont Agency of Agriculture's Plant Health & Agricultural Resource Management (PHARM) Pesticide Division's web page where you can search to identify these products **OR** call the Vermont Agency of Agriculture at (802) 828-3475.

Class "B" - Controlled Sale

• Those pesticides determined to be less hazardous than Class "A" pesticides, but which require some control over where they are sold. Class "B" includes all turf products and any pesticide that is for use outside of the home and not marketed as ready-to-use, excluding products containing either Bacillus thuringienesis or potassium fatty acids regardless of percent of total active ingredient and does not meet Class A definition. The Secretary reserves the right to classify additional pesticides as Class B.

Class "C" - Homeowner

• Homeowner includes any pesticide applied in and around the home and that are marketed as ready-to-use and have total active ingredient of 3%or less. The following additional pesticides are classified as Class C.

• Class C pesticides with a limited percentage of active ingredient include dichlorvos-impregnated strips (DDVP) with concentrations not over 20% in resin strips and pet collars.

What Class(es) of Pesticides Can a Licensed Dealer Sell?

• Class C pesticides with an unlimited percentage of active ingredients include the following: pet supplies including shampoos, dips, and tick and flea control products;wood preservatives and sapstain control agents other than creosote, inorganic arsenicals, and pentachlorophenol; animal and insect repellents; moth flakes, crystals, cakes, and nuggets; indoor aquarium products; swimming pool products; pediculocides and mange cure on humans; pheromone baits and lures; premixed paints that make pesticidal claims; antimicrobial agents such as disinfectants, bacteriostats, bactericides, mildewcides, mildewstats, viricides, sanitizers, slimicides, sterilants, and industrial preservatives; insecticides containing bacillus thuringiensis, bacillus popilliae, bacillus lentimorbus, or potassium fatty acid; and animal ear tags.

Class "A" license - entitles a pesticide dealer to sell any pesticide registered in the State of Vermont. A class A license entitles the licensee to sell class A, Class B, and Class C pesticides registered in Vermont.

Class "B" license - entitles a pesticide dealer to sell Class "B" and Class "C" pesticides that are registered in Vermont.

Class "C" license - are exempt from the dealer license examination requirements and shall obtain a Retail/Class C license. This license entitles a pesticide dealer to sell only Class "C" pesticides that are registered in the State of Vermont.

Record Keeping Requirements for Licensed Class "A" Dealers: Annual Sales Reports

Licensed Class "A" dealers are required to keep and maintain records, or annual sales reports, of their sales of pesticides and shall make them available for inspection by the Agency of Agriculture upon request.

Emergency Actions and Accident Reporting

All pesticide dealers, Class A, B and C, are responsible for the safe and proper storage and handling of pesticide products offered for sale in their establishment. If an accident involving those pesticide products occurs, immediate action must be taken to protect human health and the environment, including, but not limited to, emergency containment measures and notification of the proper authorities.

• **Emergency Notifications:** Pesticide accidents must be reported immediately by telephone to either the:

☞ **Vermont Agncy of Agriculture, Food and Markets,**
PHARM Pesticide Division
(802) 828-2431

OR

☞ **Vermont Department of Public Safety**
1-800-641-5005 (operating 24 hours/day; 7 days/week)

If you are unsure of what constitutes a pesticide accident or spill, call the Vermont Agency of Agriculture at (802) 828-2431.

☞ **The following are practical suggestions for the management of a pesticide spill:**

Be Prepared

- Establish procedures to control, contain and clean up spills.
- Train employees on proper safety procedures in the event of a spill and rehearse these procedures with them.
- Keep protective clothing and equipment available for emergency clean up.
- Provide clean water, soap, a first aid kit, and an eye wash dispenser nearby for emergencies.
- Have available a spill clean up kit or appropriate items (shovels, broom, dust pan, and absorbent materials such as sawdust, cat litter, or vermiculite).
- Post local medical and emergency numbers.

Handling A Spill - or the "Three C's" - **Control** the Spill, **Contain** It and **Clean** It Up!

- If pesticide gets on anyone, have them wash thoroughly, change their clothes, and see a doctor if necessary.
- Remove all persons, not involved in the spill clean up, from the area of any chemical spill. Rope off the contaminated area if possible.
- Make sure everyone involved in the clean up is wearing the appropriate personnel protective equipment!
- **Never hose down a spill!** It will only spread the pesticide.
- Contain the spill. Build a dam with soil, sand, or cat litter.
- Place a leaking container into a larger, leakproof container. Label that container with the name of the pesticide being contained.
- ☞ **NOTE: Do not re-sell pesticides in broken or damaged containers.**
- Clean up the spill by adding absorbent material such as sawdust, cat litter, fine sand or vermiculite until the liquid is soaked up. (NOTE: Avoid using sawdust or sweeping compounds if the material is a strong oxidizer - such a combination presents a possible fire hazard.)
- Shovel clean up materials into a leakproof container. Label the container as "pesticide - hazardous waste".
- Cover the spill area with a decontamination agent recommended for that particular pesticide. Follow the instructions provided for that agent. (Consult the product manufacturer or your supplier.)
- Dispose of the pesticide contaminated materials properly. (See "Disposal of Obsolete Pesticides")
- Do not allow any pesticide to enter groundwater or surface

Transportation of Pesticides

Once pesticides are in your possession, you are responsible for transporting them safely. Pesticide applicators shall secure pesticides during transportation to prevent spillage.

☞ NOTE: Any spills in or from the vehicle must be immediately cleaned up, using the correct procedures

☞ The following are practical suggestions that a dealer can observe when transporting pesticides:

- The safest way to transport pesticides is in the back of a truck. Flatbed trucks should have side and tail racks. Steel beds are preferable since they can be more easily decontaminated if a spill occurs.
- Secure all pesticide containers in such a way that they cannot shift, roll or bounce around.
- All containers should be protected from moisture that would saturate paper and cardboard packages or rust metal.
- Never carry pesticides inside your car, van or truck. Hazardous fumes may be released, and pesticide can cause injury or death if they spill on you or your passengers.
- Never leave your vehicle unattended when transporting pesticides in an unlocked truck compartment or open-bed truck.
- Never transport groceries or livestock feed near pesticides.

Receiving Pesticide Shipments

☞ The following are practical suggestions that a dealer can observe upon receiving a shipment of pesticides:

- Determine that all lids are on securely and no leaking has occurred.
- All containers must have labels which are securely attached and legible.
- If a product has a hanging tag, all containers of that product must have a hanging tag.
- A safety data sheet (SDS) should be sent from the distributor to the dealer with each product and should be kept on file. These sheets provide information on storage and safety in handling the chemical.

Storage of Pesticides

- Any pesticide shall be stored in accordance with requirements and precautionary storage instructions contained on the product label.
- Any container shall have a legible manufacturer label indicating the contents.
- Any pesticide or container that has not been triple rinsed shall be stored in a separate room and in such a manner as to prevent contamination to food, feed, seed, livestock remedies, drugs, plants, and other products or materials from the volatilization of a pesticide, the leakage or breakage of containers, or other causes.
- Any pesticide shall be stored inside and protected and secured in such a manner to prevent access from unauthorized persons and wildlife.
- The floor surface of the pesticide storage area shall be smooth, facilitating the complete recovery of any discharge.
- Earthen floors shall be prohibited in a pesticide storage area unless all containers are placed in a containment vessel designed to recover and contain any discharge.
- The pesticide storage area shall be identified by legible signage clearly indicating that a pesticide is in storage,
- The pesticide storage area shall be adequately vented to the outdoors prior to entry.
- Containment vessels used for pesticide storage and handling shall be of materials and construction compatible with the pesticide stored and the conditions of storage and maintained in a manner as to minimize the possibility of a discharge.
- In conjunction with pesticide storage, ambulance and fire department phone numbers or the 911 number shall be displayed at a central location where all persons have access.
- A pesticide storage area shall maintain sufficient lighting to allow the observation of containers and their labeling.
- A pesticide storage area shall be maintained in a clean condition.
- At a minimum, any discharge shall be cleaned up within 60 minutes.
- Bulk storage containers and appurtenances shall be constructed, installed, and maintained to prevent the discharge of liquid bulk pesticide.

(NOTE: You should refer to the *Vermont Rule for Control of Pesticides* for the complete regulatory requirements regarding the storage of pesticides.)

☞ **The following are practical suggestions for the storage of pesticides.**

Storing Containers

- Pesticides should be grouped by chemical type. Keep herbicides apart from other pesticides. Some herbicides can vaporize and get into other pesticides nearby. When the contaminated pesticide is used, the herbicide vapors in it could injure or kill crops and sensitive plants.
- Containers should be secured to prevent falling, sliding, or rolling.
- Bags of pesticides need to be protected from tears, punctures and moisture.
- Store pesticides away from other products such as fertilizers, feed, flammables, medicine, and clothing.
- Check the product label. If directions say to protect against freezing, do not allow the pesticide to freeze. The ingredients of some pesticides separate when frozen and the product may lose effectiveness.

Storage areas

- Storage areas should be well ventilated.
- There should be adequate light when employees must enter the area.
- Storage areas should be dry and protected from flooding, high humidity, and temperature extremes.
- There should be no floor drains or sump pumps.
- The floor should be constructed of concrete or other non-porous material.
- The local fire department should be provided with a list of class A pesticides in your storage area.

Displaying Pesticides For Sale

- Class A pesticides shall not be displayed for self-service.
- No pesticides, Class A, B, or C, may be displayed in food areas.

☞ **The following are practical suggestions for the display of pesticides.**

- Provide a covered area to display products, preferably indoors.
- Protect products from elements such as rain and wind.
- Locate pesticides away from other types of products.
- **Display products up and out of the reach of children.**
- Separate different types of pesticides on the shelves.
- Rotate inventory so that the oldest products are sold first.
- **Inspect pesticides on your shelf occasionally to see if any class A pesticides have found their way onto your shelves.**

Disposal of Obsolete or Waste Pesticides

From time to time, you may need to dispose of pesticides in damaged containers, or those with illegible labels, that you can't offer for sale. In addition, as updated health or environmental data becomes available, the Environmental Protection Agency may decide to cancel the registration of some pesticides. You may also have some waste pesticides resulting from occasional pesticide spills or accidents. Such obsolete and waste pesticides must be disposed of according to the Statutes and regulations established by the *Vermont Hazardous Waste Management Law*, 10 V.S.A., Chapter 159.

The Vermont Agency of Agriculture works in partnership with the Solid Waste Districts in Vermont to sponsor waste pesticide collections. These collections are free, non-regulatory events where homeowners, farmers and businesses can bring in old, unwanted, out-of-date or unusable pesticides, and drop them off for safe disposal.

Contact your local Solid Waste District about disposing of waste pesticide. Please call the contact person in advance before dropping off pesticides. Other questions regarding waste or obsolete pesticides should be directed to the Vermont Agency of Agriculture at (802) 828-2431.

Pesticide Applicator Certification - Restrictions on the Sale of Class "A" Pesticides

You may ask why a class B pesticide dealer needs to know about class A licenses and the certification of pesticide applicators. The answer is easy - it's important to know about the sale of class A pesticides and who can buy them. Class A pesticide dealers can sell restricted use pesticides *only* to certified pesticide applicators or to individuals operating under their direct supervision . Uncertified applicators must have written authorization from a certified applicator to purchase specific restricted use pesticides.

Class "A" pesticide dealers must:

✍ Make sure to ask to see the applicator's certificate.

✍ If selling to an uncertified applicator, make sure that individual

can produce written authorization from a certified applicator. Written authorization shall include the certificate number of the certified applicator authorizing the pesticide purchase, as well as the name and quantity of the pesticide desired.

✍ Special "by permit only" pesticides shall be sold only to certified applicators who produce a special permit authorizing the purchase of those pesticides.

Categories of certified applicators

• Certified Private applicators - use or supervise the use of restricted use pesticides (Class "A") to produce agricultural commodities on property owned or rented by them or their employer.

• Certified Commercial applicators - apply any class of pesticide (A, B, or C) to the lands or homes of another for pay. All commercial applicators must be certified, or working under the direct supervision of a certified applicator, and must be working for a licensed company.

• Non-commercial applicators - are persons who occasionally use pesticides in the course of their employment. If they use anything other than a Class C pesticide, they must become certified, or work under the direct supervision of a certified applicator.

Questions for Self-Study - Chapter 1

1. How would you determine if a pesticide has been classified as "restricted use" by the State of Vermont?

2. Briefly define the three classes of pesticides.

3. Which Class of pesticide dealer must submit annual sales report to the Agency of Agriculture? What information must be included in these reports?

4. To whom can you legally sell restricted use pesticides?

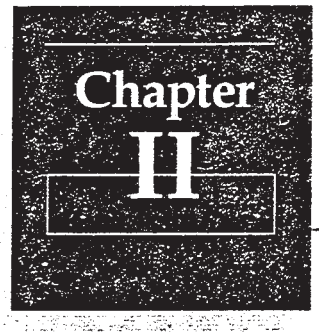
5. If you hold a Class "B" license, what classes of pesticides are you authorized to sell?

6. List some of the precautions you must observe when storing pesticides.

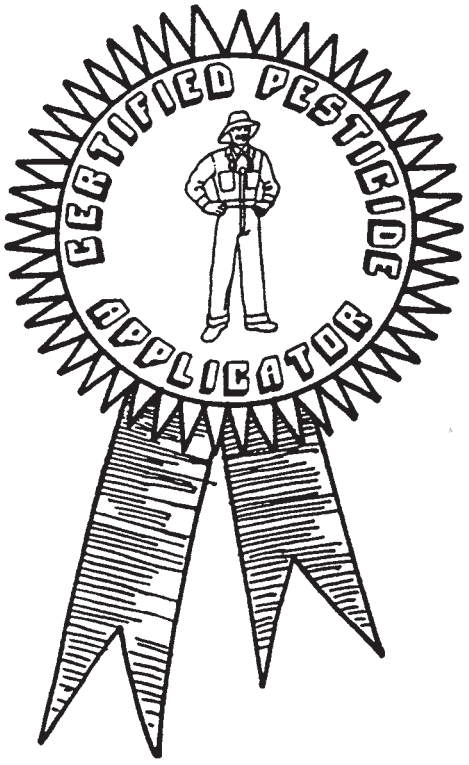
7. Describe the characteristics of an appropriate pesticide storage area.

8. Why is it important to keep herbicides away from other pesticide products?

State Laws and Regulations



Each state has laws governing pesticide use. These laws apply to anyone who wishes to use pesticides within the state's borders. The laws are written to handle pesticide problems which are special for each particular state. In some states there are laws restricting the use of certain pesticides which are considered hazardous to use in that state. The state pesticide laws cannot overrule or conflict with federal laws. Both federal and state laws and regulations apply to any person using pesticides within a state.



State of Vermont

Agency of Agriculture, Food and Markets

Public Health & Agricultural Resource Management Division

116 State Street,
Montpelier VT, 05620
802-828-2431

Vermont Rule for Control of Pesticides
Chapter 012
Document: CVR 20-031-012

Shortened version for class B dealer manual

Effective February 24, 2023

Persons requiring additional information regarding this rule or other matters relating to pesticides in Vermont should contact:

Steve Dwinell, Director, Steve.Dwinell@vermont.gov,
David M. Huber, Esq., Deputy Director, David.Huber@vermont.gov, or
Zach Szczukowski, AGR Mgmt. Specialist, zach.szczukowski@vermont.gov
Public Health and Agricultural Resource Management Division
Vermont Agency of Agriculture, Food and Markets
116 State Street, Montpelier, VT 05620-2901

For the full version of this rule, visit the Public Health and Agricultural Resource Management Division section at www.agriculture.com.

Vermont Rule for Control of Pesticides

Subchapter 1 – Definitions; Powers of the Secretary; Licenses, Certificates, and Permits issued by the Agency; Classification of Pesticides and Limitations on Sale

Section 1. Definitions

1.01 Accident means any release of a pesticide or pesticide mix from its container or application equipment that is contrary to a label instruction for use of that pesticide, or that violates this rule.

1.02 Aerial Application means a pesticide application from a motorized vehicle used for flight, including fixed-wing aircraft, rotary aircraft, and unmanned aerial vehicles.

1.03 Agency means the Vermont Agency of Agriculture, Food and Markets.

1.04 Agricultural Commodity means any plant, fungus, or algae, or part thereof, or any animal or animal product produced by a person primarily for sale, consumption, propagation, or other use by a human or animal.

1.05 Anti-Siphon Device means any equipment designed and constructed to prevent the accidental backflow or siphoning of a pesticide into any potable water supply or public water source or to prevent contamination by a pesticide of another material being injected at the same time, such as a fertilizer or other pesticide.

1.06 Applicator means any individual using a pesticide. An applicator may be certified as a commercial, non-commercial, or private applicator or may be a noncertified applicator.

1.07 Application means the dispersal of a pesticide on, in, at, or directed toward a target site.

1.08 Appurtenance means any equipment that is connected to a bulk storage container or pesticide application equipment for the purpose of transferring a pesticide and includes: valves, pumps, fittings, pipes, hoses, metering devices, mixing containers, and dispensing devices.

1.09 Bulk Pesticide means liquid pesticide in a container larger than 210 gallons (795 liters) or dry pesticide in undivided quantities greater than 100 pounds (45 kilograms), and includes mini-bulk pesticide containers, except as otherwise specified.

1.10 Bulk Storage Container means a container used for the fixed storage of bulk pesticide, that may include a rail car, nurse tank, portable container of mini-bulk pesticide, or other similarly mobile container that is used for the fixed storage of bulk pesticide for more than 15 consecutive days. A Bulk Storage Container does not include a container that is used solely for emergency storage of a leaking pesticide container that is 55 gallons or smaller.

1.11 Certified Commercial Applicator means any person certified pursuant to the requirements of this rule who uses a pesticide on the land or home of another whether for remuneration or gratis.

1.12 Certified Non-commercial Applicator means any person certified pursuant to the requirements of this rule who uses or supervises the use of a Class A or Class B pesticide in the course of their employment on their employer's property.

1.13 Certified Private Applicator means any person certified pursuant to the requirements of this rule who uses or supervises the use of a Class A pesticide on property owned or rented by the person or their employer for the production of an agricultural commodity.

1.14 Chemigation means the use of a pesticide applied through an irrigation system to land or crops.

1.15 Class A Pesticide means a pesticide that is classified as federally restricted or State restricted.

1.16 Class B Pesticide means a general use pesticide that the Secretary classifies as a controlled sale product.

1.17 Class C Pesticide means a general use pesticide that the Secretary classifies as a homeowner or specialty product.

1.18 Commercial Applicator means a person who is not certified in accordance with the requirements of this rule and uses a pesticide on the land or home of another whether for remuneration or gratis under the direct supervision of a certified commercial applicator.

1.19 Company License means a license issued by the Secretary to a business entity that uses a pesticide on the land or home of another person for remuneration or gratis.

1.20 Competency means having the practical knowledge, skills, experience, and judgment necessary to perform functions associated with a pesticide application without causing an unreasonable adverse effect, where the nature and degree of competency required relate directly to the nature of the activity and the degree of independent responsibility.

1.21 Conspicuous Point of Access means the usual and customary entrance or entrances where a person is likely to enter a treated area.

1.22 Container means a device in which a pesticide is stored, transported, treated, disposed of, or otherwise handled.

1.23 Dealer means any person who distributes a pesticide.

1.24 Dealer Outlet means any location where a pesticide is distributed within or into the State.

1.25 Direct Supervision means physical, on-site supervision of a pesticide use by a certified applicator who is capable of calibrating equipment, selecting a pesticide, calculating an application rate and responding to an emergency. Direct supervision is not permitted for use of a federally restricted use pesticide.

1.26 Discharge means a spill, leak, or other emission of a pesticide from a storage container, container, or appurtenance, and includes a release into secondary containment. Discharge shall not mean a fully contained transfer of bulk pesticide that is made pursuant to sale, storage, or distribution that is in accordance with label directions.

1.27 Distribute means to import, consign, sell, offer for sale, solicit an order for sale, or otherwise supply a pesticide for sale or use in this State through any means, including sales outlets, catalogues, the telephone, the Internet, or any electronic means.

1.28 Earth means soil, defined as a three-phase system comprised of various combinations of naturally derived solids including fine to coarse-grained rocks and minerals, organic matter (including living organisms), weathered rock, and precipitates.

1.29 Economic Poison means any substance produced, distributed, or used for preventing, destroying, or repelling any insects, rodents, nematodes, fungi, weeds, or other forms of plant or animal life or viruses, except viruses on or in living humans or other animals, that the Secretary shall declare to be a pest; or any substance produced, distributed, or used as a plant regulator, defoliant, or desiccant.

1.30 EPA means the United States Environmental Protection Agency.

1.31 Environmentally Sensitive Areas means those areas that:

(a) are significant wetlands as defined in 10 V.S.A. Chapter 037;

(b) are necessary wildlife habitat as defined in 10 V.S.A. Chapter 151; or
(c) contain endangered or threatened species as defined in 10 V.S.A. Chapter 123 or are critical habitat as designated under 10 V.S.A. Chapter 123.

1.32 Experimental Use means the use of an unregistered pesticide or the use of a registered pesticide for an unregistered use conducted under a permit.

1.33 Federally Restricted Use Pesticide means a pesticide classified for restricted use under the provisions of Section 3(d) of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and 40 C.F.R. part 152, subpart I.

1.34 Fraud means the intentional misrepresentation through a verbal or written statement, the media, a falsified record, an invoice or report, or a false statement on an application for a license or certificate.

1.35 Golf Course means any contiguous area upon which the game of golf is played including such supporting operations as practice greens, tees, and driving areas.

1.36 Groundwater means water below the land surface that occurs in a zone of saturation.

1.37 Groundwater Protection Rule and Strategy means Chapter 12 of the Environmental Protection Rules adopted pursuant to 10 V.S.A. Chapter 48, as amended.

1.38 Half-Life means the time required for degradation of one-half of the pesticide residue present.

1.39 Integrated Pest Management means an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. Pest control materials are selected and applied in a manner that minimizes risks to human health, beneficial and nontarget organisms, and the environment.

1.40 KOC means the soil organic carbon-water partitioning coefficient: a measure of the tendency of a pesticide to be strongly attached, by chemical or physical bonds, to soil particle surfaces.

1.41 Label or Labeling means:
(a) the written, printed, or graphic matter on, or attached to, the pesticide, or the immediate container thereon;
(b) the outside container or wrapper of the retail package, if there is one, of the pesticide; and
(c) the written, printed, or graphic matter that is incorporated into the label by reference.

1.42 Loading means any act of transferring a pesticide to or from any storage container, or to any application equipment.

1.43 Manufacture means to process, produce, formulate, prepare, compound, package, repackage, or label a pesticide.

1.44 Mini–bulk container means either:
(a) a container, designed for ready handling and transport, that holds more than 55 gallons (208 liters) but not more than 350 gallons (1,325 liters) of liquid pesticide; or
(b) a container that holds more than 100 pounds (45 kilograms) but not more than 1,000 pounds (454 kilograms) of dry pesticide.

1.45 Misuse means an application not made in compliance with the pesticide label or this rule, including:

(a) pre-application activities involving mixing and loading the pesticide;

(b) applying the pesticide, including supervising the use of a pesticide by a noncertified applicator;

(c) other pesticide-related activities, including transporting or storing pesticide containers that have been opened, cleaning equipment, and disposing of excess pesticide, spray mix, equipment wash waters, pesticide containers, and other pesticide-containing materials; or

(d) recommending the use of a pesticide.

1.46 Mixing means the act of combining a pesticide with another pesticide, or a pesticide with a diluent for the purpose of application.

1.47 Noncertified Applicator means a person who is not certified under this rule and uses a pesticide.

1.48 Non-commercial Applicator means a person who uses a Class A or Class B pesticide in the course of their employment on their employer's property.

1.49 Ornamental means plants such as flowers, shrubs, and trees used for decorative purposes, shade, or other landscape purposes.

1.50 Person means any individual, partnership, association, corporation, or organized group of persons whether incorporated or not, including:

(a) an unincorporated organization, trust, or other legal or commercial entity, including a joint venture or affiliated ownership;

(b) a municipality or state agency;

(c) individuals and entities affiliated with each other for profit, consideration, or any other beneficial interest derived from agricultural management, including lessors and lessees; or

(d) a farmer, rancher, vineyardist, apiarist, plant propagator, Christmas tree grower, aquaculturist, floriculturist, orchardist, forester, migrant farmworker or another comparable person.

1.51 Pesticide means economic poison as defined in 6 V.S.A. § 911 and Section 1.29 of this rule.

1.52 Potable Water Supply means the same as it is defined in 10 V.S.A. Chapter 064.

1.53 Potable Water Source means a component of a potable water supply that withdraws or collects water from soil or bedrock. Potable water sources include springs; drilled, driven, or dug wells; and surface water.

1.54 Practical Knowledge means the possession of pertinent facts and comprehension sufficient to properly perform functions associated with the use of a pesticide, including properly responding to reasonably foreseeable problems and situations.

1.55 Prescreened Pesticide List means a list of pesticides that, based on their human and ecological toxicity, relative immobility, and limited persistence in the environment (as measured by parameters such as, but not restricted to, solubility, KOC, and half-life) are deemed unlikely, under normal conditions and use, to leave established turf grass and enter surface or ground water.

1.56 Private Applicator means any person who uses a non-restricted use pesticide on property owned or rented by the applicator that is residential in nature or on property owned or rented by the applicator or the applicator's employer for the production of an agricultural

commodity. Private applicators may apply a pesticide to the property of a neighboring producer of an agricultural commodity, provided that the applicator receives no compensation other than the trading of personal services between the applicator and their neighbor.

1.57 Public Water Source means the same as it is defined in 10 V.S.A. Chapter 056.

1.58 Residential Dwelling Unit means any room or group of rooms located within a structure and forming a single habitable unit with facilities that are used, or are intended to be used, for living, sleeping, cooking, and eating. This definition includes a building or structure or part of a building or structure that is used for a home or residence by one or more persons who maintain a household. It also means a mobile home regardless of ownership of the land. This definition does not include a guest room at a hotel or motel.

1.59 Restricted Use Pesticide means a pesticide classified as State or federally restricted and is synonymous with a Class A pesticide.

1.60 Right-of-way means an interest in real property, above, on, or below the ground, that entitles the holder of the interest to pass over the land for the purpose of carrying, transmitting, or transporting liquids, gases, electricity, communications, vehicles, or people. For the purpose of this rule, it is immaterial whether the right-of-way is owned, leased, or an easement.

1.61 Secretary means the Secretary of the Agency of Agriculture, Food and Markets, and their designees.

1.62 Service Container means any container, other than an original container that is filled with an EPA-registered pesticide, used to hold, or transport a pesticide concentrate or a pesticide use-dilution preparation prior to application. A service container is neither used to distribute or store a pesticide nor does the definition include pesticide application equipment.

1.63 Simple Dilution Analysis means an analysis involving the dilution of a chemical with an expected volume of precipitation available for infiltration within a watershed or hydrologic unit. Simple Dilution Analysis is used to assess the potential for a contaminant to be transported to groundwater through the process of infiltration.

1.64 Spray Drift means the movement of pesticide dust or droplets through the air at the time of application or soon after, to any site other than the area intended.

1.65 State Restricted Use Pesticide means a pesticide classified by the Secretary as Class A but does not bear labeling as Restricted Use.

1.66 Storage means the holding of a pesticide for use or distribution in an area other than the sales floor of a licensed retailer.

1.67 Storage Facility means a location at which bulk pesticide is held in storage.

1.68 Surface Water means all rivers, streams, brooks, reservoirs, ponds, lakes, springs, and all bodies of waters, artificial or natural, that are contained within, flow through, or border the State or any portion of it.

1.69 Turf means a covering of mowed grass vegetation growing together with an upper soil stratum of intermingled roots and stems.

1.70 Undue Hazard means A substance that harms human health and the environment based on studies prepared for pesticide registration, independent peer-reviewed studies, and other data as may be requested by the Secretary.

1.71 Use means:

(a) pre-application activities involving mixing and loading a pesticide;

(b) applying a pesticide, including supervising the use of a pesticide by a noncertified applicator;

(c) other pesticide-related activities, including transporting or storing a pesticide container that has been opened, cleaning equipment, and disposing of any excess pesticide, spray mix, equipment wash water, a pesticide container, and other pesticide-containing material; or

(d) recommending the use of a pesticide.

1.72 Utility means a privately, publicly, or cooperatively owned line, facility, or system for producing, transmitting, or distributing communications, cable television, power electricity, light, heat, gas, oil, crude products, water, steam, waste, stormwater not connected with the highway drainage or any other similar commodity, including any fire or police signal system or highway lighting system, that directly or indirectly serves the public. The term shall mean the utility company inclusive of any wholly owned or controlled subsidiary.

1.73 Vapor Drift means the movement of a pesticide in the form of a volatilized gas to any site other than the area intended.

1.74 Wastewater and Potable Water Supply Rules means Chapter 1 of the Environmental Protection Rules adopted pursuant to 10 V.S.A. Chapters 47, 56, and 64, as amended.

Section 2. Powers of the Secretary

2.01 Issuance of Licenses, Certificates, and Permits

The Secretary may issue licenses, certificates, and permits pursuant to 6 V.S.A. Chapter 87.

2.02 Denial, Amendment, Suspension, or Revocation of Licenses, Certificates, or Permits

(a) The Secretary may deny, amend, suspend, or revoke any license, certificate or permit for failure to comply with 6 V.S.A. Chapter 87 or any rule adopted under its authority or for being subject to a final order imposing a civil penalty under 7 U.S.C. Section 136l or for being convicted under 7 U.S.C. Section 136l on due notice to the licensee or holder of the certificate or permit, with an opportunity for hearing if a written request is filed with the Secretary within five days of receipt of a notice of violation.

(b) If the Secretary finds that public health, safety, or welfare requires emergency action and the Secretary incorporates a finding to that effect in the order, summary suspension of a license, certificate or permit may be ordered, pending proceedings for revocation or other action.

2.03 Restriction and Regulation of Ineffective and Hazardous Products or Devices

(a) The Secretary may restrict, regulate, or deny registration of any pesticide product or device that is deemed to be ineffective, or that constitutes an undue hazard to the public or the environment.

(b) Any person aggrieved by a decision of the Secretary under this section may request a hearing within 15 days of the receipt of notice of the decision. The hearing shall be for the purpose of reviewing evidence pertaining to the ineffectiveness of the product or the hazard presented to the public from its use.

2.04 Pesticide Cease and Desist Order

(a) The Secretary may issue a cease and desist order for failure to comply with 6 V.S.A. Chapter 87, or any rule adopted under its authority with an opportunity for hearing if a written request is filed with the Secretary within five days of receipt of the cease and desist order.

(b) It shall be unlawful to violate a cease and desist order.

2.05 Right of Entry

The Secretary or a designee thereof may enter any premises, public or private, as may be necessary to carry out the provisions of 6 V.S.A. Chapter 87 and this rule, including inspecting pesticide application sites, records, equipment, or to obtain pesticide samples.

2.06 Reciprocal Agreements

(a) The Secretary may enter into a reciprocal agreement with officials of other states and federal agencies and issue certificates to a certified applicator of another state on a reciprocal basis provided that:

(1) the certification requirements are substantially the same as those required by Vermont;

(2) the certified applicator knows and abides by Vermont's pesticide control law and rules;

(3) the certified applicator pays all appropriate fees; and

(4) the certified applicator is a resident of and has a valid pesticide applicator license or certificate issued by a state that has established a reciprocal agreement with Vermont.

(b) The certified applicator's reciprocal certificate is valid for an entire calendar year.

(c) Applicators with certificates that expire on dates other than December 31 of each year shall provide confirmation that their certificate has been renewed by their state of residence within 45 days from the date of expiration.

(d) Failure to provide confirmation shall result in the revocation of reciprocal certificates.

(e) The certified applicator shall notify the Secretary within 30 days of termination of their reciprocal state's certification.

Section 3. Licenses, Certificates, and Permits Issued by the Secretary

3.01 Company License

(a) A business entity that uses a pesticide on the land or home of another person for remuneration or gratis shall obtain a company license that shall expire on December 31st of the year that the license was obtained.

(b) The following are exempted from the requirement of Section 3.01(a):

(1) A Doctor of Medicine or Doctor of Veterinary Medicine applying a pesticide as a drug or medication during the course of practice.

(2) Applicators certified under research, demonstration, or sales programs only making recommendations and applying a pesticide in research, demonstration, or sales programs.

(3) Private applicators.

(4) Non-commercial applicators.

(c) Business entities required to obtain a company license shall:

(1) be responsible for ensuring that they employ pesticide applicators that are properly certified under this rule, except those employees working under the direct supervision of a certified applicator do not need to be certified;
(2) send written notice to the Secretary within 30 days whenever a certified commercial applicator is terminated from employment; and
(3) renew the company license annually.

3.02 Dealer License

(a) No person shall distribute a pesticide within the State without the appropriate license.
(b) A person who distributes a Class A pesticide shall obtain a Class A license, that entitles the licensee to sell Class A, Class B, and Class C pesticides.
(c) A person who distributes a Class B pesticide shall obtain a Class B license, that entitles the licensee to sell Class B and Class C pesticides.
(d) A person that distributes only Class C pesticides shall obtain a Retail/Class C license and is exempt from the examination requirements of Section 3.03.
(e) A person that distributes a Class A or Class B pesticide shall employ a full-time employee that has the appropriate license for the pesticide class being distributed. A full-time employee shall be a person who works at least 32 hours per week on a year-round basis.

3.03 Dealer Licensure Examination Requirements

(a) A candidate for Class A and B licenses shall submit to a written examination covering competency standards and recordkeeping requirements, including adequate knowledge of rules, Vermont classification of a pesticide, pesticide labels, safe handling, hazards, spill cleanup, and proper disposal.
(b) A candidate shall have a maximum of three opportunities to achieve a passing score on the certification examination during a 12-month period. This 12-month period shall begin on the date the candidate takes the first examination. After an initial failing score, a candidate must wait at least seven calendar days to retake the examination. If a candidate fails twice, there shall be at least a 28 calendar day waiting period from the first examination date before taking the exam for the third time.
(c) Licensed Class A and Class B dealers are required to notify the Secretary, in writing, within 30 days of termination or a change of employment, including a change from one branch store location to another.
(d) A license may be renewed without examination provided that the conditions under which the original license was issued have not changed. The Secretary may determine that additional instruction or examination is necessary to meet new criteria relative to any use and require re-examination or training prior to renewal.
(e) A license not renewed within 365 days shall be considered lapsed and shall require re-examination prior to any re-issuance.

3.04 Applicator Certificates

(a) Commercial and non-commercial applicator certificates.

(1) A person who uses or supervises the use of a pesticide to the lands and homes of others whether for remuneration or gratis, except those who work under the direct supervision of a certified applicator, shall obtain certification as a commercial applicator.

(2) A person who uses or supervises the use of a Class A or Class B pesticide in the course of their employment on their employer's property, except those who work under the direct supervision of a certified applicator, shall obtain certification as a noncommercial applicator.

(b) Private applicator certificate. A person who uses or supervises the use of a Class A pesticide on property owned or rented by the person or their employer for the production of an agricultural commodity shall obtain certification as a private applicator.

(c) Exemptions.

(1) A Doctor of Medicine or Doctor of Veterinary Medicine who applies a pesticide as a drug or medication during the course of practice is exempt from the certification requirement.

(2) Any person conducting laboratory research involving a pesticide.

(d) All sales or technical field representatives who recommend, demonstrate, or distribute a Class A or Class B pesticide directly to an end user in this State, and who is not employed at a dealer outlet, shall obtain certification in Category 10 and the category or categories of products sold.

(e) Any applicator who uses a federally restricted use pesticide under the provisions of FIFRA shall be certified under this rule. A noncertified applicator shall not use a federally restricted use pesticide under direct supervision.

3.05 General Requirements for Applicator Certification

A candidate for certification shall:

(a) be at least 18 years of age;

(b) submit to a written examination(s) covering the applicable competency standards described in Sections 8 and 9;

(c) be certified in each category and sub-category, if applicable, that they intend to work in; and

(d) have a maximum of three opportunities to achieve a passing score on the certification examination during a 12-month period that shall begin on the date the candidate takes the first examination. After an initial failing score, a candidate must wait at least 7 calendar days to retake the examination. If a candidate fails twice, there shall be at least a 28-calendar day waiting period from the first examination date before taking the exam for the third time. Re-examination fees may apply.

3.06 Certification of Commercial and Non-commercial Applicators

(a) Certification shall expire on December 31st of the year that the certificate was obtained.

(b) Certification may be renewed annually for up to five years, after which recertification shall be required, either through training or re-examination.

(c) The Secretary may require recertification whenever necessary and determine the procedure for additional training or re-examination.

(d) Certified non-commercial or commercial applicators shall send written notice to the Agency within 30 days of termination or changing employers.

(e) A certificate not renewed in 365 days shall be considered lapsed and shall require re-examination prior to any re-issuance.

3.07 Certification of Private Applicators

(a) Certification is valid for five years, after which recertification shall be required either through training or re-examination.

(b) The Secretary may require recertification whenever necessary and shall determine the procedure for additional training or re-examination.

(c) The Secretary shall require that private applicators obtain certification, regardless of the class of pesticide used, for certain use patterns, including soil and commodity fumigation or aerial application.

(d) A certificate not renewed by April 1st of the year following the expiration of the certificate shall be considered lapsed and shall require re-examination.

3.08 Permits

(a) A person who intends to use a pesticide in any of the following areas or manners shall first obtain an approved permit from the Secretary:

(1) Right-of-way, exclusive of terrestrial invasive plant control
(2) Aerial
(3) Experimental use
(4) Golf course

(b) A person who intends to use a pesticide in any of the following areas or manners may be required to obtain an approved permit from the Secretary:

(1) Mosquito larvicide
(2) Mosquito adulticide
(3) Terrestrial invasive plant control
(4) Bird or animal control

3.09 Requirements for Licenses, Certificates, and Permits

Any form required by the Secretary shall be filled out completely and accurately and any applicable fee shall be remitted to the Secretary.

3.10 Denial, Amendment, or Revocation of Licenses, Certificates, and Permits

(a) The Secretary may deny, amend, or revoke issuance of a license, certificate, or permit to a person:

(1) who fails to demonstrate competency on any examination;
(2) who is currently under a suspension or revocation by the Secretary;
(3) who fails to provide accurate and complete information to the Secretary;
(4) who fails to remit appropriate fees to the Secretary; or
(5) for any other reason that the Secretary deems appropriate.

(b) The Secretary may amend a license, certificate, or permit upon written request and after review.

(c) Any pesticide applicator certificate issued may be revoked or further restricted when the Secretary determines that the restrictions are necessary to protect human health or the environment.

(d) A person whose license, certificate, or permit is denied, amended, or revoked may appeal the Secretary's determination within 15 days of receiving notice of the denial, amendment, or revocation by requesting a hearing, in writing, to the Secretary in accordance with 6 V.S.A. Chapter 1.

Section 4. Classification of Pesticides and Limitations on Sale

4.01 Classification and Registration

(a) The EPA classifies all registered pesticides available to consumers as either general use or restricted use for the purposes of federal regulation. Vermont recognizes federal and State restricted use pesticides as Class A. Vermont classifies any registered pesticide used, sold, distributed, or manufactured within the State into three categories known as:

(1) Class A - Restricted Use – Federal and State;
(2) Class B - Controlled Sale; and
(3) Class C - Homeowner.

(b) Any pesticide sold in Vermont shall be registered with the State under 6 V.S.A. Chapter 81.

4.02 Identification of Class A – Restricted Use, Class B – Controlled Sale, and Class C – Homeowner Pesticides

(a) Class A – Restricted Use – Federal are federally restricted use pesticides identified by the EPA designation "Restricted Use Pesticide" on the product label.

(b) Class A – Restricted Use – State are pesticides classified as general use by the EPA and reclassified as restricted use by the Agency after consideration of the following:

(1) Toxicological profile, including acute, subchronic, and chronic effects.
(2) Environmental profile, including aquatic and wildlife effects.
(3) Physical hazard profile, including the potential for fire, explosion, and reactivity.
(4) Potential for ground and surface water contamination.
(5) Potential for misuse.
(6) Potential for drift.
(7) Container construction and size.
(8) Those requiring training due to special concerns.
(9) Method of application.
(10) Product label statements, such as "professional use".

(c) Class B – Controlled Sale includes all turf products and any pesticide that is for use outside of the home and not marketed as ready-to-use, excluding products containing either *Bacillus thuringienesis* or potassium fatty acids regardless of percent of total active ingredient and does not meet Class A definition. The Secretary reserves the right to classify additional pesticides as Class B.

(d) Class C – Homeowner includes any pesticide applied in and around the home and that are marketed as ready-to-use and have total active ingredient of 3% or less. The following additional pesticides are classified as Class C.

(1) Class C pesticides with a limited percentage of active ingredient include dichlorvos-impregnated strips (DDVP) with concentrations not over 20% in resin strips and pet collars.

(2) Class C pesticides with an unlimited percentage of active ingredients include the following:

(A) pet supplies including shampoos, dips, and tick and flea control products;

(B) wood preservatives and sapstain control agents other than creosote, inorganic arsenicals, and pentachlorophenol;

(C) animal and insect repellents;

(D) moth flakes, crystals, cakes, and nuggets;

(E) indoor aquarium products;

(F) swimming pool products;

(G) pediculocides and mange cure on humans;

(H) pheromone baits and lures;

(I) premixed paints that make pesticidal claims;

(J) antimicrobial agents such as disinfectants, bacteriostats, bactericides, mildewcides, mildewstats, viricides, sanitizers, slimicides, sterilants, and industrial preservatives;

(K) insecticides containing bacillus thuringiensis, bacillus popilliae, bacillus lentimorbus, or potassium fatty acid; and

(L) animal ear tags.

(3) The Secretary reserves the right to classify additional pesticides including non-homeowner products as Class C.

4.03 State Prohibited Pesticides

(a) The distribution, sale, or use of pesticides cancelled or suspended by the EPA or the Agency, shall not be allowed in the state of Vermont, except as provided for the disposition of existing stocks in the cancellation or suspension order published in the Federal Register by the EPA or by order of the Agency.

(b) The Agency may add additional restrictions to the conditions of distribution, sale, or use of pesticides provided for the disposition of existing stocks in the cancellation or suspension order published in the Federal Register by the EPA or by order of the Agency in order to protect human health or environmental quality.

4.04 Limitations on the Sale of Pesticides

(a) Limitations on sales of Class A – Restricted Use – Federal and State.

(1) Dealers shall obtain a Class A dealer's license before they may distribute a Class A - Restricted Use pesticide.

(2) A Class A pesticide shall be sold only to certified applicators with certification in the appropriate category specific to a use site on the pesticide label.

(3) A Class A pesticide shall not be displayed for self-service or stored in food or feed areas.

(b) Limitations on sales of Class B pesticides.

(1) Dealers shall obtain a Class A or Class B dealer's license before they may distribute a Class B pesticide to the public.

(2) A Class B pesticide shall not be stored or displayed in areas containing food or feed.

(c) Limitations on sale of Class C pesticides.

(1) A dealer shall obtain either a Class A, Class B, or Class C (retail) dealer's license before they may sell a Class C pesticide to the public.

(2) A Class C pesticide may not be stored or displayed in food or feed areas.

4.05 Availability of Information

The Secretary shall make available pesticide product classifications in a public format.

Subchapter 4 – Transportation and Storage of Pesticides; Bulk Pesticide Storage; Disposal of Pesticides and Containers

Section 11. Transportation and Storage of Pesticides

11.01 Transportation

(a) To prevent any discharges, applicators and dealers shall ensure:

(1) containers are secured during transportation so they may not shift, become punctured, or otherwise compromised; and

(2) vehicles owned, leased, rented, or borrowed by them for the purpose of transporting a pesticide are placarded in accordance with State and federal transportation rules.

(b) Any pesticide held or stored in or on a vehicle shall be secured to prevent access by unauthorized persons or wildlife during use or transport.

11.02 Pesticide and Container Storage by Applicators and Class A and B Dealers

Applicators and Class A and B Dealers shall ensure:

(a) Any pesticide shall be stored in accordance with requirements and precautionary storage instructions contained on the product label.

(b) Any container shall have a legible manufacturer label indicating the contents.

(c) Any pesticide or container that has not been triple rinsed shall be stored in a separate room and in such a manner as to prevent contamination to food, feed, seed, livestock remedies, drugs, plants, and other products or materials from the volatilization of a pesticide, the leakage or breakage of containers, or other causes.

(d) Any pesticide shall be stored inside and protected and secured in such a manner to prevent access from unauthorized persons and wildlife.

(e) The floor surface of the pesticide storage area shall be smooth, facilitating the complete recovery of any discharge. Floor surfaces may include sealed concrete and plastic.

(f) Earthen floors shall be prohibited in a pesticide storage area unless all containers are placed in a containment vessel designed to recover and contain any discharge.

(g) The pesticide storage area shall be identified by legible signage clearly indicating that a pesticide is in storage, as follows:

(1) Sign(s) shall include the word "Warning," "Danger," or "Pesticides" followed by wording that indicates a pesticide is in storage.

(2) Lettering of the words "Warning," "Danger," or "Pesticides" shall be a minimum of one and 1/2 inches in height.

(h) The pesticide storage area shall be adequately vented to the outdoors prior to entry.

(i) Containment vessels used for pesticide storage and handling shall be of materials and construction compatible with the pesticide stored and the conditions of storage and maintained in a manner as to minimize the possibility of a discharge.

(j) In conjunction with pesticide storage, ambulance and fire department phone numbers or the 911 number shall be displayed at a central location where all persons have access.

(k) A pesticide storage area shall maintain sufficient lighting to allow the observation of containers and their labeling.

(l) Storage of pesticide in bulk shall comply with the bulk pesticide storage rules under Section 12.

(m) Cabinets, storage bins, lockers, or similar type storage compartment shall be considered a pesticide storage area provided that the storage compartment complies with subsections (a) – (d), and (i) – (k) of this section.

(n) Floor drains not used in conjunction with catch basins shall be prohibited in a pesticide storage area.

(o) A pesticide storage area may be equipped with a catch basin, provided that:
  (1) there are no pipes attached;
  (2) it is constructed for complete recovery of a discharge; and
  (3) it is located within the floor where liquids can be transferred to an above ground container in the event of a spill or discharge onto the floor.

(p) A pesticide storage area shall be maintained in a clean condition.

(q) At a minimum, any discharge shall be cleaned up within 60 minutes.

(r) Any container, held by an end user, having the capacity for holding greater than 55 gallons but less than 300 gallons of bulk pesticide, known as mini-bulk containers, shall be exempt from subsections (c), (e) – (h), (j) – (p) of this section provided that:
  (1) the container is identified with pesticide labeling that is affixed to the mini-bulk container by the dealer or person who sold or distributed the product;
  (2) there is a mechanism attached to the container for the purpose of securing the dispensing apparatus; and
  (3) within 90 days of receipt of the pesticide in the mini-bulk container, the container is returned to the dealer.

(s) The following minimum buffer distances are maintained around any public water source:
  (1) 100-foot buffer for all public non-community groundwater drinking water sources; and
  (2) 200-foot buffer for all public community drinking water sources and intakes, and surface water public non-community drinking water intakes.

12.11 Emergency Actions and Notification

(a) A person responsible for the application, storage or handling of a pesticide upon knowledge of an accident involving such pesticide shall immediately take actions intended to protect human health and the environment, including but not limited to emergency containment measures, and notification as described within this section.

(b) All Class A, B, and C Dealers, certified commercial and non-commercial applicators, certified private applicators, licensed pesticide applicator companies, pesticide producing establishments and persons working for licensed applicator companies under the supervision of a certified applicator, shall report pesticide accidents immediately by telephone to either:
  (1) Vermont Agency of Agriculture, Food and Markets, 116 State Street, Montpelier, VT 05620-290, (802) 828-2431; or
  (2) Vermont Department of Public Safety, 45 State Dr, Waterbury Village Historic District, VT 05676, 1-800-641-5005.

Section 13. Disposal of Pesticides and Containers

13.01 Management of Pesticide Containers Prior to Disposal

(a) Unused or unwanted pesticide being stored prior to disposal, whether in a sealed or previously opened container, and any pesticide container that has not been or cannot be rinsed shall be:
  (1) kept in a secure enclosure; and
  (2) maintained to prevent:
    (A) deterioration of containers;
    (B) unauthorized use;
    (C) mishandling;
    (D) loss;
    (E) contamination of the environment; and
    (F) risk to the public health.

(b) Disposal of pesticide containers shall comply with labeling instructions and State and federal rules.

(c) If practical, pesticide drums shall be shipped to recycling centers capable of handling pesticide containers.

(d) Empty pesticide containers shall not be stored or accumulated within a secondary containment facility.

13.02 Obsolete, Excess, and Mixtures of Pesticides

Obsolete, excess, and mixtures of pesticide shall be returned to the manufacturer, supplier or formulator for recycling, destruction or disposal or disposed of according to the statutes and rules established by 10 V.S.A. Chapter 159: Waste Management.

13.03 Disposal of Empty Containers

All containers made of materials other than paper shall be triple-rinsed and punctured prior to disposal.

Subchapter 5 – Severability; Effective Date

Section 14. Severability

If any provision of this rule, or the application thereof to any person or circumstance, is held invalid, such determination shall not affect other provisions or applications of this rule that can be given effect without the invalid provision or application, and to that end the provisions of this rule are severable.

Section 15. Effective Date

This rule shall become effective on February 24, 2023.

Federal Pesticide Laws

Chapter III

The United States government mainly through the Environmental Protection Agency (EPA) has set standards for pesticide handling and use. Some practices which were suggested for proper use in the past are now required by law. These include such areas as record keeping, transportation, storage and disposal procedures, reentry intervals, filling and mixing methods, etc. For many applicators these practices are already part of a regular routine. For other applicators some adjustment must be made to meet these new requirements. All the new standards are designed to reduce the risks, to both people and the environment.

Goals of This Chapter

- Become familiar with the names and acronyms of the laws and government agencies involved with pesticides.
- Understand the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).
- Become familiar with, as well as understand the laws and regulations (in addition to FIFRA) listed in this chapter.
- Be aware that new laws and regulations will occur in the future.

Federal laws and regulations set the standards for pesticide use. States have the right to be stricter than the federal law. The applicator is responsible for knowing and complying with the federal laws and regulations and the specific requirements in each state they may be working in.

The United States Congress established the Environmental Protection Agency (EPA) in 1970 and has mandated that the agency regulate pesticides. The U.S. Department of Agriculture (USDA) regulated pesticides before EPA was created. Through its Office of Pesticide Programs (OPP), EPA uses the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) to manage its mandate.

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

FIFRA was enacted in 1947 replacing the Federal Insecticide Act of 1910 and has been changed (amended) several times since then. The most important amendment to FIFRA was the Federal Environmental Pesticide Control Act (FEPCA) of 1972 which shifted the emphasis of FIFRA from safeguarding the consumer against fraudulent pesticide products, to a role of protecting both public health and the environment.

FIFRA governs the licensing or registration of pesticide products. No pesticide may be marketed in the U.S. until EPA reviews an application for registration, approves each use pattern, and assigns a product registration number. Registration decisions are based upon data demonstrating that the use of a specific pesticide will not result in *"unreasonable human health or environmental effects"*. In other words, FIFRA balances the risks a pesticide may pose with its benefits to society.

- requires that EPA register all pesticides as well as each use of that pesticide and approves the product label.
- requires the classification of all registered pesticides as either "general use" pesticides which can be used by anyone or "restricted use" pesticides if the environment or user could be harmed even if the pesticide is used as directed (state requirements are often stricter).
- requires that the users of "restricted use" pesticides must be certified as, or under the direct supervision of either "private" or "commercial" applicators. Certification is to be carried out by the states (except in Colorado and Nebraska which have federal programs).
- establishes tolerances for residues that may remain on raw agricultural products or in processed food
- provides penalties for "use inconsistent with the labeling" of a pesticide.
- makes it illegal to store or dispose of pesticides or containers other than as directed by regulations and provides penalties for illegal handling of containers.
- provides civil penalties when the violation of a regulation is unintentional. Fines can be $1,000 for private applicators and others or as much as $5,000 for each offense by commercial applicators. Before EPA can fine you, you have the right to ask for a hearing in your own city or county.
- provides criminal penalties when the law is knowingly violated. The maximum penalty for private applicators and others is $1,000 and/or 30 days in prison. Commercial applicators may be fined up to $25,000 or one year in prison, or both.
- permits states to establish stricter standards, but not more permissive standards.

FIFRA gives EPA the authority to develop regulations. Regulations are interpretations of the law (in this case FIFRA) and have the force of a law. The following are items from EPA's regulations published in the Code of Federal Regulations (CFR) Title 40.

- provides standards for worker protection
- provides reentry standards for treated areas

EPA defines *"Reestricted Entry Intervals"* as the time immediately following application of a pesticide when unprotected workers may not enter the treated area. The regulations state that:

- no unprotected person may be in the treated area during pesticide application.

- no pesticide application is to be permitted that will expose any person to pesticides, either directly or through drift, excepting those involved in the application.
- if labeling for worker reentry is more restrictive than the general standards specify, the label restrictions must be followed instead of the general regulations.
- when no reentry time is specified, treated areas can be reentered without protective clothing after the spray has dried or the dust has settled, unless the pesticide is exempt from reentry requirements.
- warnings of pesticide applications appropriate and timely to the situation are to be given to workers either through oral communication, by posting, or both. Warnings should be given in the language that can be understood by the workers involved.

Pesticide Registration

Under FIFRA, EPA has registered approximately 50,000 pesticide products. How the EPA handles each registration application depends on whether the product is new or has one or more uses already registered.

New Pesticides or New Formulations (Since 1972)

The law requires EPA to take into account economic, social, and environmental cost and benefits in making decisions. Pesticide registration decisions are based on Agency evaluations of test data provided by the manufacturer. Required studies include testing to show whether a pesticide has the potential to cause adverse effects in humans, fish, wildlife, and endangered species. Potential human risks include acute reactions or eye irritation, as well as possible long-term effects like cancer, birth defects, or reproductive system disorders. Data on "environmental fate," or how a pesticide behaves in the environment, also are required so that EPA can determine, among other things, whether a pesticide poses a threat to ground or surface water. Most registration decisions are for new formulations containing active ingredients already registered with EPA, or new uses of existing products.

Old Pesticides

Old pesticides registered and in use before current scientific standards were established also must be evaluated by the "no unreasonable adverse effects" guidelines applied to new pesticides. This is being accomplished through EPA's Data Call-In program by issuance of "Registration Standards and Reregistration of registered pesticides."

EPA Options for Regulation

In regulating pesticides under FIFRA, EPA chooses from a variety of options. If the risk is to people who mix, load and apply the pesticide, EPA can require:

- personal protective clothing such as gloves, hats, respirators or chemical-resistant suits.
- restriction on uses of the pesticide, or require use only by certified pesticide applicators.
- prohibition of certain formulation types such as dusts, granules, ultra-low volume concentrates or sprays.
- engineering controls such as enclosed cabs or closed mixing/loading systems.
- warning statements on the label such as cancer or birth defect risks, to encourage greater compliance with risk reduction measures stated on the label.
- restrictions on application rates or in the frequency of applications.
- prohibition of certain application methods such as aerial applications or backpack sprayers.
- other integrated pest management practices such as mechanical methods or spraying only where infestation has occurred.

If the risk is to farmworkers who reenter treated fields, EPA can require:

- restricted entry intervals which restrict farmworkers from entering a field for a certain period of time, unless they are wearing specified protective clothing.
- restriction in formulation type or application rates.
- oral notification or posting of signs to warn farmworkers that treatment has occurred.

If the risk is to consumers of crops which have been treated with pesticides, EPA can require:

- longer preharvest intervals so that residues will have more time to dissipate.
- changes in the manufacturing process of pesticides to reduce levels of contaminants or impurities.
- restrictions in the frequency of application and/or rates.

EPA can also cancel or deny registration for the uses of a pesticide. In such a case, EPA can either cancel or deny certain uses or all uses where risks are particularly high. It is possible that they may deny or gradually remove a pesticide from the marketplace to allow the development of alternative chemicals or technologies.

EPA can suspend the use of a pesticide on a regular or an emergency basis if the Agency believes the pesticide poses an imminent hazard. Suspension halts the use of a pesticide until a decision on its registration can be made through the cancellation process.

Chapter 3 - Federal Laws

1. What is the full name and acronym of the federal agency mandated to regulate pesticides?

2. What is the full name and acronym for the law that EPA uses to manage pesticides.

3. FIFRA governs the licensing or registration of pesticide products. Before a pesticide may be marketed in the US, what must EPA do?

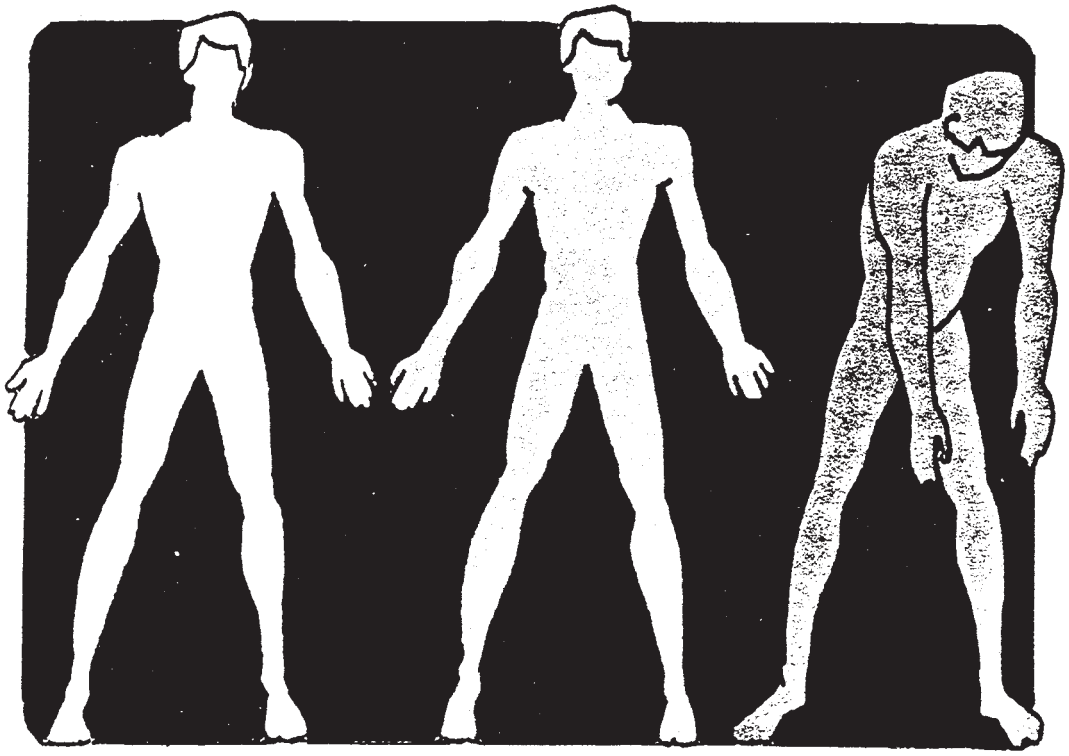
4. What is EPA's pesticide registration decision based upon?

5. If EPA determines that a pesticide poses a risk to consumers, what options for regulation does EPA have?

Toxicity of Pesticides

Chapter IV

A pesticide is any substance used to control pests. Pests may be target insects, vegetation, fungi, etc. Most control the pests by poisoning them. Unfortunately, pesticides can be poisonous to humans as well. Some are very poisonous, or toxic, and may seriously injure or even kill humans. Others are relatively non-toxic. Pesticides can irritate the skin, eyes, nose, or mouth. The most important thing to remember is that you should always use caution whenever you work with any pesticide!



Goals of This Chapter

- Understand what toxicity is and how it affects humans.
- Learn the three routes of entry (how pesticides enter the body) and the importance of each.
- Be familiar with how toxicity is measured and what is meant by label warning statements.

Toxicity: What is it?

The toxicity of a substance is its capacity to cause injury to a living system. A living system can be many things: a human body, or parts of the body (such as the lungs or the respiratory system); a pond, a forest and those creatures that live there. Toxicity represents the kind and extent of damage that can be done by a chemical. In other words, if you know the toxicity of a pesticide, you know "how poisonous" it is.

Dose-Time Relationship

The effect of a pesticide, or any substance for that matter, is dependent on a number of factors. The most important factor is the dose-time relationship. Dose is the quantity of a substance that a surface, plant, or animal is exposed to. Time means how often the exposure occurs. Thus, the dose-time relationship is how much of the substance is involved and how often the exposure to the substance occurs. This relationship gives rise to two different types of toxicity that pesticide applicators must know and understand. They are acute and chronic toxicity.

Kinds of Toxicity

Acute vs.Chronic

***Acute* toxicity** refers to how poisonous a pesticide is to a human, animal, or plant after a single short-term exposure. Acute toxicity is used to describe effects which appear promptly, or within 24 hours of exposure. A pesticide with a high acute toxicity is deadly even when a very small amount is absorbed. Acute toxicity levels are used as a way to assess and compare how poisonous pesticides are. The acute toxicity of a pesticide is used as the basis for the warning statements on the label. Acute toxicity may be measured as acute oral toxicity, acute dermal toxicity, and acute inhalation toxicity.

***Chronic* toxicity** is the delayed poisonous effect from exposure to a substance. Chronic toxicity of pesticides concerns the general public, as well as those working directly with pesticides because of potential exposure to pesticides on/in food products, water, and the air. It is measured in experimental conditions after three months of either continuous or occasional exposure.

A material that has high acute toxicity does not necessarily have high chronic toxicity. Nor does a chemical with low acute toxicity necessarily have low chronic toxicity. For many pesticides, the toxic effects following single acute exposures are quite different from those produced by chronic exposure. If, for example, large amounts of the pesticide cryolite are eaten by rats at one time little or no harmful effects will be observed. It quickly passes through the intestinal tract and is eliminated without harmful effects. However, if rats are fed small amounts of cryolite every day in their feed, they become ill and die. Cryolite is a very insoluble compound, meaning that it does not readily dissolve. The small amount of chemical that is absorbed from a one-time exposure is not sufficient to cause illness, but absorption of the same small amount every day, day after day, can cause chronic illness and death. The effects of both acute toxicity and chronic toxicity are dose-related; the greater the dose, the greater the effect.

While you cannot change the inherent toxicity of pesticides, you can limit the possibility of poisoning by preventing and/or limiting exposure. In other words, the risk of harm from pesticide exposure is equal to how poisonous the pesticide is, multiplied by the amount and route of exposure to the pesticide, or:

RISK = TOXICITY X EXPOSURE

Types of Pesticide Exposures

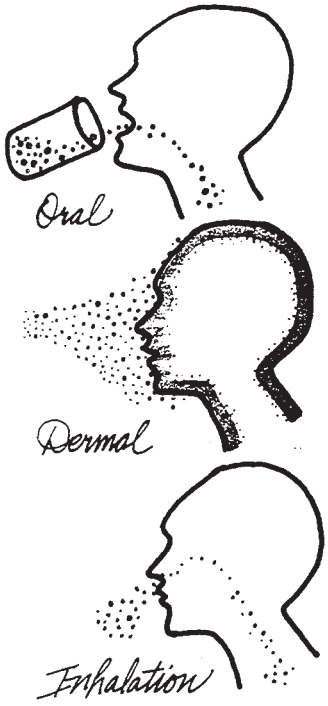
A pesticide exposure is defined as coming in contact with a pesticide. There are two types of exposure that may occur, acute and chronic.

Acute exposure refers to a one-time contact with a pesticide. When experimental animals are exposed to a pesticide to study its acute toxicity, acute exposure is defined as contact for 24 hours or less. Acute effects can be readily detected and more easily studied than chronic effects. Immediate toxic effects are more likely to be produced by those pesticides that are rapidly absorbed.

Chronic exposure refers to a repeated contact with a pesticide. The study of chronic toxicity is accomplished by repeatedly exposing test animals for more than three months. In addition to producing long-term low-level effects, chronic exposure to pesticides may result in immediate, "acute" effects after each exposure. In other words, frequent exposure to a chemical can produce acute and chronic symptoms. The potential for a chronic effect is related to the level and frequency of exposure received.

Routes of Entry

How pesticides enter the body



There are three specific ways in which pesticides may enter your body. You may be poisoned no matter how they enter. Sometimes you can even be poisoned without knowing it, especially if the pesticide enters through the skin or lungs.

Dermal Route

Wet, dry, or gaseous forms of pesticides can be absorbed through the skin. This may occur if pesticides are allowed to get on the skin while mixing or applying, or if pesticide-contaminated clothing is not removed promptly and properly cleaned before being worn again. Oil or paste forms allow greater absorption through the skin than water-based pesticides. Some pesticides do not pass through the skin very readily. Others are quickly absorbed through the skin and can be as dangerous as if they were swallowed. Skin varies in its capacity to act as a barrier to pesticide absorption. The eyes, ear drums, scalp and groin area absorb pesticides more quickly than other areas on the body. Damaged or open skin can be penetrated by a pesticide much more readily than healthy, intact skin. Once they are absorbed through skin, pesticides enter the blood stream and are carried throughout the body.

Inhalation Route

Whether as dusts, spray mist, or fumes, pesticides can be drawn into your lungs as you breathe. Inhalation of pesticides can occur during the mixing of wettable powders, dusts, or granules. Poisoning can also occur while fumigating or spraying without a self contained breathing apparatus or a proper respirator in enclosed or poorly ventilated areas such as greenhouses, apartments, or grain bins. The largest particles that are inhaled tend to stay on the surface of the throat and nasal passages, and do not enter the lungs. Smaller particles can be inhaled directly into the lungs. The number of particles needed to poison by inhalation depends upon the concentration of the chemical in the particles. Even inhalation of dilute pesticides can result in poisoning. Once they are absorbed through the surfaces of the lungs, chemicals enter the blood stream and are distributed to the rest of the body.

Oral Route

Pesticides can enter the body through the mouth (also called ingestion). This can occur when hands are not properly washed before eating or smoking. They may be swallowed by mistake, if they are improperly stored in food containers. Ingested materials can be absorbed anywhere along the gastrointestinal tract; the major absorption site is the small intestine. Once absorbed, they eventually enter the blood stream by one of several means, and circulate throughout the body.

Which Route Is More Important?

You can be poisoned no matter which way pesticides enter your body. While there are few chemicals that are equally poisonous by all routes of entry, some pesticides can enter all three ways and poison you. (For example, parathion is toxic regardless of how it is absorbed).

The dermal and inhalation routes of pesticide entry are likely to be the most important routes of pesticide applicator exposure. It is unlikely that you would purposely eat or drink the chemicals you are using, but you may breathe them in, splash them on your skin, or expose yourself to pesticide "fallout."

Healthy skin can slow the absorption of a pesticide when dermal contact occurs. Liquid pesticides containing solvents and oil based pesticides are absorbed quickly compared to dry pesticides. The applicator must know that damaged skin (chapped, cut, or abraded) has lost its ability to slow the entry of a pesticide into the body.

The Qualities of the Exposed Individual

The qualities of the exposed individual influence the toxicity of a pesticide since different individual characteristics will affect how the person responds to a pesticide. Some examples of these individual qualities include:

* health conditions: heredity, pregnancy, and disease may cause individuals to respond differently.
* age: youngest and oldest individuals tend to be most sensitive.
* gender/sex: male and female individuals may respond very differently.
* environment: exposure to other toxic substances in food, air, water, etc.
* health behaviors: customs or habits such as smoking, dietary practices, drug use, personal hygiene, etc.
* body size: the effect of a dose is closely related to body weight. The heavier the individual, the more poison needed to cause an effect.

Effects of Toxicity

In addition to being acute or chronic, toxic effects can be any of the following:

***Local or systemic** (Both effects can occur with some pesticides.)

Local effects refer to those that take place at the site of contact with a material. Examples of this include: skin inflammation on the hand, in response to hand contact with a pesticide; or irritation of the mucous membrane lining the lungs, due to inhalation of toxic fumes.

Systemic effects are quite different because they occur away from the original point of contact. Systemic effects may occur when pesticides are distributed throughout the body, or "system". An example of a systemic effect is the blocking of an essential chemical of the nervous system, called "cholinesterase" (pronounced ko-li-nes-ter-ace), upon exposure to some types of pesticides.

***Immediate or delayed** (Both effects can occur with some materials.)

Immediate toxic effects are those which are experienced upon or shortly after exposure. (For example, a sneezing attack in response to inhaling pesticides during mixing).

Delayed effects occur after some time has passed. While they may not be obvious, such as long term reproductive effects, delayed effects can result from a single exposure. Tumors may not be observed in chronically exposed people for 20 to 30 years after the original exposure to a cancer-causing or "carcinogenic" chemical.

***Reversible or irreversible**

Reversible effects are not permanent and can be changed or remedied. Skin rash, nausea, eye irritation, dizziness, etc. are all considered reversible toxic effects. Injury to the liver is usually reversible since this organ has an ability to regenerate itself.

Irreversible effects are permanent and cannot be changed once they have occurred. Injury to the nervous system is usually irreversible since its cells cannot divide and be replaced. Irreversible effects include birth defects, mutations, and cancer.

***Additive, antagonistic, or synergistic**

An **additive** effect is one in which the combined effect of two pesticides is equal to the sum of the effects of each (ie. 2 + 2 = 4.)

An **antagonistic** effect occurs when the toxic effect of the combination of pesticides is less than what would be predicted from the individual toxicities. Antagonism is like adding 2 + 2 and getting 3 as the result.

A **synergistic** effect occurs when the combined toxic effect of two pesticides is much greater, or worse, than the sum of the effects of each by itself. Synergism is similar to adding 2 + 2 and getting 5 as the result.

Exposure to pesticides may also result in the following:

*Reproductive effects:	effects on the reproductive system or on the ability to produce healthy offspring.
*Teratogenic effects:	effects on unborn offspring, such as birth defects.
*Carcinogenic effects:	produces cancer in living animal tissues.
*Oncogenic effects:	tumor-forming effects (not necessarily cancerous.)
*Mutagenic effects:	permanent effects on genetic material that can be inherited.
*Neurotoxicity:	poisoning of the nervous system, including the brain.
*Immunosuppression:	blocking of natural responses of the immune system responsible for protecting the body.

Measuring Toxicity

It is quite difficult to figure out the exact toxicity of a pesticide for humans. Animal testing is the primary way we measure toxicity. Many types of animals are used to test pesticide toxicity, including rats, rabbits, mice, guinea pigs and dogs. However, due to some differences between the way our bodies and the bodies of animals work, results of animal tests cannot always be applied or "extrapolated" to humans. In other words, a pesticide may be more or less toxic to humans than to the animals in which it was tested. Similarly, something that appears to be extremely toxic to test animals may not necessarily be poisonous in humans. **Toxicity studies are just guidelines for estimating and comparing toxic effects of pesticides**. The word "detected" is important when talking about measuring toxic effects. We can only talk about what we can see or observe. The term "No Observable Effect Level", or NOEL, means that at the stated dose, no effects were observed in test animals.

Acute Toxicity Measures

To figure out how acutely toxic a pesticide is, scientists give laboratory animals short-term exposure to doses of the pesticide being tested. Experimental doses are given orally, as well as put on the eyes, skin, and in the air that the test animals breathe. The animals are then observed carefully for changes.

Lethal Dose Fifty (LD_{50})

"Lethal Dose Fifty" (LD_{50}) is one way the toxicity of chemicals are measured. LD_{50} is the amount of a pesticide that has killed half of the animals in a laboratory test. The LD_{50} is found for both dermal and oral routes of exposure. For example, an acute oral LD_{50} indicates the amount of pesticide swallowed that has killed half of the animals tested.

The smaller the LD_{50} value, the less chemical required to kill half of the test animals, and the more poisonous the pesticide. So, a pesticide with a dermal LD_{50} of 25 (rabbit) is more poisonous than a pesticide with a dermal LD_{50} of 2000 (rabbit).

LD_{50}'s do not tell us how a chemical acts, nor do they tell us how sensitive different organs within an animal or human might be. They simply tell us how much of the chemical it takes to kill half of the test animals. LD_{50}'s for different chemicals can only be compared if the same test animal was used, and even then it cannot be taken as an indication of the full toxic potential of either chemical.

Milligrams per kilogram (mg/kg)

Pesticide LD_{50} values are measured in units of weight called "milligrams" per "kilogram" (mg/kg). A single paper clip weighs about one gram. Cutting the clip into 1000 equal parts will make pieces that weigh one milligram each. There are approximately 28,000 milligrams in an ounce. A kilogram is about equal to 2.2 pounds. The LD_{50} value refers to the number of milligrams of pesticide that was needed to kill half of the test animals for each kilogram of the animal's body weight. For example, an acute oral LD_{50} of 5 mg/kg for pesticide A (rats) indicates that it is toxic when there are 5 mg of this chemical given orally for every kilogram (or 2.2 pounds) of the animal's weight.

Parts per million (ppm)

Another way of expressing how much pesticide is involved in toxic doses is referred to as "parts per million", abbreviated "ppm". One part per million means that for every million parts of a solution or mixture, there is one part of the substance being measured. The measures mg/kg and ppm are used interchangably since a milligram is one millionth of a kilogram. Other measures that you might come across when looking at the toxicity of a pesticide include: "parts per billion" (ppb) and "parts per trillion" (ppt). The following list may help you remember how small these concentrations are:

*parts per million (ppm) =	1 milligram (mg)/kilogram (kg) 1 inch in 16 miles 1 minute in 2 years
*parts per billion (ppb) =	1 inch in 16,000 miles 1 second in 32 years
*parts per trillion (ppt) =	1 inch in 16,000,000 miles 1 second in 32,000 years

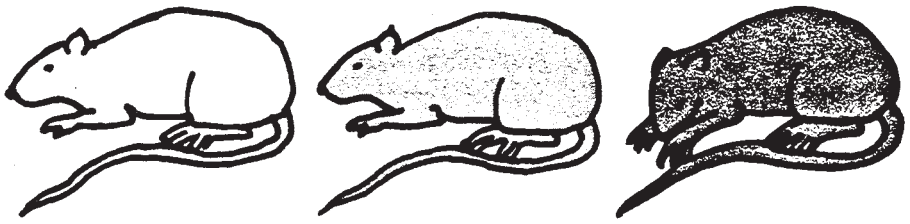
Lethal Concentration Fifty (LC_{50})

To figure out the "acute inhalation toxicity" of a pesticide, scientists add a known amount of the pesticide to air. The amount that causes half of the animals to die is the "Lethal Concentration Fifty" (LC_{50}) of the pesticide. The lower the LC_{50} value, the more poisonous the pesticide. Lethal Concentration Fifty is measured in milligrams per liter (mg/l) or ppm and sometimes in milligrams per cubic meter (mg/m^3).

Chronic Toxicity Measures

There is no standard measure like LD_{50} for chronic toxicity studies. Often the length of the experiment is in days, months, or years and the amount of each dose is stated. For example, a study of chronic oral toxicity might look like this: " 8 milligrams of pesticide were fed to rats daily for two years. No symptoms of poisoning appeared."

Two classes of pesticides, the organophosphates and carbamates, can slowly poison by attacking an essential body chemical called "cholinesterase". The chronic exposure to organophosphate pesticides can be measured by monitoring changes in blood cholinesterase levels. In humans, decreased blood cholinesterase levels are a sure sign that exposure to these types of pesticides should be avoided until the level is measured as being normal again. (For more on this subject, see Chapter VIII on cholinesterase tests).



Acute Toxicity Label Warning Statements

Based on the LD_{50} and the results of other acute tests, each pesticide is classified into a "toxicity category" and given an associated "signal word". A signal word must appear on every product label so that pesticide users are alerted to the pesticide's acute toxicity. Toxicity categories are based on the acute oral, dermal, and inhalation toxicities, as well as eye and skin irritation effects of each pesticide. A pesticide is categorized by its **highest level** of toxicity. For example, if the acute oral toxicity and acute dermal toxicity of a pesticide are in the slightly toxic category, but its acute inhalation toxicity is in the highly toxic category, the pesticide label will have the signal words for a highly toxic pesticide.

The following table indicates the four categories of pesticide toxicity:

Categories of Acute Toxicity—

Category	*Signal Word Required on Label*	LD_{50} *Oral* *mg/kg*	LD_{50} *Dermal* *mg/kg*	LC_{50} *Inhalation* *mg/l*	*Approximate Oral Dose That Can Kill an Average Person*
I Highly toxic	DANGER-*[POISON! Skull & Crossbones]	From 0 to 50	From 0 to 200	From 0 to 0.2	A few drops to 1 teaspoonful [or a few drops on the skin]
II Moderately Toxic	WARNING!	From 50 to 500	From 200 to 2000	From 0.2 to 2	Over 1 teaspoonful to 1 ounce
III Slightly Toxic	CAUTION!	From 500 to 5000	From 2000 to 20,000	From 2.0 to 20	Over 1 ounce to 1 pint or 1 pound
IV Relatively Non-toxic	CAUTION!	More than 5000	More than 20,000	Greater than 20	Over 1 pint or 1 pound

* Not used for skin and eye irritation effects.

Hazard

Hazard is the risk of danger. It is the chance that harm will come from the use of a pesticide to the applicator, bystanders, livestock, wildlife, crops, consumers, water, etc. Hazard is often confused with toxicity, but they are not necessarily the same. The hazard of a toxic chemical is always based on two things; its ability to harm (i.e. its toxicity, corrosiveness) and the ease with which a person can come in contact with the chemical. For example, a highly toxic pesticide is usually considered "hazardous" because of the risk that it poses to the public or the environment. However, with proper handling, a highly toxic pesticide can actually pose a low risk or low hazard. Many factors besides a pesticide's actual toxicity can make it hazardous. These include: the skill of the applicator; the target pest involved; the type of pesticide; the formulation chosen; the other chemicals involved in the formulation; and the concentration and dosage used.

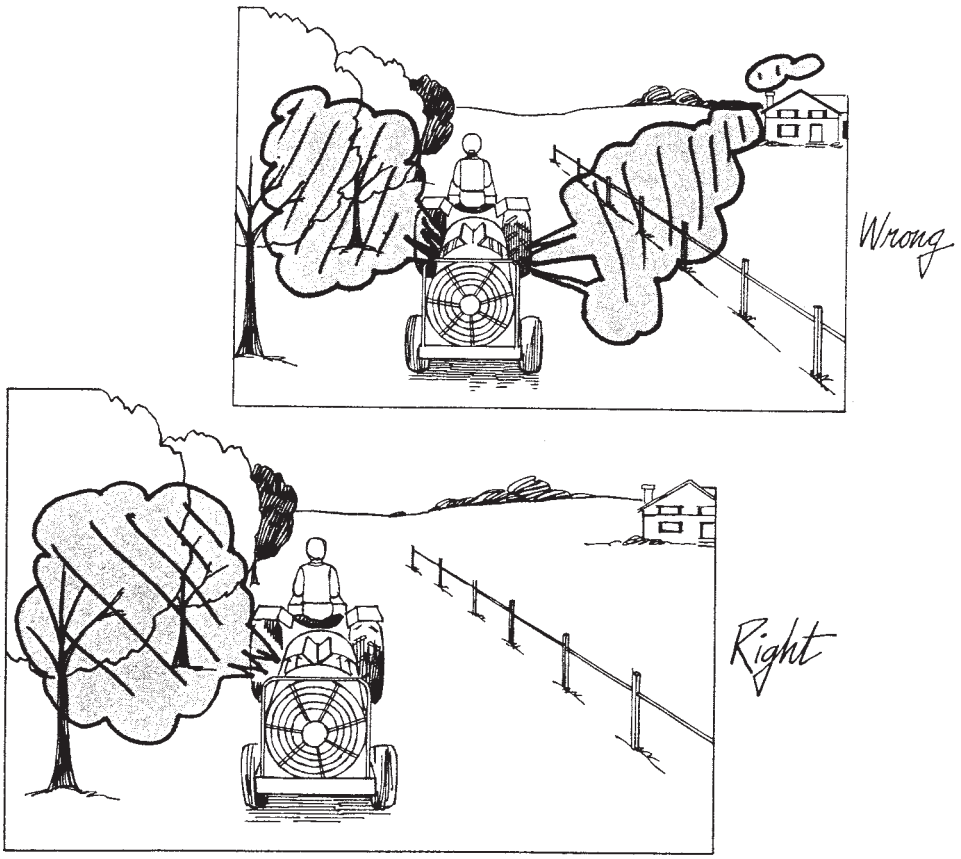
Concentration and Dosage. Usually, the more concentrated a formulation is the more hazard it poses. Dilute the concentrated pesticide and you reduce the hazard. For example, one ounce of pesticide A contains a lethal oral dose. If the same one ounce of pesticide A is diluted in ten gallons of water, each ounce of the dilute mixture will contain 0.0008 ounces of pesticide A. The handling of the dilute mixture is thus reduced when compared to the concentrate. Use good judgment when figuring out the concentration and dosage of a pesticide; try to use the lowest concentration and/or dosage that is necessary to control the target species.

Applicator. A skilled, experienced applicator using a highly toxic material will be less of a hazard to himself and others than perhaps a homeowner who applies pesticides on his/her property. A certified applicator should have the skill and knowledge to handle all pesticides safely.

Target. The site of application is called the target. It can consist of plants, soil, insects, animals, structures and many other things. The intended use of a pesticide on a target is to control specific target pests without harming fragile "nontarget species." The ideal pesticide controls the target pest and poses little or no hazard to nontarget species, as well as the target area itself.

Formulation. The hazard of a pesticide is also influenced by the way a pesticide is put together, or made into a formulation for use. Depending on the original toxicity of the pesticide, formulations that are easily absorbed or inhaled may pose more of a hazard than those that are less easily absorbed or inhaled. Keeping in mind all the factors that influence the toxicity of the pesticide, formulations generally pose the following toxicity hazard in decreasing order: emulsifiable concentrate > oil solution > water emulsion > water solution > wettable powder/ flowable (in suspension) > dust > granular. Choose the safest formulation available to do the job. (See Chapter XV for a more detailed explanation on formulations).

All pesticides can be hazardous. Use caution whenever you handle them!



Questions for Self Study — Chapter IV

1. What is the definition of toxicity?

2. Pesticides may enter the body in three different ways. Name them.

3. Can some pesticides be as dangerous when they are absorbed through the skin as they are when they are taken orally?

4. _____(oil, paste, or water-based) pesticide solutions are most likely to be absorbed through the skin.

5. Some areas of the body surface absorb pesticides more quickly than other areas. Name three areas which absorb pesticides quickly.

6. Which two routes of entry are likely to be the most important to the pesticide applicator?

7. What important piece of equipment protects an applicator from inhaling pesticides?

8. What precautions should be taken to avoid getting pesticides in the mouth by mistake?

9. What is pesticide exposure?

10. Name and define the two types of pesticide exposure.

11. The effects of which type of exposure—acute or chronic—can be more easily detected and studied?

12. What is the definition of pesticide dose? Explain the difference between exposure and dose.

13. Explain the difference between acute toxicity and chronic toxicity.

14. Name three factors that affect the toxicity of a pesticide?

15. What does LD_{50} mean? What about LC_{50}? Explain how it is used.

16. Do LD_{50}s and LC_{50}s give the exact toxicity of each pesticide?

17. Acute oral toxicity and acute dermal toxicity are measured in LD_{50}s. The higher the LD_{50} the _____(more or less) toxic the pesticide.

18. How many parts per million (ppm) is 6 milligrams per kilogram (mg/kg)?

19. Name and describe 6 different ways that pesticides can be toxic to humans.

20. What type(s) of toxicity are label signal words and warning statements based on?

21. What signal word(s) are required on the label for pesticides classified as: Relatively non-toxic? Highly toxic? Slightly toxic? Moderately toxic?

22. Is there a difference between the toxicity and hazard of a substance? If so, explain the difference.

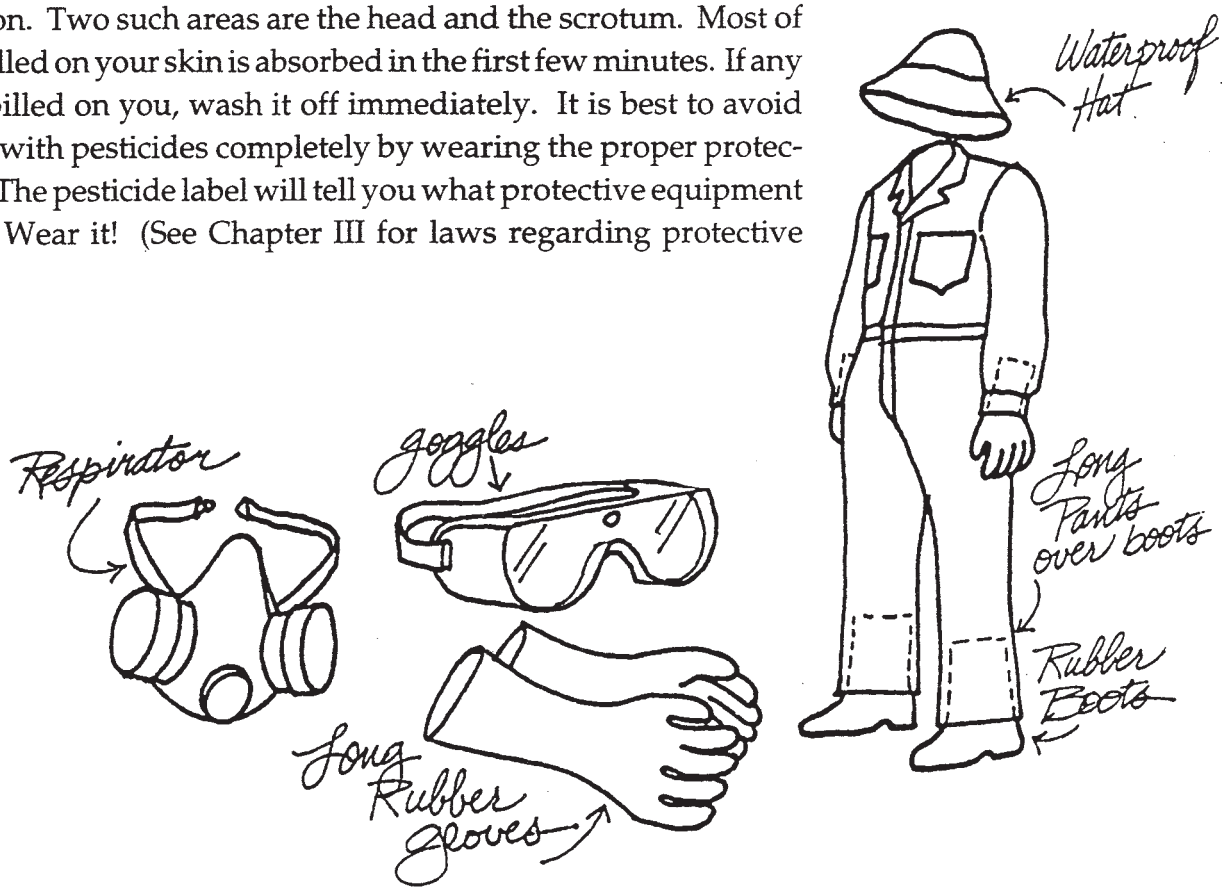
23. Is a highly toxic material always very hazardous?

24. What are some of the factors that determine the hazard of a chemical?

Personal Protection for the Applicator and Worker

Chapter VIII

Pesticides can enter the body through the skin, the eyes, the mouth, and the lungs. The most common cause of pesticide poisoning for applicators is through skin contact. Some pesticides enter the body through the skin quite readily. Concentrates can be especially dangerous. Some parts of the body absorb pesticides extremely fast and need extra protection. Two such areas are the head and the scrotum. Most of a pesticide spilled on your skin is absorbed in the first few minutes. If any pesticide is spilled on you, wash it off immediately. It is best to avoid direct contact with pesticides completely by wearing the proper protective clothing. The pesticide label will tell you what protective equipment is necessary. Wear it! (See Chapter III for laws regarding protective equipment.)



Goals of This Chapter

- Understand the importance of personal protective equipment worn during pesticide application.
- Understand why there are different fabrics and materials used to protect applicators and how they differ.
- Learn the importance of and method for layering protective clothing.
- Learn the basics of respirators and their use.

Gloves

Always wear unlined, elbow length chemical-resistant gloves when handling all pesticides except those that are relatively nontoxic (category IV or lower toxicity). The elbow length gloves protect your wrists and prevent pesticides from running down your sleeves into your gloves.

Glove materials include nitrile, butyl, neoprene, natural rubber (latex), polyethylene, polyvinylchloride (PVC) and barrier laminates like 4H® and Silver Shield®. Current research indicates that nitrile, butyl, and neoprene offer good protection for both dry and liquid pesticides. Neoprene is not recommended for fumigants. Natural rubber is only effective for dry formulations. Never use leather or cotton gloves. Cotton and leather gloves can be more hazardous than no protection at all because they absorb and hold the pesticide close to your skin for long periods of time. Check the quality of construction and material before buying any glove, because efficacy varies with the manufacturer. Protection increases with the thickness of the materials, but extra thick gloves may interfere with dexterity. Never use fingerless gloves.

Remember that proper use is as important as selection. Check closely for holes by filling the gloves with air or clean water and gently squeezing. Discard the gloves if any holes appear. In the case of overhead work, turn glove cuffs up to form a cup to trap any liquid that runs down the arm. When you are finished spraying, wash your gloves with detergent and water **before** you remove them. Then you will not contaminate your hands or the inside of the gloves when you remove them. Wash your hands with lots of soap and water after you remove the gloves.

Clean and store gloves for reuse. Replace gloves periodically because most materials will accumulate pesticide residues over time. Nitrile and neoprene gloves can be used for 120 to 160 work hours. Replace PVC and natural rubber gloves after 40 work hours. Slash discarded gloves so that they cannot be used by someone else. Wrap in a plastic bag and put with an empty pesticide container for proper disposal.

Body Covering

Regular work attire of long pants and a long-sleeved shirt, shoes, and socks are acceptable for slightly toxic (category III) and relatively non-toxic (category IV) pesticides. Many applicators prefer work uniforms and cotton coveralls that fit the regular-work-attire description and provide equal protection. Applicators should reserve one set of clothing for pesticide use only. Launder and store separately from all other clothing.

To apply moderately toxic (category II) or highly toxic (category I) chemicals, wear a clean, dry protective suit that covers your entire body from wrists to ankles. The sleeves must be long enough to overlap with gloves. Openings, such as pockets, should be kept to a minimum. Protective suits are one- or two-piece garments, such as coveralls. They should be worn over regular work clothes and underwear. Protective suits may be disposable or reusable. They are available in woven, nonwoven, coated and laminated fabrics. The degree of protection increases as one moves from woven to nonwoven to coated and laminated fabrics. Read the manufacturer's label for specific information related to care and intended use. Good quality construction, proper fit, and careful maintenance or disposal are also important.

Woven fabrics provide a barrier of fabric and air between the wearer and the pesticide. The effectiveness of the barrier depends on the specific properties of the fabric. Tightly woven, cotton twill offers better pesticide protection than other woven fabrics. Cotton coveralls are a sensible choice for general use because they are comfortable, lightweight, readily available, reusable, and affordable. They reduce the risk of dermal exposure to pesticides in dust, granule, or powder form. They do not protect the wearer against spills, sprays, or mists and are not recommended for use with liquid pesticides. Cotton coveralls may be reused if washed according to the laundry instructions in Chapter VII.

Nonwoven fabrics have a random orientation of fibers which do not allow direct paths through the material. Coveralls of nonwoven fabrics are less comfortable than coveralls made of woven fabric. Precautions should be taken to avoid heat stress situations. Most nonwoven suits are disposable; they should be discarded after eight hours of use.

Uncoated nonwoven fabrics are convenient for use with pesticides in dust, granule, or powder form. They do not protect the wearer against spills, sprays, or mists and are not recommended for use with liquid pesticides. They should not be worn when using chlorinated hydrocarbons. Tyvek, a 100% spunbonded polyethylene fabric made by DuPont, is an example of an uncoated nonwoven fabric.

Fabrics can be made more resistant to pesticide penetration by laminating fabric layers and/or by applying chemical coatings. Chemical-resistant protective suits of coated or laminated fabrics are a must if you (or your helper) will be in a mist or spray that would wet your clothing. Coated and laminated fabrics resist water penetration, but not all of these fabrics qualify as chemical resistant. Chemical-resistant suits are recommended when handling highly toxic (category I) pesticides.

Coated and laminated protective suits used for pesticide protection are listed below:

1). Tyvek QC, a DuPont product of 100% spunbonded polyethylene fabric coated with a polyethylene film, protects the wearer against dry and liquid drift or splashes. It does not protect against chlorinated hydrocarbons or organophosphorus compounds. It is not chemical-resistant and is rather uncomfortable in hot weather. It is a disposable product.

2) Tyvek QC+ is DuPont Tyvek that is laminated with Saranex-23P, a saran film made by Dow Chemical. It provides added breakthrough protection from dry and certain liquid pesticides at the category I and category II toxicity levels. It does not protect against chlorinated hydrocarbons and is uncomfortable in hot weather. It is a disposable product.

3) Waterproof rainwear. Fabrics with PVC, butyl, and neoprene coatings protect the user against liquid and toxic pesticides. Current research indicates that butyl and neoprene are more resistant than PVC. Wearers complain that these protective suits are cumbersome and uncomfortable in hot weather. They are reusable if properly maintained, but their longevity is still under investigation.

4) Goretex, a microporous film laminate produced by W.L. Gore and Associates, Inc., is chemically resistant and comfortable to wear. It is not yet a practical choice because of its expense and unresolved maintenance problems.

Apron

Wear a chemical-resistant apron when repairing or cleaning spray equipment and when mixing or loading. This is a good practice for all pesticides. It is essential for pesticides of category I and II toxicity. Aprons offer excellent protection against spills and splashes of liquid formulations, but they are also useful when handling dry formulations such as wettable powders. Aprons can be easily worn over other protective clothing and are comfortable enough for use in warm climates. Choose an apron that extends from the neck to at least the knees. Some aprons have attached sleeves. Nitrile, butyl, and neoprene offer the best protection. PVC and natural rubber are also available.

Boots

Wear unlined chemical-resistant boots which cover your ankles when handling or applying moderately or highly toxic pesticides. Purchase boots with thick soles. Nitrile and butyl boots appear to give the best protection. Do not use leather boots. If chemical-resistant boots are too hot to wear in warm climates or too difficult to put on, try wearing chemical-resistant overboots with washable shoes (such as canvas sneak-

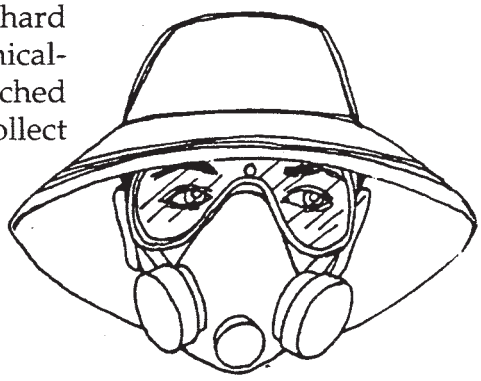
ers or layered socks.) Remember to put your pant legs outside the boots, otherwise the pesticide can drain into the boot. Wash boots after each use and dry thoroughly inside and out to remove all pesticide residue. Use them only for pesticide applications. It is wise to keep two pair of boots on hand in case of accidental contamination. Wash socks and canvas sneakers worn under chemical-resistant boots, according to the laundry instructions given in Chapter VII. Boots should be replaced at least yearly. As a reminder, write the date of purchase on the boot.

Goggles or Face Shield

Wear shielded safety glasses; a full-face respirator; snug-fitting, non-fogging goggles; or a full face shield whenever the chemical could possibly contact your eyes. Safety glasses with brow and side shields are acceptable for low exposure situations. Always wear goggles or full-face respirator when you are pouring or mixing concentrates or working in a highly toxic spray or dust. In high exposure situations when both face and eye protection are needed, a face shield can be worn over goggles. Clean them after each use. Be careful of the headband; it is often made of a material which readily absorbs and holds chemicals. Have several spares and change them often or use a chemical-resistant strap. If possible, wear the strap under your head covering.

Head and Neck Coverings

The hair and skin on your neck and head must be protected too. This is most important in situations where exposure from overhead dusts or sprays is possible, such as in airblast spraying operations or flagging. Chemical-resistant rain hats, wide brimmed hats, and washable hard hats (with no absorbing liner) are good. In cool weather, chemical-resistant parkas with attached hoods are a good choice. If the attached hood is not being used, tuck it inside the neckline so that it will not collect pesticides. Do not use cotton or felt hats; they absorb pesticides.



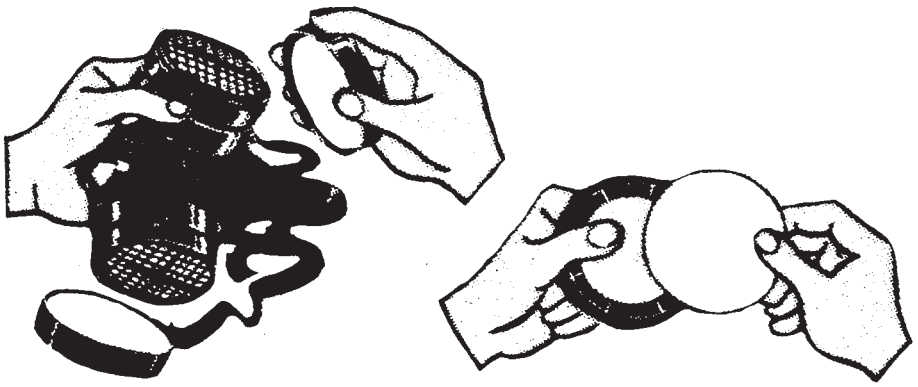
Respirators

Respirators protect you from inhaling toxic chemicals. The label will tell you if a respirator is required. Consider wearing one during any lengthy exposure with a high risk of pesticide inhalation. Always wear a respirator while mixing or filling highly toxic pesticides. Applicators who will be constantly exposed to small amounts of moderately toxic pesticides for a day or several days, should also wear a respirator.

Use the Respirators Correctly

Use the respirator correctly.

- The respirator should fit properly on your face. It should be worn tightly enough to form a seal all around your face. Respirators come in different sizes. Each person who will wear a respirator must be fit tested prior to using it. Facial hair must be groomed such that a proper seal between the face and the respirator is made. This usually means that beards or long sideburns must be removed. Do not wear the headband too tightly or headaches and/or dizziness may result.
- Respirator manufacturers make a variety of cartridges to fit their face pieces and each cartridge has its own intended use. It is essential that a cartridge designed to filter out pesticides from the air be selected and used. Having the wrong cartridge may expose the applicator to toxic levels of pesticides. Check the filter (the cloth-like outer layer) of your respirator often. Replace it when it looks dirty or if breathing becomes difficult. Cartridges should be changed after every eight hours of use. If you notice a pesticide odor first check to be sure the respirator is sealed on your face. If the odor persists change the cartridge immediately.



- After each use, wash the face piece with detergent and warm water. Rinse thoroughly and wipe dry with a **clean** cloth. Store the respirator, filters, and cartridges in a clean, dry place away from pesticides. A tightly closed plastic bag works well for storage.

Use Common Sense

Always work in pairs when handling highly toxic chemicals. Watch your co-worker carefully for unusual behavior or actions. Remind him (and yourself) to wash his face and hands before eating, drinking, or smoking. Never use the toilet before washing your hands. It is important to avoid getting toxic pesticides on **any** area of your body! At the end of the day remove your contaminated clothing carefully and put it in a plastic bag, well away from the family laundry or wash immediately yourself. Shower and clean yourself thoroughly from head to toe. Pay particular attention to fingernails and hair where pesticides could remain.

Entry Restrictions

Entry restrictions are designed to protect people from being exposed to dangerous levels of pesticides left on treated surfaces. The minimum entry restriction for all products will be until sprays have dried, dusts have settled or vapors dispersed. The Worker Protection Standard (WPS) established Restricted Entry Intervals (REI) for pesticides used to produce agricultural plants. The REI is a period of time after application of a pesticide during which worker entry to the treated area is restricted. These REIs are based on the acute dermal toxicity of the active ingredient, eye irritation effects or skin irritation effects. For example, all pesticides covered under the WPS in toxicity category II have REIs of 24 hours.

The product label will state the specific entry restrictions. It will also state that early reentry (entering a treated area before the entry restriction has expired) can only be done by personnel wearing specific protective clothing. The applicator will know that the product is covered by the WPS if the following statement is in the "Directions for Use" section of the pesticide labeling:

> "Agricultural Use Requirements
>
> Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CRF Part 170. This standard contains requirements for the protection of agricultural workers on farms, forests, nurseries, and greenhouses, and handlers of agricultural pesticides. It contains requirements for training, decontamination, notification, and emergency assistance. It also contains specific instructions and exceptions pertaining to the statements on this label about personal protective equipment, notification of workers, and restricted-entry-intervals."

Transport Pesticides Safely

Whenever a pesticide is in your possession, you are responsible for its safe transport. Do all you can to prevent problems and be prepared in case of an emergency. Carry pesticides in the back of a truck. Flatbed trucks should have racks. Steel beds are the best since they can be more easily cleaned if a spill should occur. Never carry pesticides in the passenger compartment of a vehicle. Never carry pesticides near passengers, pets, fertilizers, seed, food or feed, and risk contamination should a spill occur.

All containers should be tightly closed and have legible labels. Secure containers so they will not roll or slide. Protect all containers from moisture and temperature extremes. Never leave your vehicle alone when the pesticides are in an unlocked truck bed or compartment. The legal responsibility for the injury of curious children or careless adults is yours if the pesticides are left unattended.

Don't take chances with toxic chemicals. You are gambling with your life as well as those of others.

Questions for Self Study — Chapter VIII

1. What is the most common cause of pesticide poisoning for applicators?

2. When should you wear elbow length chemical-resistant gloves?

3. Why not use cotton or leather gloves when handling highly toxic pesticides?

4. Must you always wear a chemical-resistant suit when handling highly toxic chemicals?

5. How often should you wash your contaminated overalls?

6. Should you ever wash the inside of your boots?

7. When is it necessary to wear goggles or a full face shield?

8. Why should you especially notice the headband of your goggles or face shield?

9. What type of hats are useful to protect your head and neck from highly toxic pesticides?

10. Are cotton or felt hats good enough?

11. How do you know if a respirator is necessary?

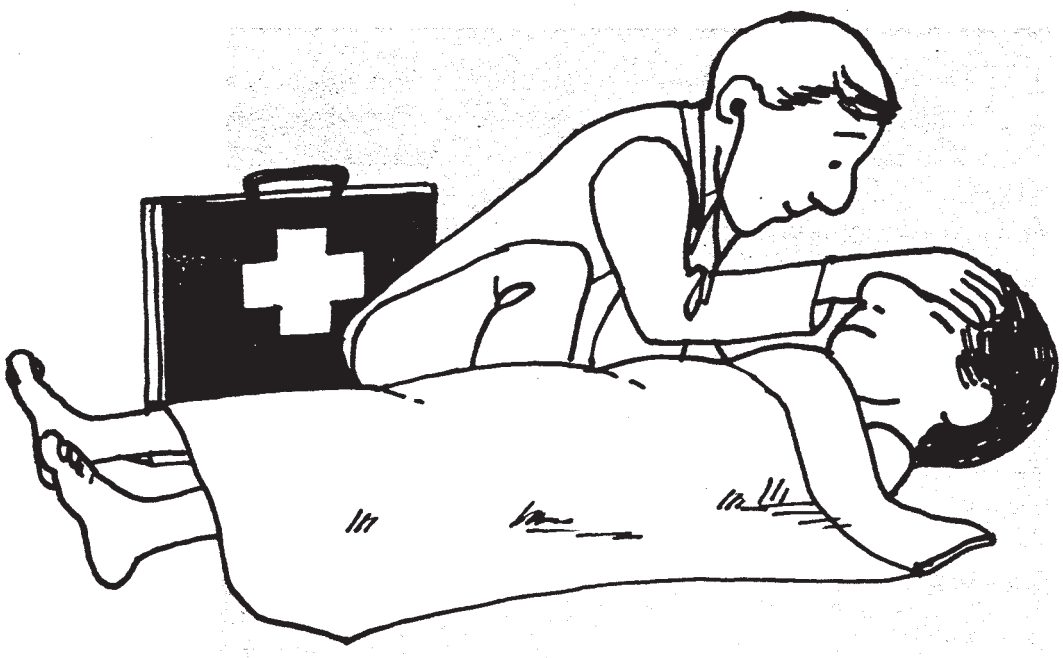
12. When must you always wear a respirator?

13. Should applicators who will be constantly exposed to small amounts of toxic pesticides for a day or several days wear a respirator?

Symptoms of Pesticide Poisoning

Chapter IX

You should be aware of the early signs and symptoms of poisoning. It is important to remove the person from the source of exposure quickly. Remove contaminated clothing and wash off any chemical which has soaked through. You may save a life.



Goals for This Chapter

- Be able to determine whether or not a person has been poisoned by a pesticide.
- Learn to recognize kinds of poisoning and their symptoms.
- Become familiar with chemical families and their toxicity.

Pesticide Poisoning or Not?

The symptoms of pesticide poisoning are similar to those of other types of poisoning and of other diseases. Heat exhaustion, food poisoning, asthma, and other illnesses are sometimes confused with pesticide poisoning. Just because a person becomes ill after using or being around pesticides is not proof that he is poisoned.

The symptoms of poisoning described here may occur in a person who has been suddenly exposed to large quantities of a toxic material. They may also occur in a person who has been continuously exposed to smaller quantities of toxic material over longer periods of time. If the symptoms appear, call your doctor and tell him what pesticide was involved.

Kinds of Poisoning

Acute poisoning is the severe poisoning which occurs after exposure to a single dose of pesticide. The appearance of symptoms may be sudden and dramatic or they may be delayed.

Chronic poisoning is the poisoning which occurs as a result of repeated, small, non-lethal doses over a long period of time. Many symptoms may appear, such as nervousness, slowed reflexes, irritability, or a general decline in health. Some test animals are unable to reproduce normally after repeated exposure to pesticides.

Medical Doctors Should Be Warned Ahead of Time

Many medical doctors may not be well informed as to the symptoms and treatment of pesticide poisoning. This is due to the few cases which they treat. Pesticide poisoning symptoms are similar to those of other illnesses and poisonings. You, the pesticide applicator, should tell your doctor which chemicals you use. Then he will know the symptoms and treatment, and can have the antidotes on hand.

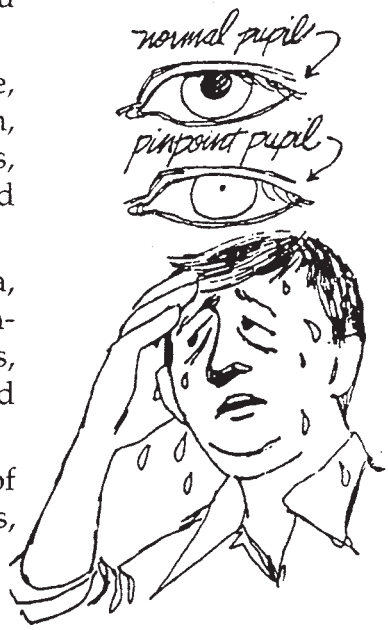
General Symptoms

Unfortunately, all pesticide poisoning symptoms are not the same. Each chemical family (i.e., organophosphates, carbamates, chlorinated hydrocarbons) can attack the human body in a different way. However, you should be aware of the general symptoms of pesticide poisoning.

Mild Poisoning or Early Symptoms of Acute Poisoning — headache, fatigue, weakness, dizziness, restlessness, nervousness, perspiration, nausea, diarrhea, loss of appetite, loss of weight, thirst, moodiness, soreness in joints, skin irritation, eye irritation, irritation of the nose and throat.

Moderate Poisoning or Early Symptoms of Acute Poisoning — nausea, diarrhea, excessive saliva, stomach cramps, excessive perspiration, trembling, no muscle coordination, muscle twitches, extreme weakness, mental confusion, blurred vision, difficulty in breathing, cough, rapid pulse, flushed or yellow skin, weeping.

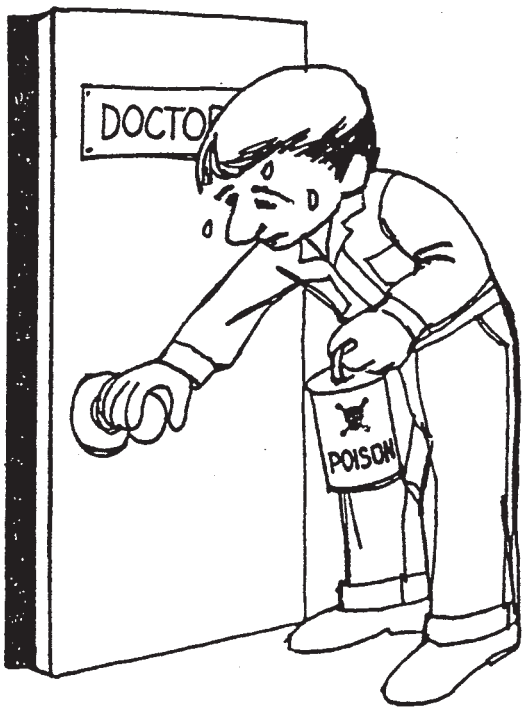
Severe or Acute Poisoning — fever, intense thirst, increased rate of breathing, vomiting, uncontrollable muscle twitches, pinpoint pupils, convulsions, inability to breathe, unconsciousness.



Chemical Families

Pesticides which are chemically similar to one another are often grouped together into "families." Each pesticide in a family attacks a pest in a similar way. Treatment and antidotes for poisoning are also the same within each family. It is important that the doctor know which chemical family is involved. The following chart identifies the symptoms of pesticide poisoning in the major chemical families.

If you are in doubt whether or not poisoning has occurred, let your doctor decide!



Questions for Self Study — Chapter IX

1. Are the symptoms of pesticide poisoning very different from all other types of poisoning?

2. Does a person who has been continuously exposed to smaller quantities of toxic material over long periods of time usually show the same symptoms of poisoning as a person exposed suddenly to large quantities of toxic materials?

3. Are the symptoms for all cases of pesticide poisoning the same?

4. What are some of the symptoms of mild poisoning?

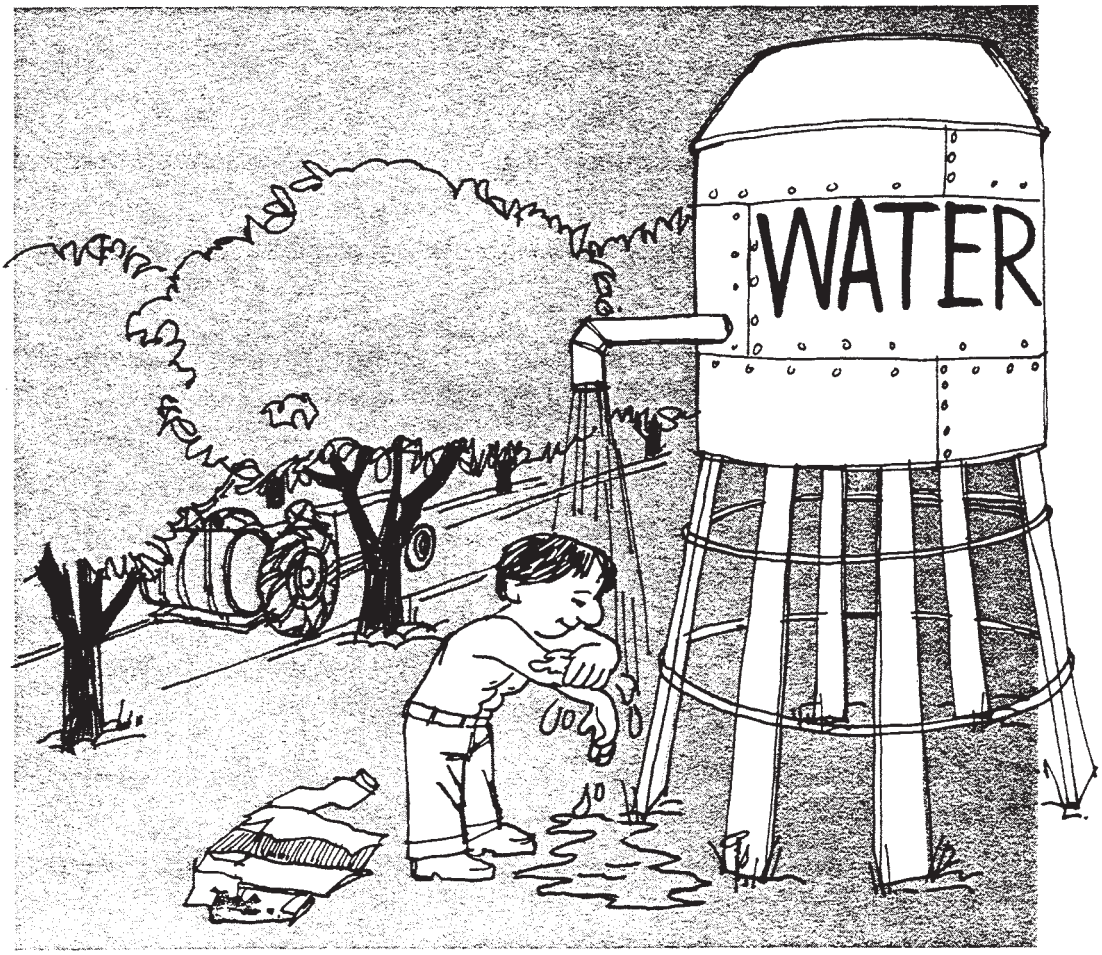
5. Are the symptoms for mild poisoning similar to the early symptoms of acute poisoning?

6. What are some of the signs for severe or acute poisoning?

7. Does each pesticide in a chemical family require the same treatment and antidote in case of poisoning?

First Aid for Pesticide Poisoning

Chapter X



Goals of This Chapter

- Recognize the signs of pesticide poisoning and know first aid treatment for it.
- Know the importance of a pesticide first aid kit and what it should contain.
- Understand the importance of poison control centers and how to get immediate information on types of poisonings and their treatment.

Call a Doctor

First Aid is the initial effort to help a victim while medical help is on the way. Step one in any poisoning emergency is to call an ambulance or doctor. The only exception is when you are all alone with the victim. Then you must see that he is breathing and that he is not further exposed before leaving him to make your phone call. Always save the pesticide and label for the doctor.

While Waiting, Do This For:

Poison on the Skin

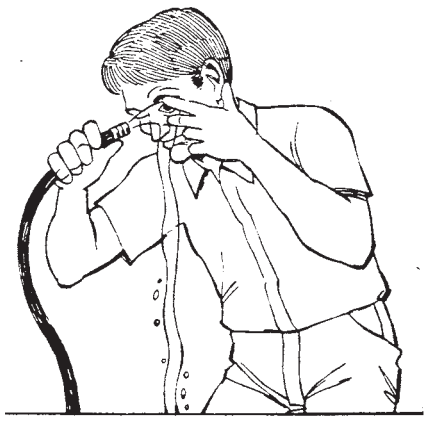
- The faster the poison is washed off the patient, the less injury that will result.
- Drench skin and clothing with water (shower, hose, faucet, pond).
- Remove clothing.
- Cleanse skin and hair thoroughly with soap and water. Detergents and commercial cleansers are better than soap.
- Dry and wrap in a blanket.

WARNING: Do not allow any pesticide to get on you while you are helping the victim.

Chemical Burns of the Skin

- Wash with large quantities of slow running water.
- Remove contaminated clothing.
- Immediately cover loosely with a clean, soft cloth.
- Avoid use of ointments, greases, powders, and other drugs in first aid treatment of burns.

Poison in the Eye



- It is most important to wash the eye out quickly but as gently as possible.
- Hold eyelids open and wash eye with a gentle stream of clean running water.
- Continue washing for fifteen minutes or more. It is important to use a large volume of water. If possible, at least five gallons should be used to flush the eye properly.
- Do not use chemicals or drugs in wash water. They may increase the extent of the injury.
- Cover the eye with a clean piece of cloth and seek medical attention immediately.

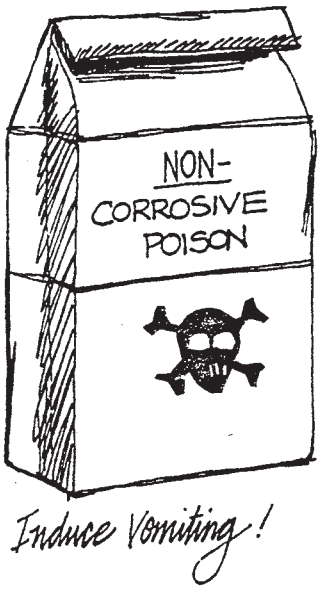
Inhaled Poisons (dusts, vapors, gases)

- If victim is in an enclosed space, do not go in after him unless you are wearing an air-supplied respirator.
- Carry patient (do not let him walk) to fresh air immediately.
- Open all doors and windows.
- Loosen all tight clothing.
- Apply artificial respiration if breathing has stopped or is irregular.
- Keep victim as quiet as possible.
- If victim is convulsing, watch his breathing and protect him from falling and striking his head. Keep his chin up so his air passage will remain free for breathing.
- Prevent chilling (wrap patient in blankets but don't overheat).
- Do not give the victim alcohol in any form.

Swallowed Poisons—When should you make the victim vomit?

The most important choice you have to make when aiding a person who has swallowed a pesticide, is whether or not to make him vomit. The decision must be made quickly and accurately; the victim's life may depend on it. Usually it is best to get rid of the swallowed poison fast . . . But:

- **Never** induce vomiting if the victim is unconscious or is having convulsions. The victim could choke to death on the vomitus.
- **Never** induce vomiting if the victim has swallowed a corrosive poison. Find out what poison the person has ingested. A corrosive poison is strong acid or alkali. The victim will complain of severe pain and will show signs of severe mouth and throat burns. A corrosive



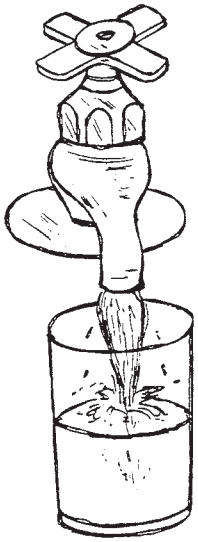
poison will burn the throat and mouth as severely coming up as it did going down. Dilute the poison as quickly as possible. For acids or alkalis, use milk or water. For patients one to five years old, use one to two cups; for patients five years and older, use up to one quart. For acids, milk of magnesia may also be used (two tablespoons in one cup of water).

- **Never** induce vomiting if the person has swallowed petroleum products such as kerosene, gasoline, oil, or lighter fluid. Most pesticides which come in liquid formulations are dissolved in petroleum products. The words "emulsifiable concentrate" or "solution" on the pesticide label are signals **NOT** to induce vomiting in the poison victim if he has swallowed the concentrates. Concentrated petroleum products (like corrosive poisons) cause severe burns. They will burn as severely when vomited up. If he has swallowed a dilute form of these formulations, he should be forced to vomit immediately.

How to Induce Vomiting

Do not waste a lot of time inducing vomiting. Use it only as first aid until you can get the victim to a hospital. Make sure the victim is lying face down or kneeling forward while retching or vomiting. Do not let him lie on his back, because vomitus could enter the lungs and do more damage.

- First give the patient large doses of milk or water. One to two cups for victims up to five years old; up to a quart for victims five years and older.
- If victim is alert and respiration is not depressed, give syrup of ipecac followed by one to two glasses of water to induce vomiting. Adults (twelve years and over): 30 ml (two tablespoons); children under twelve years: 15 ml (one tablespoon). Activity hastens the effect of the syrup of ipecac.
- Collect some of the vomitus for the doctor—he may need it for chemical tests.



The best first aid is to dilute the poison as quickly as possible with milk or preferably with water. It is very important that the victim get to the hospital without delay. Many communities have rescue units with ambulances manned by Emergency Medical Technicians who can communicate with the hospital and can begin treatment enroute.

If a rescue unit is not available in your area, you will have to transport the patient. Call the hospital emergency room or poison control center for instructions so that they can prepare for the victim's arrival. If the poison control center agrees, use activated charcoal as a "sponge" to absorb excess poisons after the instructions for corrosive or noncorrosive poisons are followed.

- Activated charcoal — it absorbs many poisons at a high rate. Mix it with water into a thick syrup for the victim to drink. Activated charcoal is available from a drug store.
- Atropine tablets — should not be taken in a poisoning emergency. The dose is much too small. Often the victim cannot or should not take oral medicine. The atropine can hide or delay early symptoms of poisoning. The victim may be fooled into thinking he is okay and may even go back to work. It is possible that a doctor may not detect the problem because the symptoms are hidden by the atropine. **WARNING: Atropine can be poisonous if misused. It should never be used to prevent poisoning. Workers should not carry atropine for first aid purposes. It should be given only under a doctor's directions.**

Shock

Sometimes poisoning victims go into shock. If untreated or ignored, the victim can die from shock even if the poisoning injuries would not be fatal.

Symptoms
The skin will be pale, moist, cold and clammy. The eyes are vacant and lackluster with dilated pupils. The breathing will be shallow and irregular. The pulse is very weak, rapid and irregular. The victim may be unconscious or in a faint.

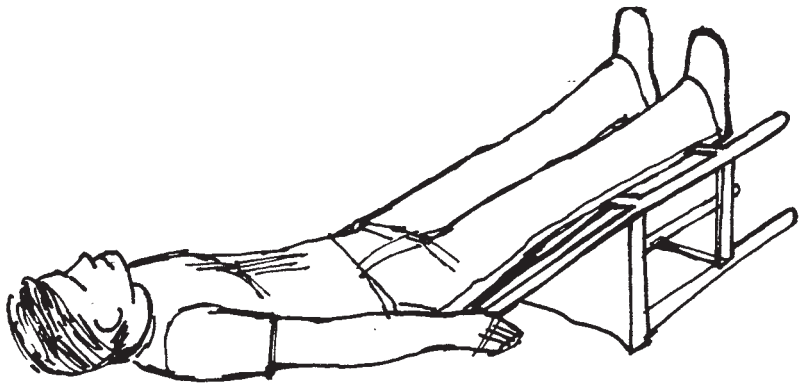
- Unless he is vomiting, keep the victim flat on his back with his legs up 1-1 1/2 feet above his head.
- Keep the victim warm enough to prevent shivering. Do not overheat.
- Keep the victim quiet and reassure him often.

WARNING: Never try to give anything orally to an unconscious victim.

Poison Control Centers

Poison control centers have been established to give pertinent information on all types of poisonings, including pesticide poisoning. The applicator should have posted near his phone the telephone number of the nearest poison control center, and his doctor should also have the number available.

In any poisoning emergency, think first of water. Your first aim is to dilute the pesticide no matter where it is. Then get the victim to a doctor fast.

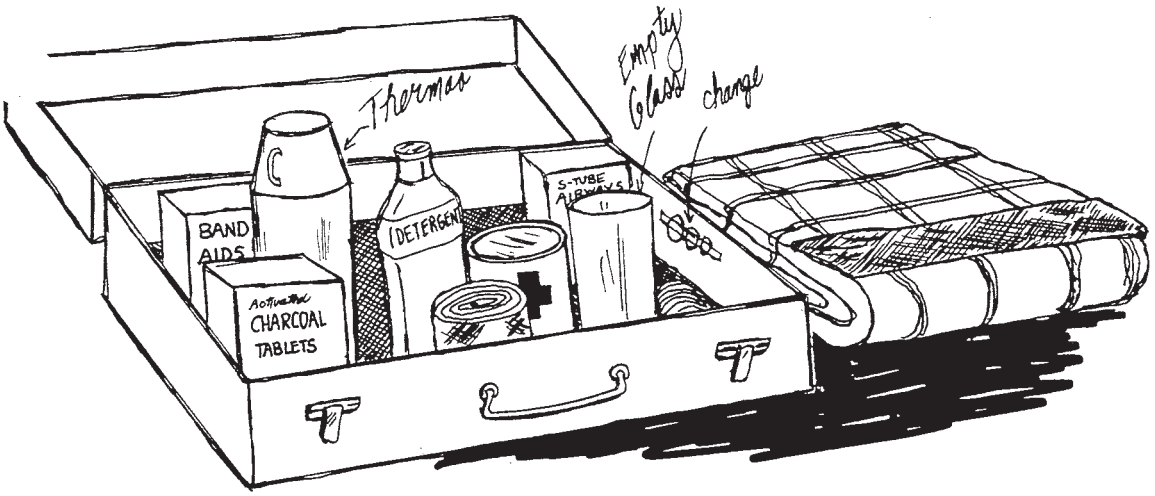


First Aid Kit for Field and On-the-Job Use

A well equipped first aid kit which is always readily available can be important in a pesticide emergency. Make up your own pesticide first aid kit from a lunch pail, tool box, or a sturdy wooden box. It should have a tight fitting cover with a latch, so that it won't come open or allow pesticides to leak inside. Label it clearly with paint or a water proof marker.

Contents

1. A small plastic bottle of a common **Detergent.** It is used to wash pesticides quickly off the skin.
2. A small package or bag of **Activated Charcoal**. Mixed with water and swallowed, activate charcoal acts as an absorber of all pesticides.
3. **A Shaped Plastic Airway** for mouth-to-mouth resuscitation.
4. A thermos or large plastic bottle (at least one quart) of **Clean Water.** If there is no clean water in an emergency, use any pond or stream water that is available.
5. Simple **Band Aids, Bandages** and **Tape**. All cuts and scrapes should be covered to prevent pesticides from easily entering the body.
6. A **Blanket** is very useful. It should be kept in a place where it will not be contaminated by pesticides.
7. **Suitable Coins** should always be taped to the inside cover of the first-aid kit. They are for an emergency phone call.



8. A small, plastic **Empty Jar** with a tight fitting lid is useful as a drinking glass for the victim, in order to induce vomiting or feed activated charcoal. It can also be used for collecting vomitus to take to the doctor.

A Checklist for Preventing Pesticide Accidents

Everyone can improve their methods for safe handling of pesticides. Experienced pesticide applicators, unfortunately, may become so familiar with the equipment and materials used that they become careless or take shortcuts. An accident is waiting to happen.

The following checklist of questions is drawn from data showing the common causes of pesticide accidents. Check it against your pesticide handling practices and see how many accidents are waiting to happen to you. Just one "No" may be the one that gets you in trouble!

Yes	No	**Store Your Pesticides Safely**
☐	☐	Do you have a separate space to store pesticides?
☐	☐	Do you keep it locked and are the windows tight, barred or boarded over?
☐	☐	Do you keep all your pesticides in this storage rather than in the garage, feed room, basement, porch, kitchen or refrigerator
☐	☐	Do you store herbicides separately from other pesticides?
☐	☐	Are there signs on your storage so firemen and others are warned?
☐	☐	Do you check periodically for leaking containers?

A Checklist for Preventing Pesticide Accidents
(continued)

Yes	No	
		Keep the Original Container So the Label Is There!
☐	☐	Do you always keep pesticides in the original container instead of old "coke" bottles, milk cartons or other food containers?
☐	☐	When people ask you for a little spray mix out of your tank do you refuse?
☐	☐	Do you always remember what is in an unlabeled container?
☐	☐	Do you always remember the safety precautions, antidotes and directions for use, even though the container is not labeled?
☐	☐	Do you safely dispose of unlabeled pesticides, rather than take a chance with your memory?
		Use the Recommended Clothing and Protective Equipment
☐	☐	Do you read the label to see what protective clothing you should wear?
☐	☐	Do you start each spraying day with clean spray clothing?
☐	☐	Do you check the signal words and precautions for use on the label to see what protective equipment is necessary?
☐	☐	Do you wear the protective equipment recommended on the label?
☐	☐	Do you clean and maintain your protective equipment regularly and often?
☐	☐	Do you throw away rubber gloves that have only tiny holes in them?
		Spills and Splashes of Concentrates can be Very Hazardous!
☐	☐	Do you know what to do if you should spill a pesticide on yourself while mixing?
☐	☐	Do you wear adequate footgear with your pant cuffs on the outside, so pesticides won't run into your footgear?
☐	☐	Do you have sawdust, vermiculite, kitty litter or some other absorbent on hand to soak up spills?
☐	☐	Do you always watch your sprayer tank when filling so it won't run over and spill on the ground?

A Checklist for Preventing Pesticide Accidents *(continued)*

Yes	No	
☐	☐	Do you have a check valve or other device on your equipment to prevent back-siphoning into the water supply?
☐	☐	Is your application equipment well maintained so it doesn't leak and leave toxic puddles or piles of pesticide on the ground?
☐	☐	Do you avoid draining leftover spray mix on the ground?
☐	☐	Do you discard old high pressure hose instead of patching it and hoping no one will be nearby when it bursts?
☐	☐	Do you clean nozzles with a brush, by rinsing, etc., instead of blowing them out with your mouth?

Poor Container Disposal May Cause Bad Accidents!

☐	☐	Do you rinse each "empty" liquid container at least three times and dump the rinse water into the tank?
☐	☐	Do you keep your used containers in your storage area until disposal?
☐	☐	Do you collect every container for disposal before leaving a job, instead of leaving them in the field or at your tank filling station?
☐	☐	Do you puncture, break or crush nonburnable containers so that they can't be reused?
☐	☐	Do you keep or return to the manufacturer 30 and 55 gallon pesticide drums, rather than giving them away for floats, trash barrels, etc.?

Attractive Nuisances Can Result in Lawsuits!

☐	☐	Do you keep your sprayer equipment where children cannot play on it?
☐	☐	Do you keep your spray equipment clean so that those touching it will not be contaminated?
☐	☐	Do you always release pressure on your equipment so spray guns won't be accidentally triggered?

Care in Application Prevents Accidents

☐	☐	Do you check the wind direction and the area downwind before applying pesticides?

A Checklist for Preventing Pesticide Accidents

Yes	No	
☐	☐	Do you consider substituting a safer chemical if you are spraying near a sensitive area?
☐	☐	Do you check for the possibility of showers and damaging runoff before applying pesticides?
☐	☐	Do you plan your pesticide application so it will have little or no effect on bees, birds, fish or other wildlife?
☐	☐	Do you remove, turn over or cover up pet dishes, sand boxes, plastic pools, etc., before spraying a private property?
☐	☐	Do you make sure that children and pets are out of the area and stay out until the spray dries?

Questions for Self Study— Chapter X

1. What is the very first thing you should do when someone has been poisoned?
2. Why should your doctor know which pesticides you normally use?
3. What is most important to do if the poison is on the victim's skin or in his eyes?
4. What do you do first if the victim has inhaled the poison? How do you protect yourself?
5. If a person has swallowed a poison, you should always make him vomit except in three cases. Name them.
6. What absorbers can be used for swallowed poison? How are they used?
7. Why shouldn't workers carry atropine?
8. Describe shock. What can be done for it?
9. Where do you get the water you need for pesticide first aid?
10. What are poison control centers?

Integrated Pest Management

Chapter XI

IPM DEFINED

Integrated Pest Management (IPM) is a decision-making, pest management system designed to provide long-term management of pests at tolerable levels by addressing the *causes* of pest problems. The IPM practitioner needs to determine *if*, *where*, *when*, and *how* pest control practices should be applied. IPM combines preventative techniques, non-chemical pest control methods, and the wise use of pesticides with preference for products that are least harmful to human health and the environment. The practice of IPM does not necessarily result in the total elimination of the use of pesticides, but provides an alternative approach to traditional pest control methods.

While IPM has historically been used by the agricultural community to manage economically damaging pest infestations in commodity crops, IPM is both appropriate and valuable for the homeowner and the pest control operator managing pests in residential and urban environments.

- *Integrated* means that all available strategies are used to avoid or solve a pest problem. These strategies are based on information from different disciplines, such as disease information from plant pathologists, weed information from agronomists, and insect information from entomologists.

- *Pests* are unwanted organisms that are a nuisance to man or domestic animals, and can cause injury to humans, animals, plants, structures and possessions.

- *Management* is the process of making decisions in a systematic way to keep pests from reaching intolerable levels. Small populations of pests can often be tolerated. Total eradication is often not necessary unless the pest is posing a public health threat.

HISTORY OF IPM

IPM is not just a passing fad being promoted by environmentalists and pesticide regulatory agencies to reduce the amount of pesticides that enter our environment. IPM was developed in the 1920's in response to the need for a cost-effective control of the boll weevil, which was damaging cotton crops in the southeastern United States. At that time, pesticides were not yet well developed. To control this pest, it became clear to entomologists that a detailed understanding of the insect and its relationship to its environment, particularly factors that affected the growth and spread of weevil populations, was necessary so these factors could be manipulated in order to minimize the occurrence and level of weevil damage.

Although this early effort was successful, IPM did not gain momentum until the 1960's. Until that time, progress in promoting the adoption of IPM techniques was slow, largely due to the arrival of inexpensive, effective, synthetic pesticides, and limited knowledge of the long-term effects of pesticides on organisms and the environment. However, as the use of pesticides increased, several factors lead to an increased interest in designing IPM programs. These factors included: pest resistance to pesticides; pesticide effects on non-target organisms and the environment; and, increased regulation of pesticides.

- ***Pest Resistance*** - Most weed and insect pests have short life cycles, a wide geographic range, and large populations. As a result, there is great genetic diversity found in pest populations which allows them to adapt to varying environmental conditions. When these populations are all sprayed with the same pesticide, a few individuals are not killed because they are genetically resistant to the chemical. These individuals then reproduce, leading to a local population of resistant organisms which then spread to a larger area. As a result, higher doses of pesticide are needed to kill pests and finally new chemicals must be developed. The cycle continues, resulting in increased costs, increased amounts of chemicals used, and ever decreasing effectiveness of pesticide products.

- ***Effect on Non-target Organisms and the Environment*** - Broad spectrum pesticides kill a wide range of organisms indiscriminately. This effect can be useful for controlling several pests at once. Often, however, insects that were not a problem before suddenly become pests, a phenomenon known as "secondary pest outbreaks". This is because most insect species are kept under control naturally by other parasitic or predaceous insects, mites or spiders. The use of these pesticides kills these "beneficial" insects, resulting in "secondary" pest outbreaks and the need for yet more chemical use. In addition, pesticide use has

lead to groundwater contamination; honeybee, fish and bird kills; and, the accumulation of certain pesticide compounds in the food chain.

❧ ***Regulation*** - As a result of the problems associated with pesticides, the late 1960's and early 1970's saw increased environmental activism, education and regulation of most aspects of pesticide registration and use, both at the state and federal levels. Over the years, legislation has been enacted that has restricted the reregistration and availability of many pesticide products.

IPM IN PRACTICE

Pest management is the science of preventing, suppressing, or eradicating biological organisms that are causing a problem. Pest management practices may be classified according to the approach or the methods used to deal with a pest problem. In terms of *approach*, pest management practices may be designed to: 1) prevent a problem; 2) suppress a problem; or, 3) eradicate a problem. In regard to *method*, pest management practices may be classified as: 1) cultural; 2) physical/mechanical; 3) biological; and, 4) chemical.

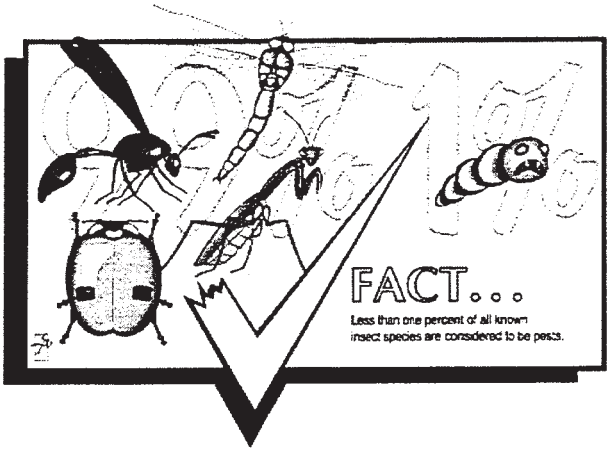
The term "integrated pest management" implies the integration of ***approaches*** and ***methods*** into a pest management ***system*** that seeks to minimize environmental impacts and economic risks. Since IPM considers all applicable methods, it is assumed that emphasis on chemical methods may be reduced when effective non-chemical alternative methods are available.

Selection of the most appropriate pest management system in a particular situation should be preceded by ***accurate pest identification*** and ***scouting or monitoring*** of the site to determine the exact location and extent of the pest population. A decision must also be made as to *when* pest management actions should be taken. This decision is usually based on an ***action threshold*** for the particular pest in question.

PEST IDENTIFICATION

All yards and gardens are inhabited by a diverse array of organisms, including insects, spiders, mites and small animals. Most of these cause little or no damage and are generally considered non-pests. Others are actually beneficial to the health of the garden and aid in the breakdown of

organic material, pollination of crops, or serve as natural enemies ("beneficials") of pests. Only a few of the insects and mites present are actually plant-feeding pests. Because of the wide diversity of species present, and the many similarities between pests and non-pests, proper identification is needed before control strategies can be adopted.



In addition, it is important to recognize the different stages of insect development for several reasons. The caterpillar eating your plants may be the larvae of the butterfly you were trying to attract. The small larvae with six spots on its back is probably the young of the ladybug, a very beneficial insect. Some control practices are most effective on the larval stage of the insect, and have no effect on the adult stage. Different stages may also be more damaging than others. It is essential to learn about a pest's life cycle and habits so control actions can be taken at the optimum time.

Finally, some insect damage may be mistaken for a disease, especially if no visible insects are present. Nutrient problems may also mimic diseases or pest damage. Herbicide damage resulting from misapplication of chemicals also can be mistaken for other problems. You must have a clear understanding of what situation you are dealing with in your yard or garden before you select a pest management strategy.

PEST SCOUTING OR MONITORING - THE BACKBONE OF IPM

The regular inspection of the home, yard or garden is absolutely critical to detecting pest problems before they get out of control, and when they are most effectively treated.

Benefits of pest monitoring include:

- A greater awareness of pest activity, including changes in pest population;
- Up-to-date information on the health of your plants;
- Data that can be used to compare pest outbreaks from season to season;
- Early detection of pest problems, resulting in the availability of more management options;
- Information to enable you to determine when, where and how often to spray.

Remember! Not all insects found in the garden are pests! Lady beetles, lacewings, praying mantids, parasitic wasps and soldier beetles are just a few of the beneficial insects that may be found in a garden (**Figure 1**). Observing the beneficial insects as well as the pests, should be part of every scouting program. Ideally, a healthy balance of beneficial insects and pests should be present. Spraying a pest to the point of eradication should not be a goal of your pest management program. By doing so, you may kill the beneficial insects as well, or cause them to migrate to other areas where pray is available. In either situation, pest populations will typically re-establish themselves more quickly than the beneficial insects, resulting in unchecked plant damage as the pest population builds up. Therefore, the presence or absence of a healthy population of beneficial insects, or pests showing the effects of parasites, should be taken into consideration when determining the need for a "rescue treatment".

Rescue Treatment

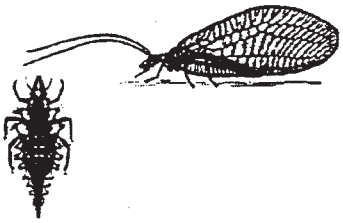
Sometimes a pest infestation is too heavy or severe to be managed by non-chemical control strategies. In these cases, a pesticide is used to bring the pest numbers down to a level that can then be kept under control by non-chemical means.

Figure 1. Beneficial Insects that Feed on Pests

A. Lady beetle larva(left) and two types of adults

The lady bug is predaceous in both its immature and adult form. They are particularly good at taking care of the aphids in the garden and scale insects that affect many woody ornamentals.

B. Lacewing larva (left) and adult (right)



Green lacewing larvae are important "generalist" predators. When the larvae are small, they eat insect eggs, mites and thrips. As they grow, the larvae attack larger soft-bodied pests, such as aphids, mealybugs, white flies, and small caterpillars.

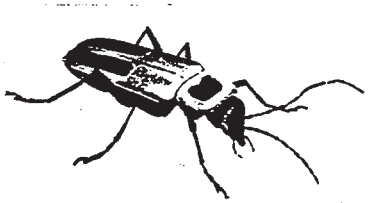
C. Parasitic wasps

Parasitic wasps parasitize a variety of caterpillars, beetle larvae, flies, aphids and other insects. The female inserts her eggs into host insects - which are eventually killed as the larvae develop.

D. Praying Mantis

The praying mantis is a very efficient predator and will capture and eat almost any insect that gets close enough. The mantis creates a paper-mache like egg case that is deposited on twigs and branches. They will begin to hatch around bud break time in Spring.

E. Soldier Beetle



Both the adult and larval form of soldier beetles are common predators of aphids and other insects. They are long and narrow, often orange or red, with black or brown wings.

Attract and Keep Beneficials in Your Garden!

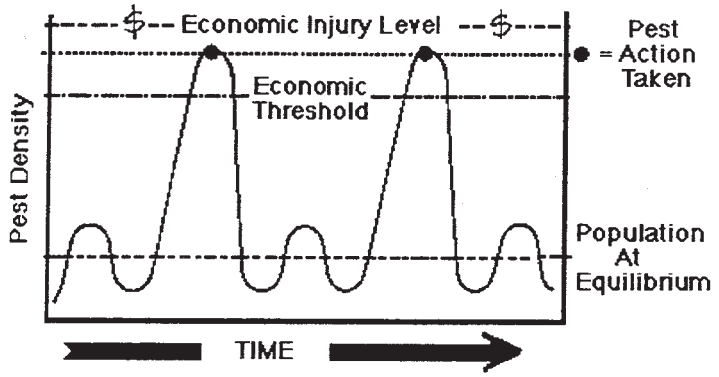
❧ Beneficial insects require lots of energy to search for prey. When pests are scarce, beneficials rely on pollen (a source of protein) and plant nectar (a source of carbohydrates) for energy. Pollen is especially important to beneficial insects when they are laying eggs. When pollen is abundant, beneficials can reproduce quickly, providing rapid pest control.

❧ Certain plants are particularly good at attracting beneficials with nectar and pollen: sunflowers, vetches, sweet alyssum, candytuft, and plants in the carrot and daisy families are beneficial favorites.

ACTION THRESHOLDS

In a successful IPM program, pests are detected before they reach damaging levels. In the classic IPM model, first developed and used in agriculture, all management strategies are based on "thresholds", or more specifically, on "economic thresholds". As illustrated in Figure 2, economic thresholds are levels that mark the highest point a pest population can reach without the risk of economic loss of a crop - a major consideration in production agriculture. Populations above these thresholds can reach the "economic injury level", where they can cause enough damage for the grower to lose money. At the economic injury level, the cost of control is equal to the loss of yield or quality that would result otherwise.

Figure 2.



Thresholds for many pests and crops have been determined scientifically. The advantages of thresholds is that if a pest has not reached threshold, there is no risk of economic loss, and, therefore, there is no need to spray. Once the pest density (number of pests per unit area) has reached threshold, action is justified. The cost of control will be less than equal to the estimated losses that the pests would cause if left uncontrolled.

In a home garden, the action threshold can be difficult to determine. What you are growing and how you intend to use it will determine how much damage you are willing to tolerate. At the heart of IPM is the understanding that many crops can tolerate a certain amount of pest damage before a rescue treatment with a pesticide is needed. Remember that larger plants, especially those close to harvest, can tolerate more damage than a tiny seedling. A few flea beetles on a radish seedling may warrant control whereas numerous Japanese beetles eating the leaves of beans close to harvest may not.

While urban pest thresholds, or those associated with non-agricultural land uses, are often related to aesthetics rather than economic considerations, there is one exception. Where health concerns or individual sensitivities exist, the tolerable level of a pest may be "zero". A zero threshold forces action, even if only one pest has been detected. Zero thresholds exist in hospitals, food production, warehousing, and retail facilities.

APPROACHES TO PEST MANAGEMENT

1) **Prevention** - When a pest problem is anticipated, preventative action can be taken to prevent a significant problem from occurring. The preventative approach may include the use of chemical and/or non-chemical methods.

2) **Suppression** - Suppressive actions are taken after a pest problem has been detected and the action threshold has been reached. In practice, few treatments totally eliminate a pest problem, but the pest population is reduced to a point at which it is no longer perceived as a problem. While the use of chemicals is usually associated with suppression practices, non-chemical methods may also be used to suppress a pest population.

3) **Eradication** - When a pest problem must be totally eliminated from a designated area, the approach is termed eradication. Examples: If a dangerous new pest is identified in a fruit growing area, regulatory agencies may implement widespread actions to totally eliminate the pest before it becomes established to a point at which it can no longer be eradicated. When a serious insect pest problem is detected in a commodity of foreign origin, fumigation tactics may be employed to totally eliminate the pest from the contaminated stock. If a pest population of public health importance is detected in a hospital or food establishment, efforts may be taken to completely eradicate the pest population. In general, however, the eradication approach does not apply to the elimination of an established pest population from a large area.

PEST MANAGEMENT METHODS

The range of pest management methods can be represented as a "pyramid". Methods located at the bottom of the pyramid are preventative in nature and low in toxicity, and therefore should be our first line of defense against pest infestations and disease. As you progress up the pyramid, pest management methods are designed to intervene (suppress or eradicate) in an ongoing pest problem. Management methods become more toxic to humans, non-target organisms and the environment when chemical methods are employed.

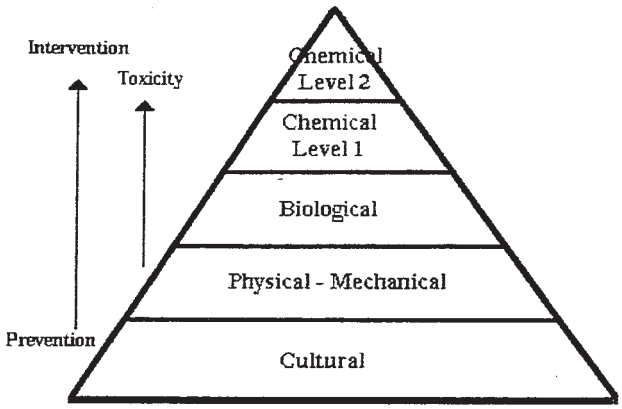


Figure 3. (Source: The Pennsylvania IPM Program, http://paipm.cas.psu.edu)

1) <u>Cultural</u> - Cultural methods involve manipulating the environment to make it less suitable for pest survival. This includes keeping plants and animals healthy so they can resist pest attacks, and eliminating pest harborages so a population can't become established in the home, yard or garden. Use of cultural measures requires a good understanding of the life history and habits of the pest. The most vulnerable stage in the pest's life history must be identified, and cultural practices used to minimize attack by the pest, slow its rate of increase, or destroy it. Examples of cultural control methods include:

✔ **Sanitation -** Sanitation is perhaps the most important cultural practice that can be used to help manage pests in the home, yard, and garden. This management method simply involves: removing diseased plants or plant parts; removal of dead or diseased limbs from trees and shrubs; garbage management to discourage flies and rodents; careful attention to pet food areas; scrupulous clean-up of food crumbs in the home; and, elimination of paper bags, newspapers and other materials that provide food and shelter for pests such as cockroaches and rodents.

✔ **Household Maintenance** - Every repair that you make may prevent one or several species of pests from taking up residence in your home. The following are several critical areas that you want to check: **Gutters**: Gutters should be kept free of leaves. There are many species of mosquitoes and aquatic flies that will lay eggs in gutters that have standing water. Also, check fascia and soffits. Wasps, carpenter ants and carpenter bees will be attracted to fascia and soffits that are not painted or in good repair. **Roof:** Check for loose shingles and rotted boards, which are especially attractive to carpenter ants and a variety of insects that overwinter as adults. Also, pruning back tree branches that hang over or touch the roof or eaves will help to keep carpenter ants off the roof. **Chimney:** Check for loose flashing around the chimney base and loose bricks. Make sure a screen is covering the chimney opening. **Siding, Windows, Doors and Basement Foundation:** Check for cracks, holes, cracked and loose mortar and weather stripping that needs to be replaced. Check boards for rot. If rotted, check for signs of termite or carpenter ant damage. **Attic:** Check and repair screens on attic vents and windows. Check attic for bird and rodent nests. If present, they will probably contain bird mites, bat bugs and carpet beetles that will eventually find their way into the living space of the home. Also, remove nests from eaves and gutters for the same reason.

✔ **Plant Selection -** When selecting landscape plants, turfgrasses, or garden crops or flowers, choose plant materials that are well adapted to local soil and environmental conditions. Make sure the plant you select is appropriate for your hardiness zone. (Refer to the "New Vermont Hardiness Map" at the end of the Chapter.) Consult your local Cooperative Extension Office, garden center or nursery for suggestions on what plants grow best and without significant pest problems. Avoid plants that are recognized as being marginally hardy. Cold temperatures can predispose tender woody and perennial plants to pest damage.

Some plant cultivars resist or tolerate pest damage. Examples include tomato cultivars that are resistant to wilt diseases, apple cultivars resistant to scab diseases, and plants bred to produce more surface hairs that will discourage insect feeding.

✔ **Crop Rotation -** If space permits, rotate the location of garden crops. While this method will not affect the incidence of foliar-feeding insects, it may reduce the damage caused by soil-inhabiting pests such as white grubs, corn rootworms, millipedes, and some cutworms. Avoid planting root crops into areas recently infested with soil insects or into plots that were not cultivated or were in sod the previous year.

✔ **Cultivation** - Keep garden and crop areas weed-free. Many weeds serve as reservoirs for insects which may later move to garden crops. Use fall and spring cultivation to incorporate compost or crop residues and expose soil-dwelling insects to natural enemies and the weather.

✔ **Planting Dates** - There are recommended planting intervals for most crops, and it is wise to recognize their importance. Careful selection of planting dates enhances crops' defenses against disease and insect infestations. Planting too early in the spring can result in plants weakened by cold, wet soil conditions, and late spring frosts can damage or kill crops planted too early. Root and seed rots usually can be avoided by choosing later planting dates when soil conditions are more favorable.

✔ **Intercropping and Landscape Variety** - Intercropping involves planting two or more crops in adjacent plots to slow the spread of pests and provide habitat for natural enemies. In addition, a diversity of plants and variety of planting patterns utilized in the landscape increases the likelihood that predatory and parasitic insects will be present in a yard or garden. Many of these beneficial insects feed on the pollen, nectar or plant sap of these plants in addition to, or in the absence of, their prey. Having a diversity of flowering plants with different blooming periods can increase the survival of these beneficial insects.

✔ **Water and Fertilizer Management** - Proper fertilization and watering encourages healthy vigorous plant growth resulting in plants that are better able to tolerate pest damage.

2) **Mechanical/Physical** - Mechanical/physical pest control methods are the oldest, and in some cases, the simplest of all insect control methods. These tactics differ from cultural control methods because they are directed against the pest itself rather than the pest's environment. Examples of mechanical/physical control methods include:

✔ **Mechanical Exclusion** - Rodents and other mammals such as bats can be excluded from homes by permanently closing entrance holes with caulking, steel wool, or structural repairs. Many insects can be excluded from homes by caulking holes and cracks and ensuring that doors and windows are tightly sealed and screened. Storing food products and pet food in tightly sealed containers will guard against other insect and rodent infestations.

Outdoors, barriers and devices such as fences, lights, row covers and noisemakers are examples of mechanical exclusion methods used to keep pests away from

garden plants and out of homes. Cardboard or metal collars placed around garden transplants or bedding plants will reduce the risk of cutworm and millipede damage. Metal screens or cold frames covering high-value crops can be used to exclude larger insects, birds and rabbits.

✔ **Hand Removal** - Remove large or readily visible insects by hand and destroy, or dislodge pests into a can containing a small amount of water and detergent. The egg masses of many insects can be scrapped off and crushed. Hand removal requires considerable time and may not be feasible for larger landscapes or gardens.

✔ **Trapping** - Various kinds of traps can be used to monitor insect abundance, and in some cases, help reduce pest numbers. Yellow sticky traps are highly attractive to white flies, aphids, thrips, leafhoppers and other small flying insects, and are used by some commercial greenhouses for insect control. In outdoor settings, traps placed near susceptible plants may capture some invading insects before they can cause damage. Other trapping devices use pheromones, or attractive scents, to lure flying adult stages to their sticky surfaces. These are better used as monitoring tools rather than control measures. Glue boards for cockroaches and traps for wildlife are other examples of devices that can be used to keep pests away from homes and plants.

✔ **Syringing** - A vigorous stream of cold water from a hose can be used to dislodge aphids, spider mites and other small insects from turfgrasses, landscape plants and garden crops. This method must be applied frequently, however, as it has little effect on eggs, and will not prevent some insects and mites from crawling back onto the plant.

3) **Biological** - This IPM strategy uses beneficial organisms (See Section on Scouting) including predators, parasites or insect pathogens to reduce pest populations. It can be implemented by releasing beneficial organisms into the landscape or garden or by modifying cultural, chemical and other control practices to conserve existing natural enemies. Examples of biological control agents include:

✔ **Beneficial Insects and Mites** - Natural populations of predators (e.g., lady beetles, lacewings, syrphid flies, praying mantids, wasps and predaceous mites) and parasites (parasitoid wasps and tachnid flies) are valuable in reducing infestations of insect and mite pests. If these or other beneficial organisms are observed near or in the yard or garden, take care to ensure their survival. If pest suppression through the use of chemicals becomes necessary, select control

measures that minimize injury to beneficial organisms, while still providing satisfactory control of the target pest.

☞**REMEMBER: A low level of pest infestation may need to be tolerated to attract and maintain natural enemy populations.**

Several species of beneficial insects are available from commercial suppliers, but timing the release of these predators into your garden is tricky. For example, if lady beetles are released to control cabbage aphids and insufficient aphids are present at the time of release, most of the beetles will simply fly elsewhere in search of food. In the long run, it is generally more practical to conserve naturally-existing enemy populations through wise pest management practices.

✔ **Nematodes -** Certain species of nematodes (microscopic worms) that only attack insects are available commercially. Since they are soil organisms, they are most suitable for use against soil insect pests (cutworms, white grubs, etc.)

4) <u>Chemical</u> - If a pest population reaches threshold levels despite the use of preventative measures and other types of non-chemical controls, chemicals may be the last resort as a rescue treatment. Even chemicals are not a foolproof way of controlling pests. If the pest is too far along in its growth cycle, or has built up resistance to a pesticide, the use of chemicals may do little to control the pest and may do more harm than good by killing beneficial organisms, other non-target species, and contaminating the environment.

When pesticides are used as part of an IPM program, they should be carefully selected and their application timed with respect to the developmental stages of both the target pest and crop. Proper selection and timing of pesticide applications are extremely important in obtaining the best possible control with the least effect on the environment.

> ☞ **Always try to select pesticides that are labeled "Caution" (slightly/relatively non-toxic) over products that are labeled "Warning" (moderately toxic) or "Danger" (highly toxic).**

☞ **If a pesticide is needed for a rescue treatment, regardless of what type, be sure to follow the directions on the label. The pesticide label is a legal document! Do not apply at higher rates than directed on the label or use on crops that are not listed on the label. Also, be certain to wear the appropriate protective clothing as required by the label, and observe re-entry and pre-harvest limitations.**

Chemical controls can be divided into five classes: conventional synthetic pesticides, inorganic pesticides, botanical pesticides, biological pesticides, and insecticidal soaps/horticultural oils. As represented in the pyramid in Figure 1, two levels of chemical intervention are identified as part of the IPM approach to pest control. "Chemical Level 1" includes the inorganic, botanical, and biological pesticides, along with the insecticidal soaps and horticultural oils. People interested in gardening "organically" usually use products from Level 1. Chemical Level 2 encompasses the universe of conventional synthetic pesticides.

i) Conventional Synthetic Pesticides (examples: diazinon, carbaryl [Sevin], malathion, methoxychlor) This group comprises the largest number of products used to control pests. Most synthetic pesticides consist of organic compounds, which means they are formulated from molecules that contain carbon, hydrogen, and oxygen. Some of the more common groups of organic pesticides include:

- ✔ Chlorinated hydrocarbons (methoxychlor)
- ✔ Organophosphates (diazinon, malathion)
- ✔ Carbamates (Sevin)
- ✔ Synthetic pyrethroids (permethrin, resmethrin) Synthetic pyrethroids are based on the chemical structure of natural pyrethrins, but are much more stable and do not break down as easily in the environment.

ii) Inorganic pesticides (examples: sulfur, copper, lime sulfur) Inorganic compounds do not contain carbon, but are derived from mineral sources.

- ✔ Finely-ground sulfur can be applied as a dust or a spray for controlling spider mites and some fungal diseases.

iii) Botanical Pesticides (examples: rotenone, pyrethrum and pyrethrins, sabadilla, ryania, neem)

- ✔ Pyrethrins are refined from natural pyrethrum, which is extracted from a species of chrysanthemum in Kenya. While pyrethrins provide a quick knock-down of

insect pests, particularly soft-bodied insects, residual activity is brief.

✔ Rotenone is produced from the roots of two legumes, derris and cube, which grow in Asia and South America, respectively. Rotenone is highly toxic to cold-blooded animals, especially fish, but only slightly toxic to most warm-blooded animals. Residual activity of this product, like the pyrethrins, is very short.

iv) Biological Pesticides (example: *Bacillus thuringiensis*)

✔ *Bacillus thuringiensis*, commonly called "Bt", is marketed under a number of trade names. When certain species of insects ingest the spores of this common, soil-inhabiting bacterium, the action of a bacterial toxin on the insect's digestive track causes the insect to stop feeding, sicken an die. Until recently, control with this microbial insecticide had been limited to the caterpillars of certain butterflies and moths, and to mosquito larvae, but strains of Bt are now available for the control of some leaf-feeding beetles such as the Colorado potato beetle and the elm leaf beetle.

v) Soaps and Horticultural Oils

✔ **Insecticidal Soaps** are used as desiccants on soft-bodied pests such as aphids, mites, leafhoppers, scale crawlers, and thrips. Insecticidal soaps kill insects and mites by disrupting cell membranes, causing cells to burst. To achieve maximum control, these products usually require thorough coverage and multiple applications. Insecticidal soaps need to come into direct contact with the pest in order to be effective. Use insecticidal soaps with caution because they can injure the leaves of certain plants. Always perform a test application on a few leaves first.

✔ **Horticultural Oil Sprays** are highly refined petroleum oils that work on the basis of suffocation of the insect and its eggs. They are commonly used to control insects and mites on selected fruits and vegetables, shade trees, shrubs, flowers and other foliage plants. Spray oils are also often used as dormant treatments to control overwintering pests such as aphids, mites and scale insects. As with insecticidal soaps, horticultural oils need to come into direct contact with the pest in order to be effective.

THE ROLE OF PESTICIDES IN INTEGRATED PEST MANAGEMENT

IPM does not exclude the use of pesticides. In fact, IPM does permit integrated utilization of pesticides. But, at the same time, IPM is designed to minimize pesticide applications through the use of three primary strategies:

❶ **REDUCE the Use of Pesticides**. IPM reduces pesticide applications:
⇨ through pro-active, integrated application of non-chemical management practices;
⇨ by maximizing spot treatment and minimizing broadcast treatments; and,
⇨ by making applications only where the development of a pest has exceeded the established action threshold as determined by routine monitoring or scouting.

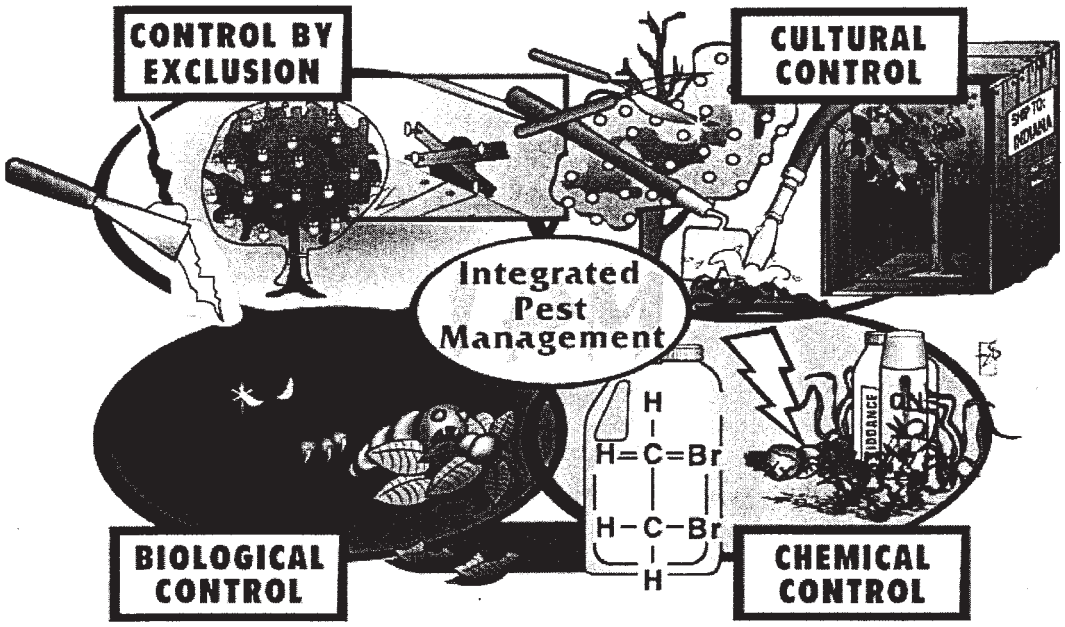
❷ **REPLACE the Use of Conventional Pesticides.** IPM reduces the use of conventional pesticides by favoring products that minimize risks to human health and safety, and are least toxic to the environment in general.

❸ **(RE)DESIGN the Use of Pesticides Out of the System**. IPM reduces pesticide use by:
⇨ correction of past design and construction practices that have created or exacerbated pest management problems;
⇨ incorporating low-chemical, low-maintenance design and construction practices in the development of new and rebuilt facilities to prevent or mitigate the occurrence of new pest problems.

DEVELOPING A STRATEGY FOR THE HOME, LAWN and GARDEN

(The following information is adapted from "Pesticides and Pest Prevention Strategies for the Home, Lawn and Garden", Purdue University Cooperative Extension Service, Purdue Pesticide Programs, Fred Whitford, et.al., May 1995. Graphics by Stephen Adduci)

When various pest management methods - cultural controls, physical/mechanical controls, biological controls, and/or chemical controls - are used in conjunction with regular inspections of the home environment to monitor and manipulate pest activity, the process is recognized as ***integrated pest management***. In most cases, an IPM approach is considered sensible and environmentally sound, and will keep pest levels and damage below economically or aesthetically injurious levels.



A preferred strategy in most pest control situations is to think in terms of reducing pest activity to a level that poses only minimal potential for damage or annoyance of the host, be it plant, animal or structure. For instance, it is not necessarily desirable to kill all the spiders in the home environment. However, while it is extremely important to remember that *total eradication of a pest population is not the goal in most cases*, it is equally important to recognize that sometimes it is necessary to totally eliminate a pest when it is causing damage to a structure, or when it presents the possibility of disease transmission to people or pets.

A STRATEGY FOR LAWN PEST MANAGEMENT

Healthy turf can compete with weeds, survive attacks by insects, and fend off disease. The key is to create an optimum environment where grass plant have every advantage for vigorous growth. The following suggestions can assist the homeowner in establishing and maintaining healthy turf with no, or minimal, use of pesticides.

✔ Choose an Adapted Grass with Pest Resistance

Select grass species and cultivars that are insect resistant. Chose those that are adapted to grow under the sun or shade conditions of your landscape. The amount of maintenance required and the intended use of the turf should also be considered in the homeowner's selection process.

Always blend two or three cultivars of each species included in a turf seed mixture to provide better disease resistance and adaptability to the site. A mixture of bluegrass, fine fescue and perennial ryegrass is the best mixture for Vermont. Planting a single cultivar can lead to the loss of your lawn if attacked by an aggressive disease or pest.

✔ Seed the Lawn When Conditions are Favorable

It takes six to eight weeks of good growing conditions for turf to become established. In Vermont, turf should be seeded in early Spring, or late Summer in order to avoid the hot, dry conditions of mid-Summer.

✔ Determine a Lawn's Nutrient Needs with a Soil Test

Lawn grasses require ample nutrients for healthy growth and resistance to disease damage. Test the soil about every three years to identify nutrient deficiencies and changes in soil acidity. A routine soil test will determine the soil's pH (acidity or alkalinity), its lime index, and its levels of phosphorus and potassium. (Contact the University of Vermont Agricultural and Environmental Testing Lab: (802) 656-3030)

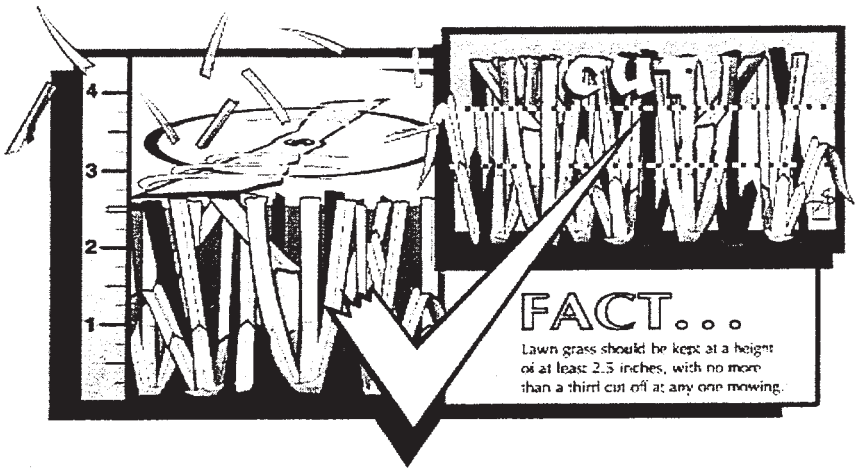
✔ Fertilize the Lawn for Sustained Growth and Reduced Pest Competition

It is important to understand how nutrients are packaged in fertilizer products. The three numbers on the label are required by law to inform the consumer of the percentage (by weight) of nitrogen, phosphorous, and potassium in the package. The numbers 24-6-12 on a fertilizer label indicate that the product contains 24% nitrogen, 6% phosphorous, and 12% potassium (potash). A good lawn turf fertilizer contains a nutrient ratio of about 4 parts nitrogen, 1 part phosphorous, and 2 parts potassium. It is normally recommended that the fertilizer product used for routine maintenance of a lawn provide two to four

pounds of nitrogen per thousand square feet of lawn per year.

In Vermont, fertilizers should be applied in April through early May, and in October through November. By applying fertilizer in the cooler months, root growth, as well as shoot growth, is promoted - leading to a thicker lawn better able to withstand pest pressure.

✔ Mow Properly for a Healthy Lawn and Fewer Weeds



Improper mowing practices result in more damage to lawns than any other cultural factor. Many lawns are mowed too short, infrequently, and with a dull blade. This restricts root growth and increases insect, disease, and drought damage, resulting in more weeds.

The grass species in a lawn should determine the mowing height. Kentucky bluegrass, turf-type perennial ryegrass, and fine fescues should be mowed at least 2.5 inches high. A mowing height of at least 3 inches is best for turf-type tall fescues.

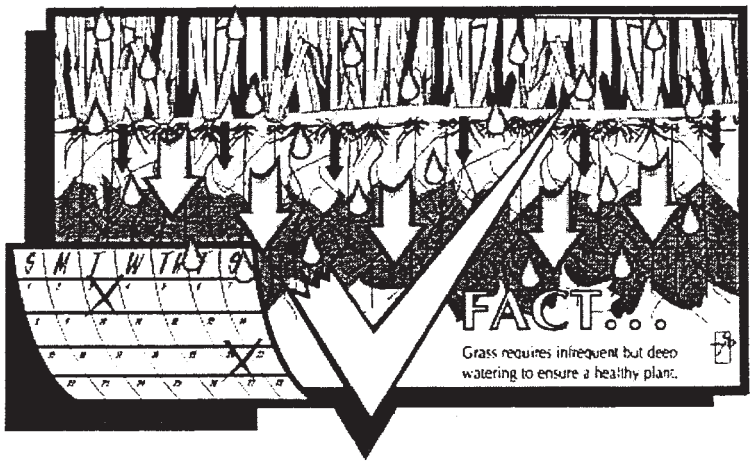
Mow often so that no more than 1/3 of each leaf blade is removed each time the grass is cut. This may mean more frequent mowing in the spring and fall, with less frequent mowing during the summer. Lawns should be mowed about ½ inch higher in summer to help grass plants tolerate heat and drought stress. Always mow with sharp blades. Leave the clippings on the lawn unless they are needed for mulch or compost. This important practice will return nutrients to the soil to be taken up by the grass plants; it will not increase the buildup of thatch. When too many clippings remain on the surface of grass plants after mowing, spread the clippings uniformly with a rake or re-cut the lawn.

✔ Reduce Diseases and Weeds with Proper Irrigation

Improper watering is the second largest cause of lawn pest problems. Irrigation for established lawns should be thorough, with each watering wetting the soil about 6 inches

deep. Watering should not be repeated until the turf begins to show signs of drought stress, such as a bluish-gray color or footprints that do not disappear as someone walks across the lawn. Such signs are not cause to worry; the grass can withstand mild stress and will recover when watered thoroughly again.

It is best to water between 4 and 8 A.M. because the evaporation rate is low early in the morning, allowing most of the water to soak into the soil. Midday watering is not advised due to the likelihood of rapid evaporation. Likewise, watering late in the evening is not advisable because flowers and other landscape plantings are more likely to stay wet, making them more vulnerable to disease.



✔ Reduce Pests by Controlling Thatch

Microorganisms and earthworms help decompose dead organic materials in and on the soil. This activity releases nutrients into the soil to be taken up by grass roots. Grass clippings decompose easily in this manner; they do not contribute to thatch.

The thatch layer in lawns is composed of dead and living shoots, stems, and roots of grass plants. These parts of grass plants resist decay and accumulate on the soil surface, forming thatch. A small amount of thatch is desirable; however, the accumulation of more than ½ inch of thatch limits water and air movement, reduces the effects of fertilizer and pesticide applications, promotes shallow rooting, and increases disease and insect damage. Excessive thatch buildup can be managed with proper applications of moderate amounts of fertilizer and water.

Removal of excessive thatch is difficult and expensive. It may require the use of aerification equipment or, at worst, the physical removal of the sod (including the thatch layer) and the reestablishment of a new lawn. Power rakes (dethatching machines) are effective in minimizing thatch, but they are not effective in removing excessive layers of thatch.

✔ Renovate the Lawn to Correct Major Problems

A lawn that has been seriously damaged by insects or disease cannot be repaired with pesticides. These chemical compounds are formulated to manage pests; but once serious damage occurs, pesticides can't bring dead grass back to life.

Pesticides are useless on neglected or poorly managed lawns. When more than 5 percent of a lawn consists of weeds and dead grass, complete renovation is required. The homeowner may choose to do the renovation with the aid of information available from the local Cooperative Extension Service; in some cases, however, it may be better to employ a professional firm to renovate the lawn. In either case, lawn renovation is a major undertaking that has to be done properly and completely. The optimum time for renovating a lawn is late summer. Preparation should begin in August so seed can be planted in the fall according to recommendations for the geographical area.

✔ Use Pesticides Only for Major Pest Outbreaks

Good cultural practices result in healthy grass that can withstand some damage from insects, weeds, and diseases. Regular inspections will help detect early insect infestations, the presence of weeds, and symptoms of disease. Pest populations and the damage they cause should be monitored closely. If it is determined that the situation does require a pesticide application, it is essential that the person making the application know what they are doing.

First, the pest must be positively identified, followed by the selection of a pesticide product suitable for both the pest and the site to be treated. The pesticide label must be read carefully and followed explicitly. If any part of the label is unclear to the applicator, it is important that a professional be consulted for clarification. Children and pets must be kept well away from the area during treatment; and in the case of lawn spray applications they must be kept away until the pesticide has dried completely. When granules are applied to lawns, they should be watered thoroughly into the soil and the grass allowed to dry. Some pesticide labels state specific periods of time ("Restricted Entry Intervals") during which people must stay off a treated lawn. Consideration of neighbors can be exhibited by posting `keep off' signs which indicate that a pesticide application has been made to the area.

Many grubs species hatch in late Summer in Vermont. Egg hatch is the optimal time for grub control applications because newly hatched grubs are very susceptible to insecticides and because only minimal turf damage will have occurred. Waiting until severe damage is apparent before treating means killing larger, hardier grubs in an

already stressed turf.

On the other hand, not all turfgrass will be infested with grubs every year. Responsible use of chemicals dictates that they be used only when and where needed. To determine if treatment is required, you need to monitor for grubs by cutting a small section of turf at several locations during peak egg hatch (use a knife for this sampling). Search through the soil just below the thatch for tiny white grubs. Grubs in low concentrations (4 or less per square foot of turf) seldom cause any damage and do not merit concern; slightly increased irrigation will rejuvenate the turf with no apparent or lasting damage. Larger numbers (8 or more grubs per square foot) require immediate treatment to prevent damage. Concentrations of 4-8 per square foot call for individual judgment. Points to consider are (1) whether slight grub damage in the affected area would be tolerable and (2) whether more irrigation to the area might negate the effects of minimal root pruning by grubs; if the answer to the latter is yes, the homeowner might elect to forego the cost and energy of an insecticide application.

However, if treatment is required, it is important to irrigate, apply the product correctly (calibrate equipment properly), and follow all label directions during application. Regardless of whether or not the decision is to treat, the area should be monitored again the following week as well as throughout late summer and fall.

Most **lawn diseases** go essentially unnoticed in the early stages; and once they have advanced to the point of recognition it is very unlikely that control can be accomplished, even with pesticides. However, good cultural practices will aid in the recovery of your lawn as not all diseases are seriously damaging to turf. In those cases where large damaged areas do not respond to good maintenance practices such as fertilization and watering, complete renovation may be necessary.

The best control for **lawn weeds** is to mow and fertilize appropriately. A dense lawn, mowed as needed and at the proper height, will prevent many annual weeds from becoming a problem. When a weed does create a problem, a positive identification becomes the first step in achieving control. Then, if chemical control is determined to be the best approach, comes product selection, followed by application according to label directions. It should be noted that some perennials are difficult

A STRATEGY FOR PEST CONTROL IN HOME GARDENS

Home vegetable and fruit gardening is a popular outdoor recreational activity in the United States. The gardener gains satisfaction in growing food crops at home. However, insects, weeds, and diseases can become a problem. ***The best pest management plan for home gardens is prevention.*** **The following pest prevention methods are recommended.**

✔ Plant Disease-Resistant Cultivars

Controlling infectious diseases is difficult; therefore, emphasis should be placed on prevention. The first step is to determine what diseases are most common on the crop to be grown, where it will be grown; then, if available, choose cultivars known to be resistant to those diseases.

If a fungal disease is identified, a fungicide registered for controlling it on the host plant must be applied on a regular basis according to the label use directions. Very thorough coverage of the leaf and stem surfaces of the entire planting is necessary since most fungicides available to homeowners are not curative, but preventative; i.e., they must be applied to healthy leaves to prevent invasion by the fungus.

✔ Remove Plant Residues

Since many pests can overwinter in dead plant debris, it is important to remove vegetation as soon as its produce is harvested, thereby eliminating possible harborage. Removing expended plant material will render the garden less attractive to insects overall, thus lessening the potential for infestation of plants not yet harvested. Weeds should be removed before they have a chance to produce seed. In orchards, fallen fruit and leaves should be collected and removed to ensure that they do not host pest populations destined to become a problem the following year.

✔ Purchase Healthy Plants

Plants should be inspected carefully, before purchase, to be sure they are free of insects and disease. Discoloration and stunting are two signs of pest damage.

✔ Improve the Soil

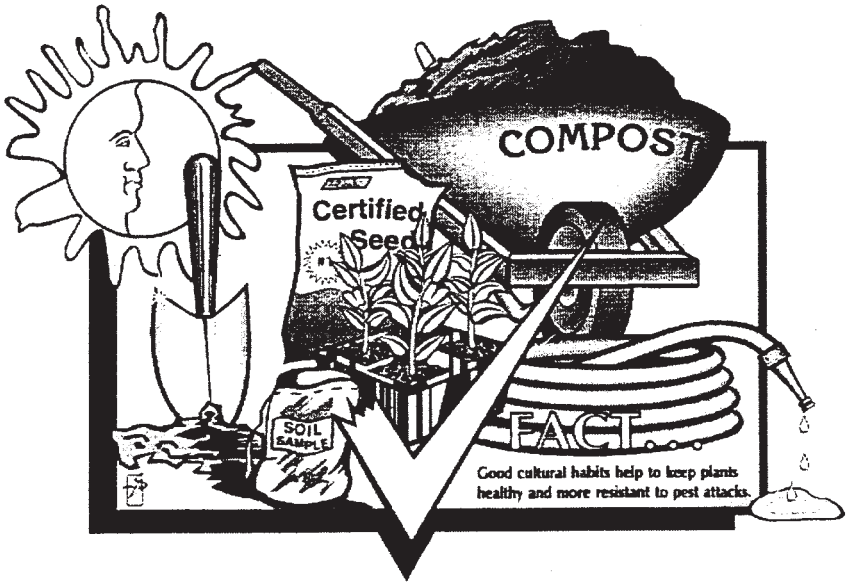
Organic matter such as compost should be mixed into the soil at the beginning of each gardening season unless the soil is heavy clay that holds too much water for long periods of time. Garden soil should be tested at least every three years and amended by fertilizing as required. A loose, fertile soil promotes healthy plant growth, and healthy plants can out-compete pests, yielding more high quality produce. (Contact the University of Vermont Agricultural and Environmental Testing Lab: (802) 656-3030)

✔ Use Proper Gardening Practices

Optimum growing conditions yield plants with fewer pest problems. Planting, spacing, watering, fertilizing, and controlling weeds according to prescribed guidelines for the particular plant will result in gardening success.

✔ Mulch to Prevent Weeds

A thin layer of grass clippings (not recently treated with herbicides), leaves, straw, sawdust, wood chips, or compost can be spread around plants to control weeds. As these organic materials decay, they add nutrients to the soil. Mulch helps retain soil moisture and moderates soil temperatures in the summer.



Black plastic can be used as a ground cover to conserve moisture and control weeds. It will warm the soil in the spring but may retain too much heat for some plants in summer. Plastic mulches should be used only with plantings of annual vegetables and flowers. In landscape beds, it can prevent water and air from reaching the roots of trees and shrubs. It also may encourage shallow rooting, leaving the plants more susceptible to cold injury.

✔ Rotate Crops and Diversify Plantings

Vegetable crops should be rotated to different locations in the garden each year in an effort to reduce the potential for buildup of pest problems in the soil. But if a serious problem does occur, the crop involved should not be replanted in the questionable area for at least five years.

✔ Encourage Beneficial Insects

Less than one percent of all known insect species are considered pests. It is important to know the difference between beneficial and harmful insects. Beneficial insects include lady beetles, bees, green lacewings, praying mantids, dragonflies, and wasps. Spiders are examples of beneficial arthropods.

✔ Scout for Pests and Symptoms of Pest Damage

Plants should be inspected for pests several times each week. Insects feeding on plants present the gardener with two choices: Tolerate the damage, or try to control it. Control methods that don't require pesticides include hand removal of the insects, early harvest, or tolerance of small amounts of damage. For example, corn earworm damage to the tips of sweet corn ears can be cut off; the outer leaves of cabbage damaged by insects can be removed; superficial blemishes on the skin of an apple can be peeled off.

An insecticide application may be necessary when plants are in danger of being severely damaged or destroyed. But before using a pesticide, the home gardener should understand that:

- The pesticide label is a legal document;
- It is the user's responsibility to read and follow the label explicitly;
- Pesticides may not be applied at rates greater than that specified on the label (although you may apply at a rate lower than that indicated on the label);
- Pesticide labels may stipulate waiting periods--called pre-harvest intervals--which must elapse between application and harvest of the crop for human consumption; fruits and vegetables always should be washed thoroughly before eating.

And, of course, when more than one pesticide is available to control the pest on the specified site, it is always a good idea to select the least toxic product.

A STRATEGY FOR PEST CONTROL ON LANDSCAPE PLANTS

The diversity of plant materials in the residential landscape translates to a wide range of potential pest problems. Keeping plants healthy can prevent many of them. Plants that are stressed from undesirable cultural or site conditions grow poorly and become prime targets for pests. For example, a landscape plant is more likely to have spider mite problems when it is planted in a hot, dry area. Likewise, plants that have been damaged by a lawn mower are more likely to have borer problems than undamaged, healthy ones. The best way to discourage plant pest problems is to fulfill their cultural requirements.

✔ Select Recommended Plants

It is wise to choose proven performers--plants known to do well in the area intended for planting. Those known to have a history of pest problems should be avoided. Resistant plant species and cultivars should be used when available. Clavey's dwarf honeysuckle, for example, is resistant to an aphid that seriously damages other honeysuckles; and a scab resistant crab apple cultivar is a wise choice over a susceptible species. When a pest becomes a recurring problem, consider replacing the plant with a non- susceptible cultivar.

✔ Design with Diversity

Increasing plant diversity makes it more difficult for pests to spread between plants, so it is recommended that a wide variety of plants be included in a landscape. For example, there are four pests--the mimosa webworm, the honey locust spider mite, the locust plant bug, and the leafhopper--that can cause serious damage to honey locust stands; merely planting other tree species among the honey locusts will reduce the damage potential.

✔ Inspect Plant Materials at the Source

Plants should be inspected for pests before they are purchased, no matter where they are purchased. New (infested) plants can introduce pest problems to the landscape.

✔ Provide a Properly Prepared Site

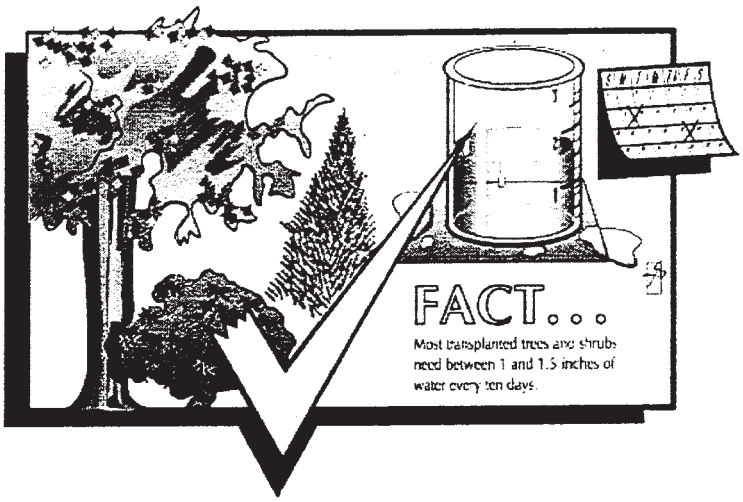
Site selection is critical: The site must be compatible with the plants' requirements. Things to consider are exposure to sunlight, drainage, soil pH, and nutrition. The soil must be prepared carefully, using soil amendments as required for healthy growth. Lime should not be added unless a reliable soil test has indicated the need.

✔ Plant at the Proper Depth

Planting at the proper depth may prevent damage that could make plants more attractive to pests. The hole for planting should be dug just deep enough to accommodate the root ball of the plant. Loosening soil under the root ball will result in settling and subsequent injury to the roots.

✔ Provide Proper Fertilization and Irrigation

Plants need proper and adequate nourishment for healthy growth, and deciding what fertilizer to use and how much to apply is crucial to successful landscaping. Soil tests are helpful in determining the needs of the soil itself, but it is equally important to address the nutritional needs of each plant, as well. Transplanted trees, shrubs, and other landscape plants may benefit from a small application of fertilizer at planting, but care should be taken not to overdo it. Established plants usually receive adequate nutrients when the lawn is fertilized.



✔ Apply Mulch Around Landscape Plants

Mulch will conserve moisture and protect plant roots from extreme temperatures; and it can prevent bark injury from lawn mowers and string trimmers. It should be applied 2-4 inches deep and kept at least 2 inches away from tree trunks and the bases of shrubs.

✔ Know When to Prune

There are good and bad times to prune. Caution should be taken to ensure that the pruning process does not leave trees and shrubs more vulnerable to damage from other sources. For example, oak wilt, a serious disease of red and white oaks, is spread by a fungus which beetles carry from infected trees to fresh wounds on others; therefore, oaks

should not be pruned in spring and early summer when insect activity is high.

Most plants can be pruned in late winter or early spring, but trees and plants that flower in the spring should be pruned after the blooms fade.

✔ Manage Noninfectious Problems Promptly

Problems transmitted from one plant to another by living organisms are called infectious; those that result from factors other than living organisms are called noninfectious. Many landscape plant problems are caused by noninfectious factors. Plant problems resulting from soil compaction and mechanical damage to the bark often are caused by people, not pests.

Environmental factors such as extreme cold or hot temperatures, drought, flooding, and lightning also can cause problems, many of which can be diminished by implementing proper cultural practices. Watering during periods of drought, improving soil drainage, and fertilizing appropriately can minimize injury from noninfectious factors. Pesticides cannot prevent damage caused by noninfectious factors.

✔ Inspect for and Monitor Insects and Diseases

There are two things to remember relative to monitoring landscape plants for pests: Regular inspections are helpful in preventing serious pest damage; and early season infestations can be more damaging than those that show up later.

✔ Physically Remove the Pest

Physical removal and destruction is one effective way to manage many pest problems. The eastern tent caterpillar is an example. This insect problem starts in a small group of eggs attached to a twig in a tree. After the eggs hatch, the caterpillars feed on leaves at night. During the day they hide from birds in webbed tents built in the forks of tree limbs. Much of their damage can be avoided by removing and destroying these tents when the caterpillars are still small and inside. Pruning out pest-infested branches can be an effective way to avoid further damage on vigorously growing plants. Oystershell scale on red twig dogwood can be controlled in this manner.

✔ Identify the Location of Injury

When pest damage is identified, it is important to determine which part of the plant is being affected. This will help in deciding whether or not a pesticide is needed. Pest

damage to plant leaves usually is less serious than damage to trunks, stems, or roots, so pesticides might be ruled out if only the leaves are involved.

✔ Use Biological Management Methods

Biological control involves the use of natural enemies to reduce or prevent pest damage. Not all insects, mites, and diseases are harmful to plants; many, in fact, are predators, parasites, or pathogens. It is important to distinguish between pests and their natural enemies. When the natural enemies are present, they should be given time to become established and control the pest.

Predators attack, kill, and eat multiple numbers of pests. Parasites lay an egg in or on a pest; and when the egg hatches, the new parasite consumes and usually kills the pest as it matures. Pathogens are free-living microscopic organisms (bacteria, fungi, viruses, etc.) that invade the pest and cause a disease that weakens or kills it.

✔ Use Pesticides as a Last Resort

Pesticides should be used only when the pest threatens to cause serious damage to the host. When more than one pesticide is available to control the pest on the specified site, the one that is least harmful to natural enemies should be selected.

A STRATEGY FOR PEST CONTROL IN THE HOME

IPM principles for the indoor home environment are the same as those used for crops and ornamental plants: inspect regularly and thoroughly, identify problems accurately, act only when the expense is justified by the benefit, consider all possible management options, and choose the least toxic approach. Practical methods are available for managing pest infestations in the home, but the homeowner should be aware that a one-time pesticide application usually will not provide long-term control. However, thorough, one-time applications of baits for roaches and rodents can and have solved pest problems. The following methodology applies to many situations and should be considered in developing pest management strategies for use in the home environment.

✔ Identify the Pest

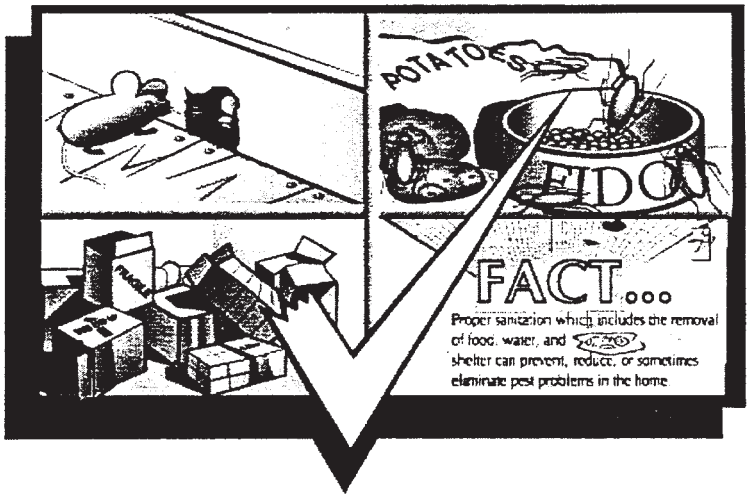
Proper and complete identification of the pest is critical. For example, identifying an insect pest as a cockroach is not sufficient. German, American, Oriental, and brown-banded cockroaches have very separate and distinct biologies and behavior patterns; and a thorough understanding of those characteristics is essential in the development of a sound management strategy. With this information, one can determine how, when, and where to inspect for the pest.

✔ Inspect the Home for Pests

Routine and detailed visual inspections are critical to long-term pest management. The inspection should identify conditions favorable for pest infestations. Some insects (e.g., cockroaches, silverfish, carpenter ants) and rodents are active at night; therefore, nocturnal inspections conducted perhaps an hour or two after dark are important in determining where they are nesting, feeding, traveling, etc. The exercise should occur quietly and with the aid of a powerful flashlight, covering all areas that might possibly provide the pest with food, water, warmth, or shelter. During warm weather, the inspection should be extended to the outdoor perimeter of the structure.

✔ Use Good Sanitation Practices

Elimination of a pest's food, water, and shelter sources will almost certainly reduce the infestation and may even eliminate it altogether. Good sanitation practices for the home include proper management of household garbage; the avoidance of long term storage of food products and clutter in garages, attics, and basements; and, regular cleaning around appliances and in areas frequented by pets.



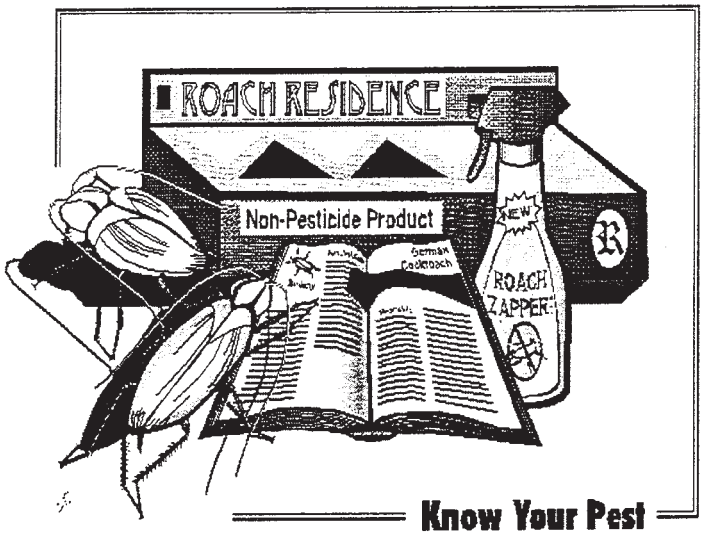
✔ Pest-Proof the Home (Exclusion)

The best method of managing pests in the home is to exclude them--in effect, to 'pest proof' the house: Caulk cracks and crevices; repair a leaky roof; add screens; seal thresholds and chimneys. All openings larger than 1/4 inch must be closed to exclude

mice; smaller openings and cracks must be sealed to exclude insects. Many 'how-to' home repair and improvement books offer tips on pest-proofing the home.

✔ Use Traps for Minor Problems

Although traps cannot be used to control major, established pest infestations, there are many types of traps that can be used for small infestations of certain pests. Examples include snap traps for mice; sticky boards for cockroaches and mice; yellow jacket sugar traps; and sticky fly strips. The key to success with traps is placement. Since pests will not travel out of their way to locate traps, it is important to determine where the pest is most active, or where the pest population is concentrated.



A sufficient number of traps--for mice, 3 or 4 per individual--should be placed in those areas. It is always advisable to use more than one trap.

✔ Use Pesticides Properly

Understanding pest biology and behavior can reduce unnecessary or excessive use of pesticides in the home. Pesticides should be applied only as ***spot treatments*** in pest-populated areas identified during an inspection. Only pesticides labeled for indoor use should be used inside the home. It is important to realize that one application of a pesticide inside the house may not provide long-term control. Multi-purpose pesticides labeled for outdoor use should not be applied indoors unless the label specifically permits it. Routine application of pesticides on baseboards and shelves, and in attics is not necessary or effective for most pests.

Pesticide treatments around the perimeter of a building can be effective for some pest problems. In many cases, pest management professionals are better trained and equipped than the homeowner to make perimeter treatments. Perimeter treatments should be used only when needed, not as a cure-all for keeping insects out of the home. It is more

important to identify and correct food, water, and shelter conditions that favor pests, both inside and out, and to "pest-proof" the home.

✔ Eliminating Breeding Places for Mosquitoes

The most effective method of mosquito control around the home is to prevent or eliminate breeding sites:

- Destroy or dispose of tin cans, tires, and any other object in which water might accumulate.
- Inspect water in flower plots and plant containers on a weekly basis; if mosquito larvae are detected, change the water.
- Change the water in bird baths and wading pools at least once or twice a week; drain wading pools not in use.
- Stock garden and lily ponds with top-feeding minnows.
- Keep rain gutters unclogged and flat roofs dry.
- Drain and fill stagnant pools, puddles, and ditches.
- Keep margins of small ponds clear of vegetation.
- Place tight covers over cisterns, cesspools, septic tanks, fire barrels, rain barrels, and tubs where water is stored.
- Fill all tree holes with sand or mortar, or drain them.
- Remove tree stumps that may hold water.

Questions for Self-Study - Chapter XI

1. Name the three pest management approaches.

2. What are the four pest management methods?

3. Integrated Pest Management involves the integration of _____ and _____ into a pest management system.

4. Name two things you should do before you select a pest management system to control a pest problem.

5. Name three elements that must be present in order for a plant disease to become established.

6. When dealing with a plant disease, is it easier to directly control the disease or alter the environment so it is unsuitable for the development of the disease?

7. Why is good record keeping so important when practicing IPM?

8. Why is monitoring so important in IPM?

9. What is an action threshold?

10. Briefly describe the three non-chemical pest control methods.

11. When using chemicals as part of an IPM approach, what should you take into consideration when selecting a product?

Pests

There are many kinds of pests. Each structure, crop, or animal have pests. You must recognize or be able to identify the common pests that you work with and their hosts. Otherwise, you may use the wrong method of control, choose the wrong pesticide, or treat too early or too often and do more harm than good. (See Chapter XI, IPM)

If you know the general pattern of the pest's life cycle, the damage it does, and when it does the damage, it will help you to:

- know the best time to control the pest.
- use less pesticide, or use other methods of control.
- avoid injury to the host (plant or animal).
- avoid injury to non-target areas.

Never guess at your pest problems.

Goals of This Chapter

- Be able to recognize pests by identifying physical characteristics and damage.
- Understand how different pests reproduce and develop.
- Be familiar with how diseases affect plants.

Pests

Human civilization has been competing with insects, rodents, diseases, and weeds for survival throughout its history. Historical records of plagues, famine, and pestilence fill volumes of texts. Modern man has, through his technology, created tools to combat these pests. The use of a tool, such as a pesticide, depends on the applicators ability to know when they are needed. Proper identification of the problem is the first step to proper application.

A pest is considered to be anything that:

- injures humans, animals, crops, structures, or possessions.
- competes with humans, domestic animals or crops for food, feed, or water.
- spreads disease to humans, domestic animals, or crops.

The certified applicator must know the pests that are most likely to be encountered. To be able to control these pests, you need to know the following:

- the common features of pest organisms.
- characteristics of the damage they cause.
- the biology and development of the pest.

Pests can be placed into four main categories:

- insects and closely related animals
- plant diseases
- weeds
- vertebrates

Insects

Insects, as a class of animals, outnumber all other living animals on earth. There are three times as many insects as there are animals in the rest of the animal kingdom. Insects are found everywhere; in snow, water, air, soil, hot springs, and in or on plants and animals. They compete with man and animals for food and are also considered food for a significant number of other animals. Some insects survive solely by feeding on man, for example human lice, and cannot survive for long if removed from the

human body. Insects are an extremely important part of the earth's ecosystem, and despite our dread of insects we could not survive without them.

The certified applicator controlling insects must be more knowledgeable of insects than the average person. Insects can be divided into three groups by their importance to man:

- **Species not considered pests.** About 99 percent of all insect species are in this group. They are food for other animals (birds, fish, mammals, reptiles and other insects). Some insects, butterflies for example, are considered pleasant to look at.
- **Beneficial insects.** This important group includes predators and parasites that feed on pest insects, mites, and weeds. Good examples are ladybird beetles (lady bugs) and praying mantids. Pollinating insects are also very important, such as honey bees, bumble bees, moths, butterflies, and beetles. Honey bees make food for humans and animals. Some other benefits derived from insects are silk from the cocoons of silkworms, or dyes for paints made from insect secretions.
- **Pest insects.** This group includes the smallest number of species. These insects feed on, cause injury to, or transmit disease to humans, animals, plants, food, fiber, and structures. Some examples of pest insects are mosquitoes, fleas, termites, aphids, and beetles.

Insect Body Characteristics

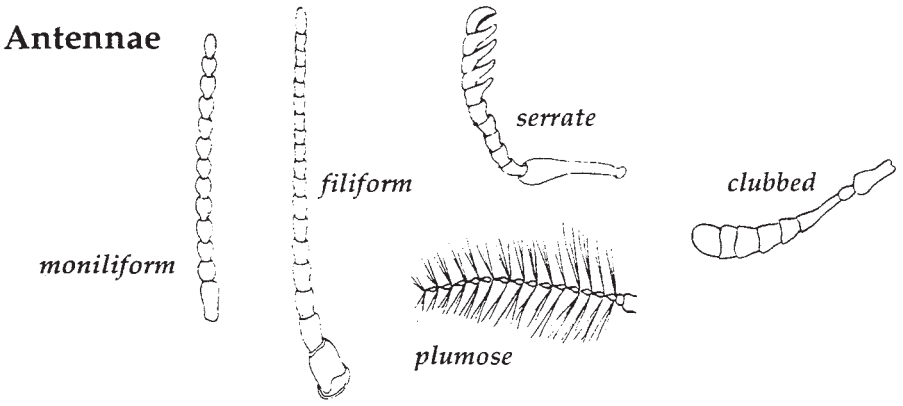
All adult insects have two characteristics in common; they have three pairs of jointed legs, and they have three body regions - the head, thorax, and abdomen.

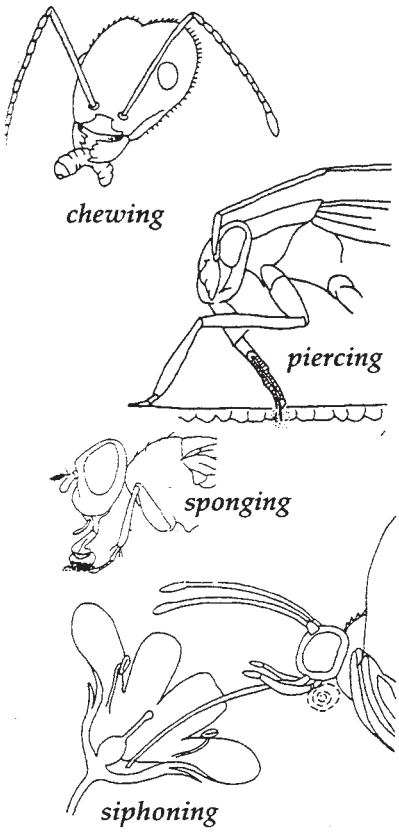
Head. Attached to the insect head are the antennae, eyes, and mouthparts. All of these parts vary in size and shape, and can be helpful in identifying some pest insects.

Antennae are paired appendages usually located between or below the eyes. Antennae vary greatly in size and form and are used in classifying and identifying insects. Some of the common antennae types are:

- **filiform** - threadlike; the segments are nearly uniform in size and shaped like a cylinder (ground beetle, cockroach).
- **moniliform** - look like a string of beads; the segments are similar in size and round in shape (termites).
- **serrate** - sawlike; the segments are more or less triangular (click beetle).
- **clubbed** - segments increase in diameter away from the head (Japanese beetle).
- **plumose** - feathery; most segments with whorls of long hair (male mosquito).

Antennae



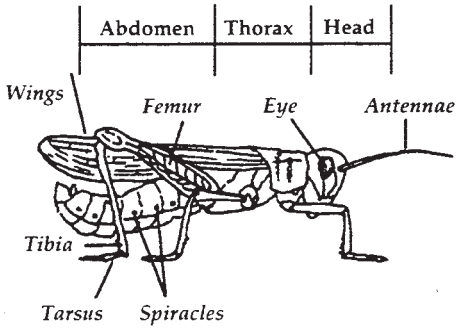


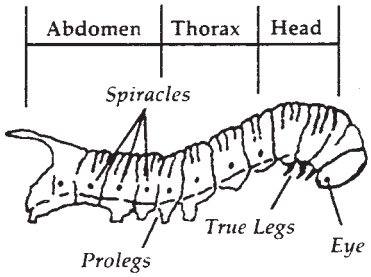
Mouthparts are different in various insect groups and are often used in classification and identification. The type of mouthpart determines how the insect feeds and what sort of damage it does. It is important that the applicator have some knowledge of the these types of insect mouth parts:

- **chewing mouthparts** have toothed jaws that bite and tear the food (beetles, cockroaches, ants, caterpillars, and grasshoppers).
- **piercing-sucking mouthparts** are usually long slender tubes that are forced into plant or animal tissue to suck out fluids or blood. (mosquitoes, aphids).
- **sponging mouthparts** are tongue-like structures that have spongy tips to suck up liquids or food that can be made liquid by the insect's vomit (house flies, blow flies).
- **siphoning mouthparts** are long tubes used for sucking nectar (butterflies, moths).

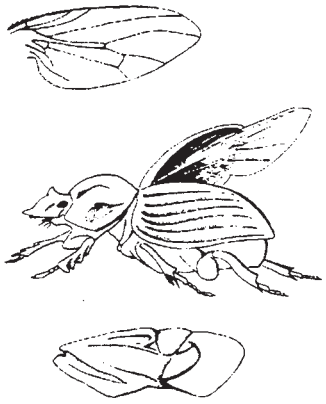
Thorax. The thorax, or middle body segment, has three pair of legs and sometimes one or two pair of wings (forewings, hindwings).

Legs come in many sizes, shapes, and functions and are helpful in identifying insects. Used for walking, running, jumping and climbing, legs have become very specialized in some insects like the large jumping leg in the grasshopper. Crickets and Long-horned Grasshoppers have an eardrum at the base of one of their leg segments.





Wings also vary in size, shape, and texture. The pattern of veins on the wings of an insect are often used to identify insect species. Forewings in some insects are hard and shell-like, as in beetles. The grasshoppers have forewings that are leathery. The forewings of flies are thin, clear, and like membranes. The wings of moths, butterflies, and mosquitoes are membranous and are also covered with scales.



Abdomen. The abdomen of the insect is built of segments. Along the side of the segments are openings, called spiracles, which the insect uses to breathe. The abdomen contains digestive and reproductive organs. Parts of the abdomen used in identification include: the ovipositor, male genitalia, and cerci.

Insect Reproduction and Development

Insect reproduction. In most insects, reproduction results from the males fertilizing females. The females then lay the eggs. This is the pattern of life for most insects, but there are a few interesting variations. For example, some parasitic wasps produce eggs without ever mating. In some of these species, males are unknown. There are a few insects that give birth to live young, without the egg stage.

Egg hatching is affected by temperature, humidity, and light. Eggs come in several shapes (round, oval, flat, and elongate) and sizes. They are laid one at a time, in groups, and in floating rafts. Some insects lay eggs in capsules containing several eggs, then carry them until hatching to be sure of the survival of their young (German cockroach). Sometimes eggs are placed inside the bodies of animals, trees, and green plants. In some species, the eggs are used to identify the adult. For example, the egg capsules of cockroaches can be used to identify an infesting species of cockroach.

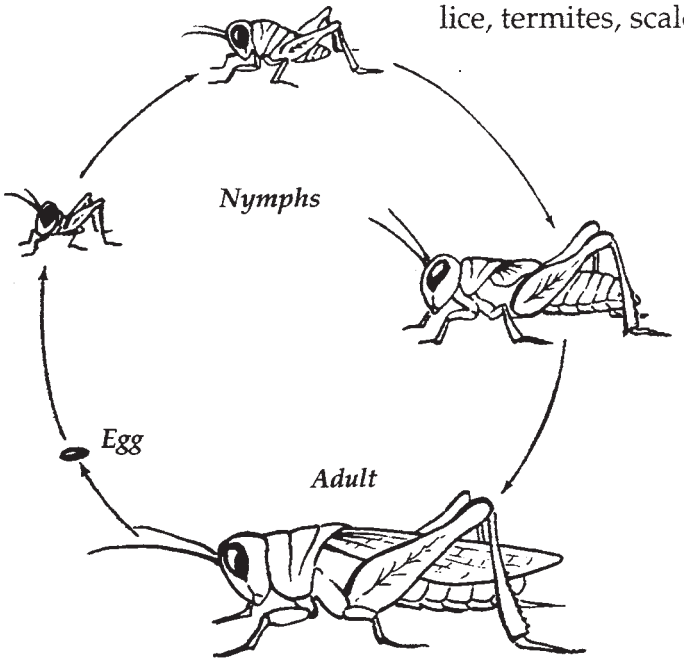
Insect Metamorphosis (development). Insects go through a series of changes as they develop from the egg to adulthood. This process of growth is called metamorphosis.

After hatching from an egg, the young insect is called either a larva, nymph, or naiad. The young feed for a while and grow. When they grow to a point where the skin cannot stretch further, the young insect molts and a new skin is formed. These stages of growth and skin shedding (called instars) differ from insect to insect and sometimes may vary with the temperature, humidity, and food supply. Generally, the heaviest feeding occurs in the last two instars. There are four types of metamorphosis:

- **No metamorphosis.** A few insects change very little except in size between hatching and reaching adulthood. The insect grows larger with each instar until it reaches maturity. The food and habitats of the nymphs are similar to those of the adult. The adults and nymphs

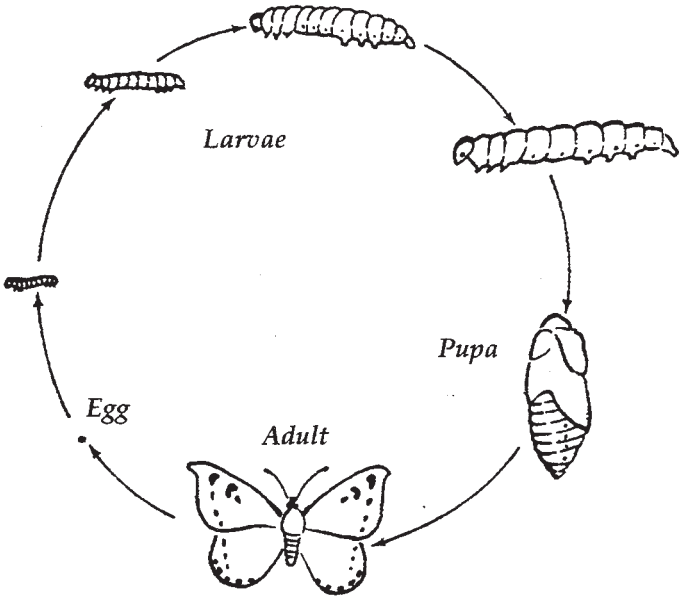
are both wingless. Some examples are: springtails, firebrats, and silverfish.

- **Simple or gradual metamorphosis.** Insects in this group mature through three distinct stages of development before reaching maturity; egg, nymph, and adult. The nymphs resemble the adults in both form and feeding behavior, and live in the same environment. If the adult has compound eyes, the nymph will have compound eyes. However, nymphs will not be able to reproduce. The body matures gradually, with the wings and reproductive organs becoming fully developed only in the adult stage. Some examples are: cockroaches, lice, termites, scales and aphids.



Gradual metamorphosis

- **Incomplete metamorphosis.** Insects with incomplete metamorphosis also pass through three stages of development; egg, naiad, and adult. There are some similarities between the adult and naiad, but there are also some dramatic differences. The naiads live in the water (aquatic) and breathe through gills. The adults have wings and live near the water, but do not have gills. Some examples are: stoneflies, mayflies, and dragonflies.
- **Complete metamorphosis.** This is a four stage development process, consisting of stages called; egg, larva, pupa, and adult. The young are called larvae and are familiar to everyone as caterpillars, maggots, or grubs and are entirely different from the adults. The larvae and the adults usually live in different habitats and eat different food. For example, caterpillars may live on a plant and eat leaves, while the adult butterfly flies freely, sipping nectar for food.



Complete metamorphosis

The larvae hatch from an egg. As they grow larger they molt and pass through one to several instars. Larvae come in several forms, shapes, and sizes such as caterpillars with many legs to maggots which are legless.

The pupa is often called the resting stage, but the insect is doing anything but resting. While in this stage, the larvae changes into an adult with legs, wings, antennae, and a fully functional reproductive system.

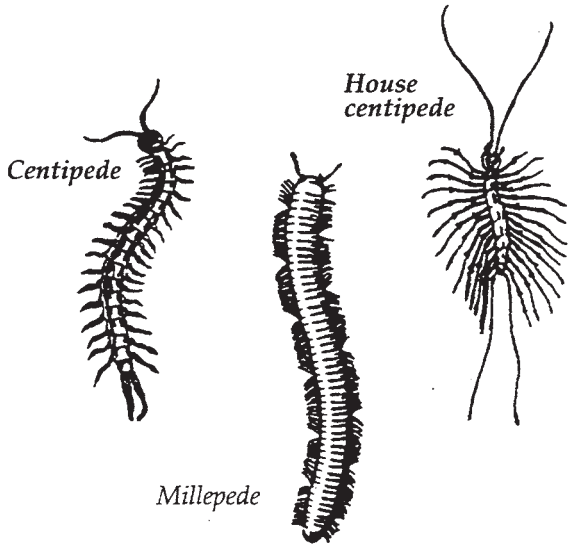
Insect-Like Pests

Spiders, ticks, mites, sowbugs, pillbugs, millipedes, and centipedes resemble insects in habit, appearance, life cycle, and size. Although they are not insects, they are often mistaken for them. The pesticide applicator needs to be familiar with these pests when evaluating a problem.

Centipedes and Millipedes.

Centipedes are flat, long, worm-like animals, with each body segment having one pair of legs. They have chewing mouthparts. Some can give painful bites to humans. Centipedes are found in protected places under tree bark or in rotting logs. They are very fast and predaceous, capturing and feeding on insects, spiders, and other small animals. All centipedes have poisonous jaws.

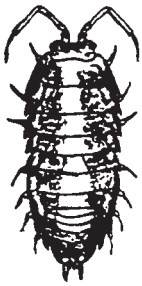
Millipedes have a cylindrical shape, like an earthworm, and have many legs, two pair on each body segment. The mouth parts are



adapted to feeding on decaying organic material. Thus, they are found in decaying leaf litter, rotting logs, and near damp debris near foundations.

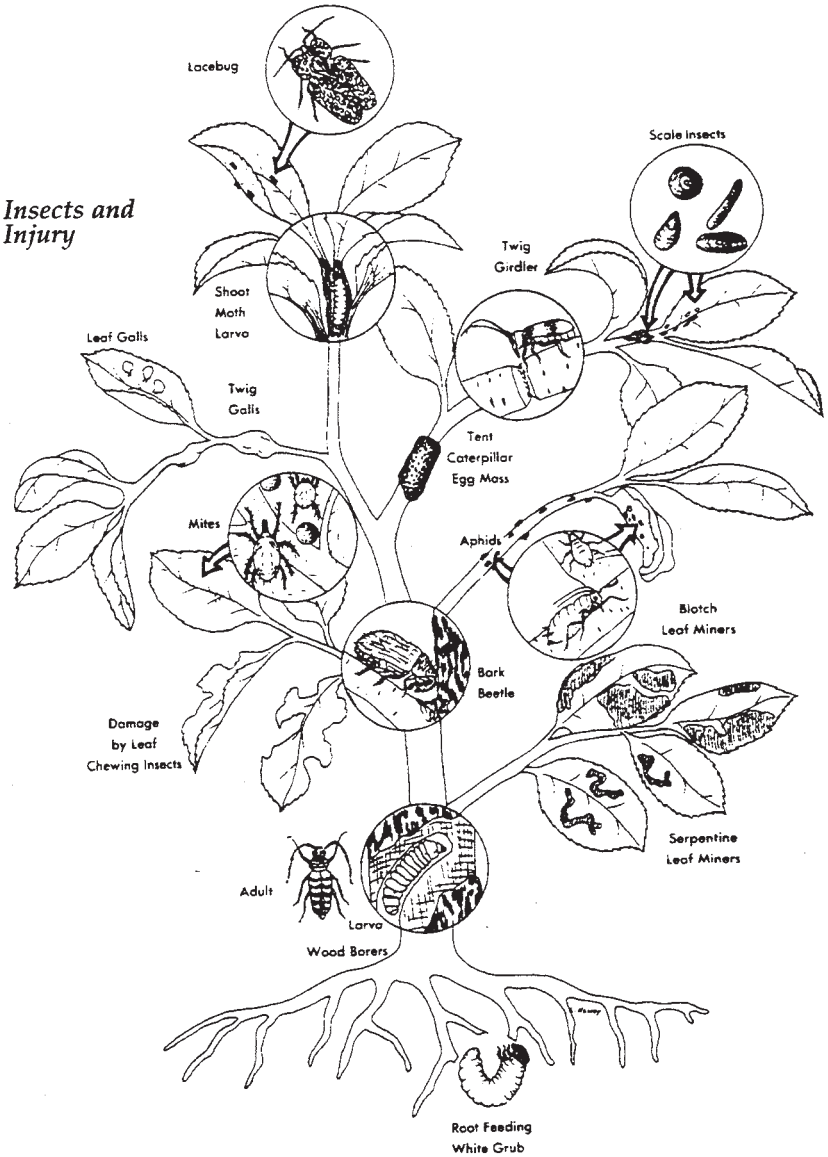
Millipedes and centipedes have no metamorphosis. They only change in size between hatching from the egg and reaching the adult stage.

Sowbug



Crustaceans. This class of animals (lobsters, shrimp) are nearly all aquatic (living in water) but there are members living on land that may become pests and are often thought to be insects. Sowbugs (often called pillbugs) are black, gray, or brown and are capable of rolling up into a ball. Sowbugs are found in damp decaying wood or under objects such as stones, boards, or blocks. There have been cases when crustaceans have been considered pests of cultivated plants in some areas, but usually are found living in damp basements or garages where people don't want them.

Insects and Injury



Arachnids. This group, which consists of spiders, mites, ticks, and scorpions all have eight legs and only two body regions. Arachnids are wingless and lack antennae. They mature through gradual metamorphosis that includes both larval and nymphal stages. Eggs hatch into larvae (six legs) which molt into nymphs (eight legs) and then adults. Spiders and scorpions have chewing mouthparts. Ticks and mites have a modified version of piercing-sucking mouthparts. Ticks are of particular interest because they sometimes transmit diseases such as Lyme disease and Rocky Mountain Spotted fever to man during feeding.

Plant Diseases

A plant disease is any harmful condition that alters a plants growth, appearance, or function. Diseases are caused by biological agents called pathogens. They are of interest to pesticide applicators because some diseases can be cured with pesticides, while other pesticides can prevent the pathogen from infecting the host plant. Pathogens include bacteria, fungi, viruses, and nematodes. They are spread by wind, rain, insects, birds, snails, slugs, and earthworms. In addition, pathogens can be carried by transplanted soil, nursery grafts, vegetative propagation, contaminated equipment and tools, infected seed, pollen, dust storms, irrigation water, and people.

Plant pathogens are parasites which live and feed on the host plant. In order for a disease to develop, a pathogen must be present, the host plant must be susceptible, and the environment must be favorable for development of the pathogen. Temperature and moisture are especially important to the success of the pathogen.

The disease starts with the arrival of the pathogen on the plant. If the parasite can get into the plant, the infection starts. Three main ways a plant responds to a disease are:

- overdevelopment of tissue, galls, swellings, and leaf curls.
- underdevelopment of tissue, stunting, lack of chlorophyll, and incomplete development of organs.
- death of tissue, blights, leaf spots, wilting, and cankers.

Bacteria. Bacteria are microscopic (can only be seen with a microscope), one-celled organisms that reproduce by single cell division. Bacteria numbers multiply quickly under warm, humid weather conditions. Bacteria may attack any part of a plant, either above or below the soil surface. Several of the leaf spot and rot diseases are caused by bacteria.

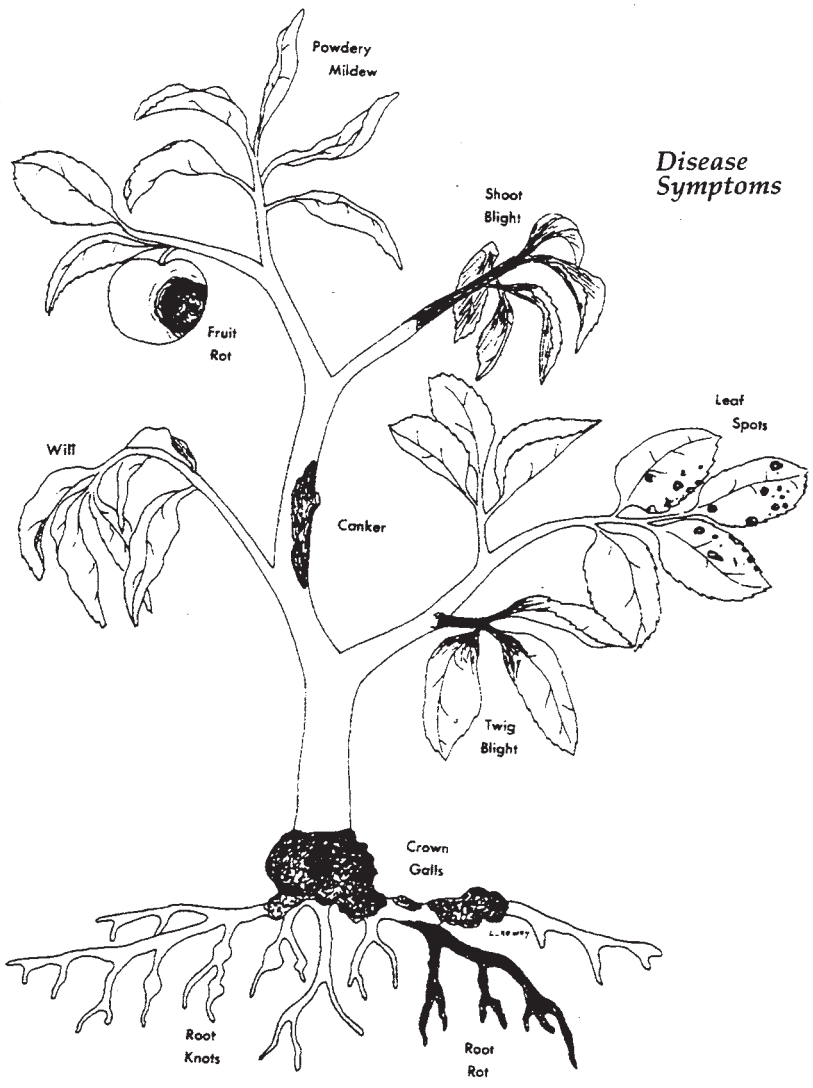
Fungi. Fungi are plants that lack chlorophyll and cannot make their own food. Fungi are the most frequent pathogens on plants. They feed off other living organisms or live on dead or decaying organic matter. Most of the time fungi are beneficial because they help release nutrients from dead plants and animals, adding to the fertility of the soil. Fungi reproduce with spores, which function about the same way seeds do. Fungus spores are usually microscopic and are produced in high numbers. Most spores die because they do not find a host to feed on, though some can survive for months without a host. High humidity (above 90 percent) is essential for spore germination and active growth. Mildew and smut are good examples of fungal diseases.

Viruses. Viruses are tiny organisms smaller than bacteria and cannot be seen with an ordinary microscope. Viruses are usually recognized from the symptoms they induce on the infected plant. They depend on other living organisms for food and cannot live long on their own. Viruses invade healthy plants through wounds or during pollination. Insects that feed with piercing-sucking mouthparts (aphids, whiteflies, leafhop-

pers), as well as chewing insects (beetles) can transmit viruses while feeding. Viruses can also be spread by nematodes. Practically all plants can be infected by viruses.

Mycoplasmas are the smallest known independently living organisms. Unlike viruses, they can exist apart from the host organism. Mycoplasmas obtain their food from plants. Yellows disease and some stunts are caused by mycoplasmas.

Nematodes. Nematodes are tiny (microscopic) eel or worm-like organisms. Nematodes destroy root systems while feeding, which causes a loss in the uptake of water and minerals by the plant, thus weakening the plant. Common symptoms are wilting, stunting, and lack of vigorous growth under good growing conditions. Nematodes may also spread plant diseases while feeding. Nematodes feed by sucking the contents of a cell through a hypodermic-like mouth inserted into a cell. Not all nematodes feed on roots. Some foliar feeding nematodes attack chrysanthemums and leave triangles of brown, dried tissue that develop on the leaves late in the season. Some nematodes are parasitic to insects.



Weeds

Any plant can be considered a weed when it is growing where it is not wanted. This is a very broad definition, but consider the following problems caused by weeds.

Weeds can harm man by:
- causing skin irritation (poison ivy).
- causing hay fever (ragweed).
- harboring pests such as rodents, ticks, or insects.

Weeds can harm desirable plants by:
- releasing toxins in the soil which inhibit the growth of desirable plants.
- contaminating the product at harvest.
- competing for water, nutrients, light, and space.
- harboring pest insects, mites, vertebrates, or plant disease agents.

Weeds can harm grazing animals by:
- poisoning.
- causing an "off-flavor" in milk and meat.

Weeds may become pests in water by:
- hindering fish growth and reproduction.
- increasing mosquito reproduction.
- hindering boating, fishing, and swimming.
- clogging irrigation ditches, drainage ditches, and channels.

Weeds are dangerous and undesirable on rights-of-way because they:
- block vision, road signs, and crossroads.
- increase road maintenance costs.

Plant Development Stages

After a plant seed has germinated, development can be separated into four stages:

- **seedling** - very small, very vulnerable plantlets.
- **vegetative** - rapid growth, root stems, and foliage produced. Nutrients and water move rapidly throughout the plant.
- **seed production** - becomes the priority for energy use. Water and nutrient uptake are slow and directed to flower, fruit, and seed production.
- **maturity** - movement of water and nutrients slow down, energy production is low.

Duration of the Weed

Annuals. Plants that grow from seed, mature, and produce seed for the next generation in one year or less are called annuals. This group has many grass-like weeds (crabgrass) and broadleaved (pigweed) members. There are two basic types of annual weeds:

Summer annuals grow from seeds that sprout in the spring. These weeds grow, mature, produce seed, and die before winter. Some examples are: foxtail, pigweed, lambsquarters, and crabgrass.

Winter annuals grow from seeds which sprout in the fall. These weeds mature, produce seed, and die before the next summer. Some examples are: henbit, common chickweed, and annual bluegrass.

Biennials. These plants have a two-year life cycle. During the first year, they grow from seed and develop a heavy root and compact cluster of leaves (called a rosette). During the second year, they mature, produce seed, and die. Some examples are: bull thistle and burdock.

Perennials. When plants live more than two years they are called perennials. Perennials may mature and reproduce in the first year, but they will repeat the cycle for several years or maybe indefinitely. Some perennial plants die back each winter. Others, such as trees, may lose their leaves but do not die back. Most perennials grow from seed and many produce tubers, bulbs, rhizomes (below-ground root-like stems), or stolons (above-ground stems that produce roots).

Simple perennials usually reproduce with the use of seeds. They also may reproduce when root pieces are cut by cultivation. The pieces then grow into new plants. Examples: trees, shrubs, plantain, and dandelions.

Bulbous perennials may reproduce by seed bulblets, or bulbs. Wild garlic produces seed and bulblets above ground and bulbs below ground.

Creeping perennials produce seed, rhizomes (below-ground stems), or stolons (above-ground stems that can produce roots). Examples: Johnsongrass, field bindweed, and Bermudagrass.

Weed Identification

Arrangement of Leaves

Alternate - one leaf found at each level on the stem.
Opposite - two leaves opposite each other or paired.
Whorled - three or more leaves at each level on the stem.

Leaf Structure

Simple - the leaf blade is a single piece and not divided into separate leaflets.

Compound - the leaf blade is divided into several leaf-like parts called leaflets.

Leaf Shape

Ovate - Egg-shaped, elliptical, broadest at the base.
Lanceolate - lance-shape, are longer than ovate and usually pointed at the tip.
Linear - long and narrow with parallel sides (grasses).

Arrangement of the Flowers

Inflorescence - in a definite cluster, usually at the top of the plant.
Axillary - along the stem of the plant in the angles (leaf axils) between the foliage, leaves and the stem.

Flower Parts

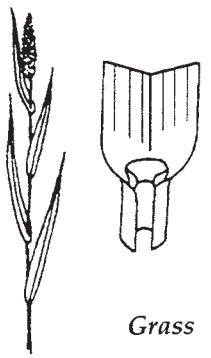
Petals - the expanded and usually colorful parts of the flower.
Sepals - the greenish hull surrounding the flower when it is budding.

Major Classes of Weeds

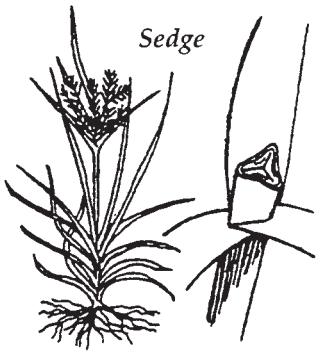
Grasses. Leaves of grasses are narrow, stand upright, and have parallel veins. When the seedlings sprout, they have only one leaf. Grasses grow from a point (growing point) located below the soil surface, thus the growing point is sheltered. This is why grass can be mowed without killing the plant. Most grasses have fibrous root systems. Grasses have both annual and perennial species.

Sedges. These are similar to grasses, but they have triangular stems and three rows of leaves. They are sometimes listed under grasses on the pesticide label. These plants often are found in wet places, but are principal pests in fertile, well-drained soils. Yellow and purple nutsedge are perennial weed species and produce rhizomes and tubers.

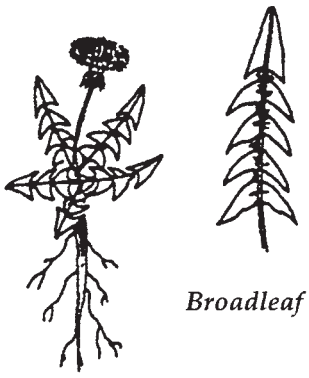
Broadleaves. Seedlings of broadleaves have two leaves that emerge from the seed. The veins of their leaves are netlike. Broadleaves usually have a taproot and their root system is relatively coarse. All broadleaf plants have exposed growing points that are at the end of each stem and in each leaf axil. The perennial broadleaf plants may also have growing points on roots and stems above and below the surface of the soil. The broadleaves have species with annual, biennial, and perennial life cycles.



Grass



Sedge



Broadleaf

Vertebrate Pests

Vertebrate animals all have a jointed backbone. Humans are vertebrates, as are mammals, birds, reptiles, amphibians, and fish. Like insects, most vertebrate animals are not pests and can be an enjoyable part of our environment.

There are situations when vertebrates can be pests. Sometimes birds, rodents, raccoons, or deer may damage crops or ornamentals. Birds and rodents eat the same food as humans and often ruin more food than they eat. Mammal and bird predators of livestock and poultry cause financial losses to farmers and ranchers each year. Great flocks of roosting birds can soil buildings.

There are also those in the vertebrate group (particularly rodents) that are a hazard to public health when they are in homes, restaurants, offices, or warehouses. Rodents, other mammals, and some birds are potential reservoirs of serious diseases of humans and domestic animals. Some examples are: rabies, plague, and tularemia.

Fact and picture sheets are a handy and easy to use aid for identifying vertebrate pests. You can obtain them through Cooperative Extension or other professional associations.

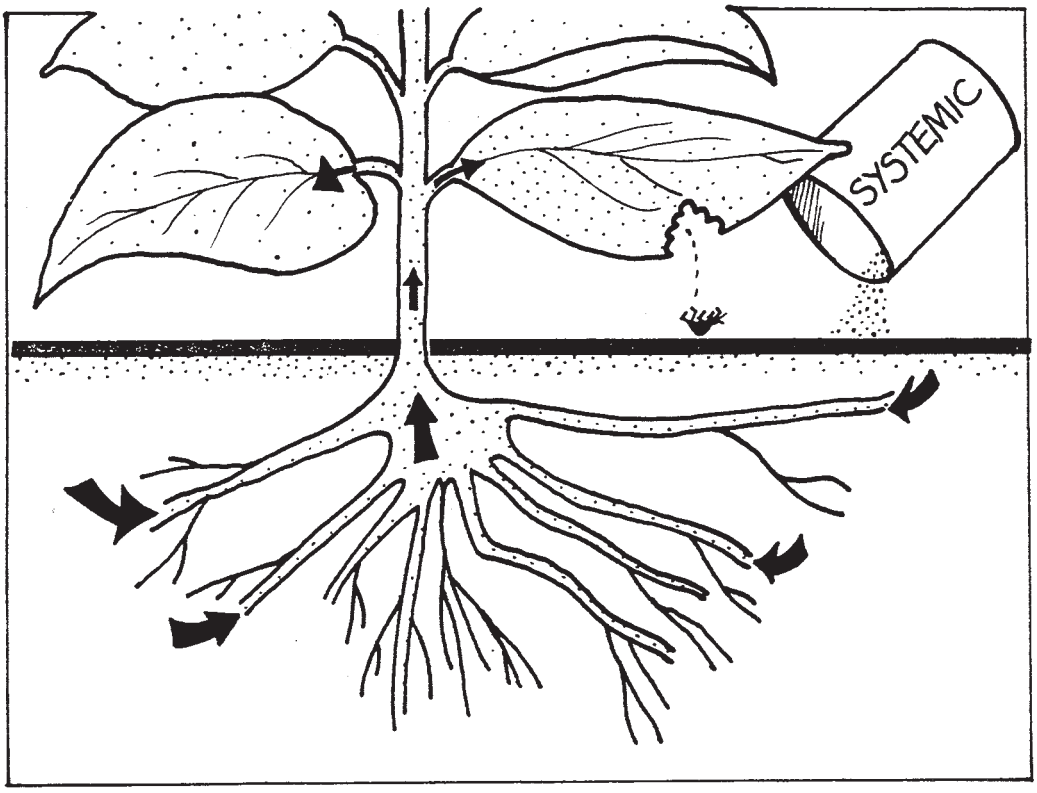
Questions for Self Study - Chapter XII

1. What are some examples of the characteristics of a pest?
2. What percentage of insects are considered pests?
3. Name the three main body parts of an insect.
4. Give three examples of pests that look like insects, but are not.
5. What causes plant disease?
6. Name four organisms associated with plant disease.
7. Give three examples of situations in which weeds are pests.
8. Name the three types of life cycles that plants have.
9. What does the term "vertebrate" mean?
10. Give two examples of a vertebrate pest.

Types of Pesticides

Chapter XIII

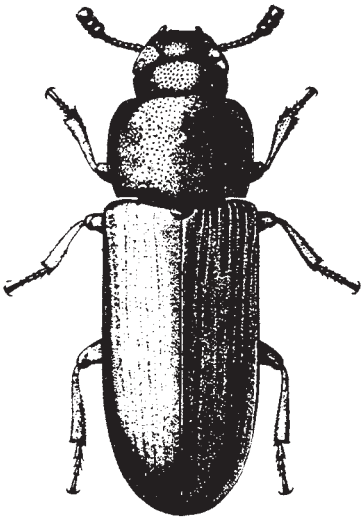
A pesticide is any chemical which is used by man to control pests. The pests may be insects, plant diseases, fungi, weeds, nematodes, snails, slugs, etc. Therefore, insecticides, fungicides, herbicides, etc., are all types of pesticides. Some pesticides must only contact (touch) the pest to be deadly. Others must be swallowed to be effective. The way that each pesticide attacks a pest suggests the best way to apply it; to reach and expose all the pests. For example, a pesticide may be more effective and less costly as a bait, rather than as a surface spray.



Goals of This Chapter

- Learn the different types of labeled pesticides.
- Be able to determine what type of pesticide should be used to control different pests.
- Understand that different pesticides attack pests in different ways and that these differences require that pesticides are used according to label directions.

Insecticides



Insecticides are chemicals used to control insects. Often the word "insecticide" is confused with the word "pesticide." It is, however, just one of many types of pesticides. An insecticide may kill the insect by touching it or it may have to be swallowed to be effective. Some insecticides kill both by touch and by swallowing. Insecticides called **Systemics** may be absorbed, injected, or fed into the plant or animal to be protected. When the insect feeds on this plant or animal, it ingests the systemic chemical and is killed.

Broad Spectrum. Insecticides vary in the numbers of different kinds of insects they kill. Some insecticides kill only a few kinds of insects. Sometimes you can choose these insecticides when you wish to kill only one insect pest and not other beneficial insects in the area. Many insecticides are general purpose or wide range killers. These "broad spectrum" pesticides are used when several different kinds of insects are a problem. One chemical can kill them all. No broad spectrum insecticide kills all insects; each varies as to the kinds of insects it controls.

Narrow Spectrum. While many insecticides are broad spectrum, killing a wide variety of animals by attacking a system common to all, such as the nervous system, a new group of insecticides are much more selective. The chitin inhibitors only affect animals with chitin in their exoskeleton (i.e. insects). Growth regulators are even more specific. They affect certain groups of species that have a particular hormone. Finally, pheromones are the most restrictive because they react with only one species or one sex of a single species.

Chitin synthesis inhibitors interfere with the development and molting of immature insects causing their death. Chitin is the primary structural chemical in an insects body wall. An immature insect treated with a chitin inhibitor dies the next time it attempts to molt.

Insect growth regulators or IGRs mimic the action of an insect's naturally occurring juvenile hormone. They interfere with certain normal processes and prevent immature insects from completing development into normal reproductive adults. The effects of IGRs on insects include abnormal molting, twisted wings, loss of mating behavior, and some-

times death to embryos in eggs. IGRs attack a growth process found only in insects, thus there is a great margin of safety for humans and other vertebrates. However, one disadvantage is that growth regulators act slowly, since they do not kill the insect until it molts into an adult.

Pheromones are naturally produced chemicals used by animals to communicate to each other. There are three basic types of pheromones. Aggregation pheromones attract many individuals together, for example, a site where food may be plentiful. Sex pheromones are used by one sex of a species to attract a mate. Trail pheromones are deposited by walking insects, such as ants, so that others can follow. Synthetic pheromones produced in laboratories mimic these natural chemicals. They are used to attract pest insects into traps, disrupt mating, and monitor populations of insects. Because they do not kill insects, they are often not considered to be pesticides.

Short Term vs. Residual. Insecticides also vary in how long they last as a killing agent. Some break down almost immediately into nontoxic by-products. These "short term" chemicals are very good in situations where the insects do not return or where long-term exposure could injure non-target plants or animals. For example, short-term insecticides are often used in homes and dwellings where people and domestic animals might be exposed. Other insecticides remain active killers for a fairly long period of time. These "residual" pesticides are very useful when the insects are a constant problem and where they will not be an environmental and/or health hazard. For example, residuals are often used for fly control in livestock buildings or for termite control in wooden structures.

Miticides and Acaricides

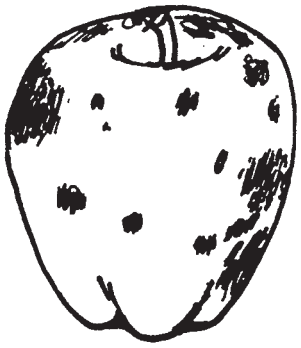
Miticides (or Acaricides) are chemicals used to control mites (tiny spider-like animals) and ticks. The chemicals usually must contact the mites or ticks to be effective. These animals are so numerous and small, that great care must be used to completely cover the area on which the mites live. Miticides are very similar in action to insecticides and often the same pesticide kills both insects and mites. The terms "broad spectrum," "short term," and "residual" are also used to describe miticides.

Fungicides

Fungicides are chemicals used to control the fungi which cause molds, rots, and plant diseases. All fungicides work by coming in contact with the fungus, because fungi do not "swallow" in the normal sense. Therefore, most fungicides are applied over a large surface area to try to directly hit every fungus. Some fungicides may be **systemic** in that the plant to be protected may be fed or injected with the chemical. The chemical then moves throughout the plant, killing the fungi.

Protectant vs. Eradicant. There are two basic approaches in the use of fungicides. One is designed to prevent the plant from getting the disease. These fungicides are used as **"protectants"** and are similar in purpose to polio and smallpox vaccinations for humans. They are applied before the disease gets a start. This type of fungicide is very useful when a particular disease or group of diseases are likely to attack a plant or crop, year after year. Protectants, for example, have often been used as a routine precaution on fruit and vegetable crops.

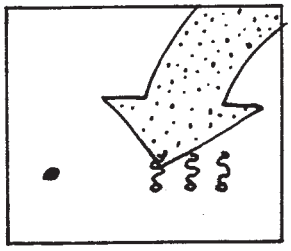
Most protectant fungicides are fungistatic. This means they prevent or inhibit fungal growth. Once the fungistatic action ceases, the controlled fungus may grow again or produce spores. Thus, a protectant fungicide may have to be applied at regular intervals to continue the protection from infection.



The other type of fungicide kills the disease after it appears on (or in) the plant. These fungicides, called **"eradicants,"** are like penicillin or other antibiotics which cure diseases in humans after the sickness appears. Eradicants are less common than protectants because once the fungus is established in a plant, it is often difficult to destroy. Eradicants are often used when protectants aren't available, aren't applied in time, or are too expensive. Eradicants are also applied when the disease appears unexpectedly on a plant or in an area. For example, a common use is on fruit and vegetables when the protectant spray wasn't applied on time to prevent infection. Eradicants are also used by orchardists in combatting diseases of fruit trees, such as apple scab.

Herbicides

Herbicides are chemicals used to control unwanted plants. These chemicals are a bit different from other pesticides because they are used to kill or slow the growth of some plants, rather than to protect them. Some herbicides kill every plant they contact, while others kill only certain plants.



pre-emergence

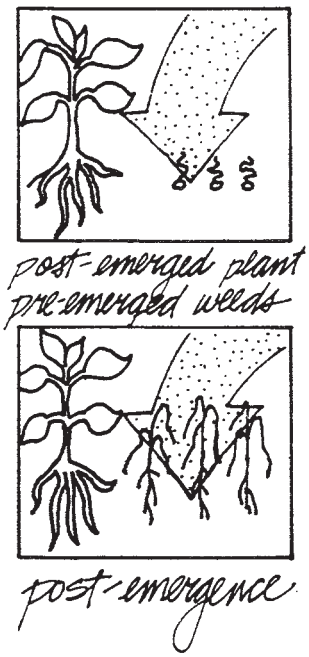
Nonselective herbicides are toxic to all plants. These are often used when no plants are wanted in an area. For example, nonselective herbicides could be used for clearing under guardrails or for total control of weeds in industrial areas.

Selective herbicides kill some plants with little or no injury to other plants. Usually selective types will kill either broadleaved plants or grassy plants. These are useful for lawns, golf courses or in areas with desirable trees. Some very selective herbicides may kill only certain plants in a group; for example, crabgrass killers on lawns.

Preplanting vs. Preemergence vs. Postemergence. The timing of an herbicide application is important. Care must be used to get the job done effectively without injuring desirable plants. The directions on the label tell you when to apply the herbicide for best results. **Preplanting** treatments are made before the crop is planted. These chemicals may be used in seed beds or incorporated into the soil before planting.

Any treatment made before the crop and weed appears is called **preemergence**. The application may be made before both the crop and weeds appear, or after the crop appears but before the weeds appear. The label or directions will state "preemergence to the crop," "preemergence to the weeds," or "preemergence to both crop and weeds."

When the herbicide treatment is made after the crop or weeds appear, it is called **postemergence**. Postemergence applications must be very selective. They must control the weeds but leave the crop unharmed. Often, the chemical will be applied postemergent to the crop but preemergent to the weeds.



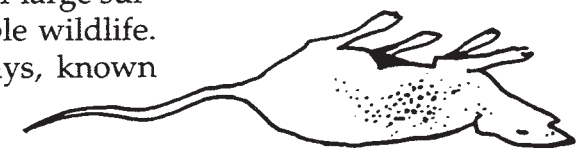
Growth Regulators and Harvest Aids

A **plant growth regulator** (or plant regulator) increases, decreases or changes normal growth or reproduction in a plant. Fertilizers and other nutrients are not included. Some growth regulators are used to move up or move back the normal harvest date for the crop. Others are used to obtain better quality and/or yield of the crop. Electric power utilities could use growth regulators to slow the growth of a tree threatening power lines, thus saving the tree from being cut.

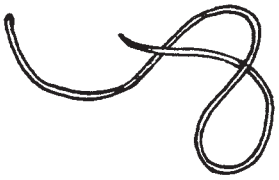
Defoliants and desiccants are pesticide materials generally referred to as **harvest aids**. A **defoliant** causes the leaves of a plant to drop off early, but does not kill the plant. A **desiccant** draws moisture from a plant, killing the plant foliage.

Rodenticides

Rodenticides are chemicals used to control rats, mice, bats and other rodents. Chemicals which control other mammals, birds, and fish are also grouped in this category by regulatory agencies. Most rodenticides are stomach poisons and are often applied as baits. Even rodenticides which act by contacting the pest are usually not applied over large surfaces because of the hazard to domestic animals or desirable wildlife. They are usually applied in limited areas such as runways, known feeding places, or as baits.



Nematicides



Nematicides are chemicals used to control nematodes. Nematodes are tiny hair-like worms, many of which live in the soil and feed on plant roots. Very few of these worms live above ground. Usually soil fumigants are used to control nematodes in the soil. (See section on fumigants in Chapter XV.) However, a few contact insecticides and fungicides are also effective against these tiny worms.

Molluscicides

Molluscicides are chemicals used to control snails and slugs. Usually the chemicals must be eaten by the pest to work. Baits are often used to attract and kill snails or slugs in an area.

Repellents

A repellent is a pesticide that makes a site or food unattractive to a target pest. They are registered in the same way other pesticides are and must be used according to the label. Insect repellents are available as aerosols and lotions and can be applied to skin, clothing, or plants to repel biting and nuisance insects. Vertebrate repellents are available as concentrates to be mixed with water, powders, and granules. They can be sprayed or painted on nursery crops, ornamental plantings, orchards, vineyards, vegetables, and seeds. Repelling deer, dogs, birds, raccoons, and others can protect sites from damage.

If pesticide use is warranted, be sure you know which type of pesticide you need to use, as well as how and when to apply it effectively.

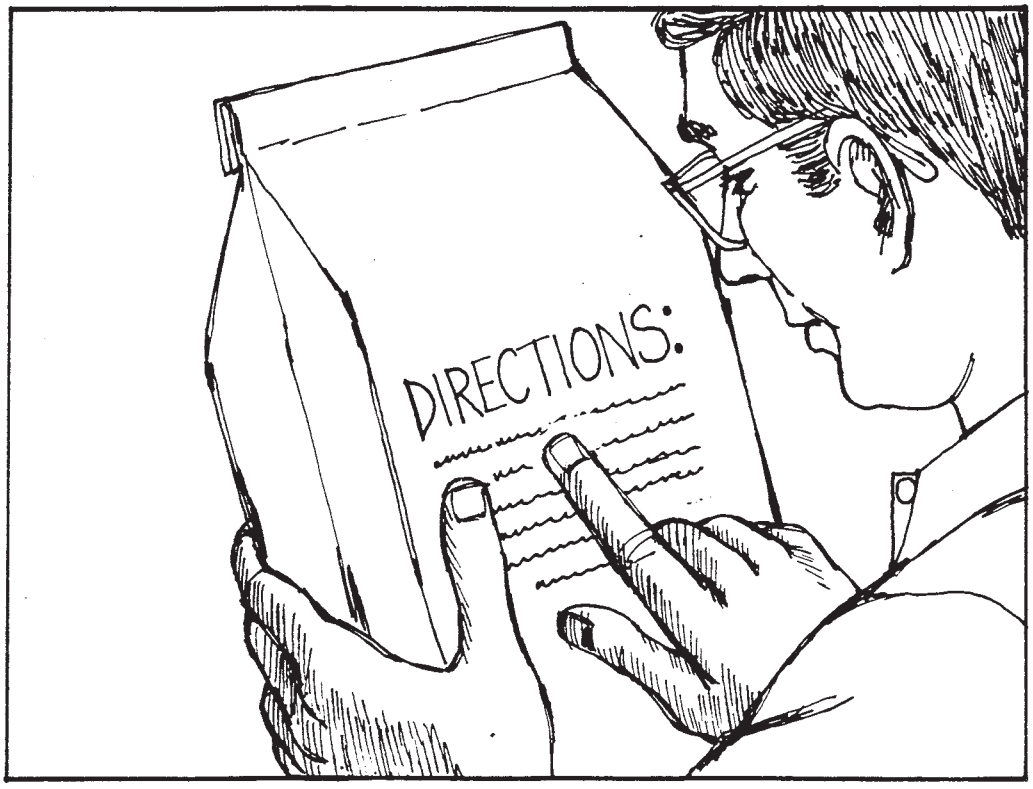
Questions for Self Study — Chapter XIII

1. What is a pesticide?
2. Is *insecticide* just another word for *pesticide* ?
3. How does a systemic insecticide act on the pest?
4. What must you consider when choosing a broad spectrum versus a specific insecticide?
5. What are the advantages of short term insecticides? Residual insecticides?
6. Miticides are very similar in action and application to _____ icides.
7. What pests do fungicides control?
8. What are the two basic approaches in the use of fungicides?
9. When are eradicants often used?
10. Would you choose a selective or nonselective herbicide to control weeds in a park?
11. Why is the timing of an herbicide application so important?
12. Explain herbicide application as it relates to preplant, preemergence and postemergence.
13. What types of chemicals are used to alter or change the crop itself?
14. Pesticides which control mammals, birds and fish are usually grouped by the regulatory agencies along with _____ icides.
15. What are nematodes?
16. What do chitin inhibitors do?
17. Why are IGRs so safe for use near humans and other animals?
18. Is a repellent a pesticide? Are repellents registered by EPA?

The Label

Chapter XIV

The pesticide label is extremely important to every user. The information and instructions on it come from years of costly tests and studies. The label tells you how to correctly use the pesticide. The label, when properly followed, provides protection for applicators, consumers and the environment. Completely read all labels for every pesticide you use. ***Don't rely on your memory.***



Goals of This Chapter

- Learn what kinds of information are on a label and why they are important.
- Learn when and why you should read the label.
- Be able to apply the label information to the use of any pesticide.

Identification of Chemical Hazards

First, the label identifies the chemicals in the container. The contents are listed in a standard form so that you know exactly what you are applying. Mistaken uses of chemicals can cause crop injury, poor control, or illegal residues. The crop may be unfit for market making you, the applicator, legally responsible for any losses.

Signal words are used on most labels to state the toxicity of the pesticide to humans. The label also lists the protective equipment needed for proper handling and use of the chemical. This may include masks, gloves, respirators, etc. The applicator who often works with these chemicals must be especially careful. Don't take chances with your health — follow the simple safety requirements on the label.

Registered Uses

The label lists the uses for the pesticide that are approved by the Environmental Protection Agency (EPA). If the intended use is not on the label, the product should not be used! You are legally responsible for any accident or crop loss which results from using materials which are not approved. Certain formulations of a particular pesticide may be intended for a specific use only, for example, on livestock. The label in this formulation may list only the uses for livestock, even though the pesticide is also registered for other uses. Generally, however, any non-labeled use is a misuse and the applicator may end up in court.

Recommended Doses

Recommended doses and directions for applying approved uses also appear on every label. These suggestions can be helpful to you because they state the maximum dosage permitted by law. However, local conditions may not require maximum doses to achieve good control of the pest. You should use no more pesticide than is needed.

Compatibility

The label will usually state which other chemicals can be mixed with the pesticide. Often, either pesticides or fertilizers can be combined with the pesticide for one application. Sometimes the chemicals cannot be mixed without destroying their effectiveness. Check on compatibility **before** you mix.

Phytotoxicity

The label will also tell if the pesticide is phytotoxic and likely to injure plants. Some plants are more sensitive than others to pesticides. The injury to plants can range from slight burning to complete loss of leaves to death of the plant. Choose a pesticide which is not phytotoxic to the target plant.

The Label and the Law

The label is the law. Pesticide users are forbidden to use a pesticide in a way contrary to its labeling. Any use not indicated on the label is prohibited. It is also illegal for consultants or sales persons to recommend a pesticide be used contrary to its label. The information found on the label has passed strict government requirements. The label itself, not just the pesticide product, must be registered by the EPA before it is used. EPA reviews and approves each statement which is on the label. The EPA Label Improvement Program updates pesticide labels in areas that contribute to health and environmental safety. According to the program, pesticide manufacturers revise product labels so both the applicator and the regulatory agency can delineate legal uses for pesticides released after April 30, 1988. As part of health and safety, the toxicity warnings on labels come from tests required by the government. The pesticide and the label are registered by EPA only when the applicators, consumers, and fish and wildlife will be protected. If the label statements are carefully followed, no illegal residues will be found on any crop. Applicators, dealers, consultants and salesmen making recommendations other than those recommended on pesticide labels are liable under the law. Getting a single pesticide ready for registration can take seven to nine years and usually costs the chemical company $20-40 million dollars. Surely if it costs that much, the label is worth reading!

Each pesticide you buy has a label which gives you instructions on how to use the product. Labels vary greatly depending on what the product is used for, when it was issued or reviewed, size of the package, and company format.

Labeling

Labeling is all the information that you receive from the manufacturer about the product. It includes the label on the product container plus any supplemental information including brochures, leaflets, and information handed out by your dealer or a recognized authority. It is the responsibility of the applicator to comply with all of this information.

Label

The label is the information printed on or attached to the container of a pesticide.

- To the manufacturer, the label is a "license to sell."
- To the state or federal government, the label is a way to control the distribution, storage, sale, use, and disposal of the product.
- To the buyer or user, the label is a source of facts on how to use the product correctly and legally.
- To physicians, the label is a source of identification and information or proper treatment for poisoning cases.

All labels will tell you how to use the product correctly!

Parts of the Label

Brand, Trade, or Product Names. Each manufacturer has a brand name for their product. Different manufacturers may use different brand names for the same pesticide active ingredient. The brand name shows up plainly on the front panel of the label. Applicators should avoid choosing a pesticide product by brand name alone. Many companies use the same basic name with only minor variations to designate entirely different pesticide chemicals.
For example:

Tersan LSR = zinc and maneb

Tersan SP = chloroneb

Tersan 1991 = benomyl

Tersan = thiram

Classification. Every use of every pesticide will be classified by the U.S. Environmental Protection Agency as either "general" or "restricted." Every pesticide product which has been restricted must carry this statement in a prominent place at the top of the front panel of the pesticide label:

"RESTRICTED USE PESTICIDE. For retail sale and use only by certified applicators or persons under their direct supervision and only for those uses covered by the certified applicator's certification."

Your state lead agency has the authority to deem a product as restricted use. When a product has been restricted by a state, the "restricted use" statement will not appear on the label. Contact your state lead agency for the list of state restricted use products. When a pesticide is classified for general use, the words "General Classification" will appear immediately below the heading "Directions for Use."

RESTRICTED-USE PESTICIDE

FOR RETAIL SALE TO AND APPLICATION BY CERTIFIED APPLICATOR OR PERSONS UNDER THEIR DIRECT SUPERVISION.

NOTE: At the time of this printing, EPA has not completed the classification of the many pesticide products on the market. Therefore, the absence of a RESTRICTED USE statement does not necessarily indicate that the product has a low hazard level. Use the signal word and the precautionary statements to judge the toxicity hazard of all pesticide products.

General Classification

Ingredient Statement. Each pesticide label must list what is in the product. The list is written so that you can see quickly what the active ingredients are and the amount (in percentage) of each ingredient listed. The ingredient statement must list the official chemical names and/or common names for the active ingredients. Inert ingredients need not be named, but the label must show what percent of the total contents they comprise.

ACTIVE INGREDIENT

Benomyl [Methyl 1-(butylcarbamoyl)-2-benzimidazolecarbamate ... **50%**

INERT INGREDIENTS ... **50%**

U.S. Pat. 3,631,176 EPA Reg. No. 352-354 AA

Chemical Name. The chemical name is a complex name which identifies the chemical components and structure of the pesticide. This name is almost always listed in the ingredient statement on the label. For example, the chemical name of Sevin 50% WP is 1-naphthyl methyl carbamate.

Common Name. Because pesticides have complex chemical names, many are given a shorter "common" name. Only common names which are officially accepted by the U.S. Environmental Protection Agency may be used in the ingredient statement on the label. The official common name may be followed by the chemical name in the list of active ingredients. A label with the trade name Sevin 50% WP would read:

Active ingredient:

carbaryl (1-naphthyl methyl carbamate) 50%
Inert ingredients..... 50%

Type of Pesticide. The type of pesticide usually is listed on the front panel of the pesticide label. This short statement usually indicates the kind of pests that the product will control.
Examples:

- Insecticide for control of certain insects on fruits, nuts, and ornamentals.
- Soil fungicide.
- Herbicide for the control of trees, brush, and weeds.
- Algicide.

Net Contents. The front panel of the pesticide label will tell you how much is in the container.

Name and Address of Manufacturer. The law requires the maker or distributor of a product to put the name and address of the company on the label.

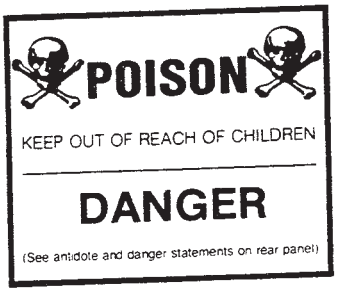
Registration and Establishment Numbers. These numbers are needed by the pesticide applicator in case of accidental poisoning, claims of misuse, faulty product, or liability claims.

Xylene	30%
Inert Ingredients:	**16%**
Total:	**100%**
EPA Reg. No. 100-461 AA	
EPA Est. No. 100-AL-1	

Registration Numbers. An EPA registration number appears on all pesticide labels, unless an older label has a USDA number. This indicates the pesticide label has been registered by the federal government. Most products will contain only two sets of numbers, for example, EPA Reg. No. 3120-280; the first set of digits, 3120, is the manufacturer's identification number and the second set, 280, is the product identification number. Sometimes additional letters and numbers are part of the EPA Registration Number, for example 3120-280-AA-0850. The letters AA are alpha (alphabetical) letters required by a particular state and will appear on a few labels. The 0850 is the distributor's identification number and will appear on some labels.

In some cases, special local needs (SLN) pesticide products may be approved by a state. These registrations are designated, for example, as EPA, SLN No. KS-770009. In this case, SLN indicates "special local need" and KS indicates that the product is registered for use in Kansas. SLN numbers may not appear on the package label, but are part of the supplementary label.

Establishment Numbers. The establishment number (for example, EPA Est. No. 5840-AZ-1) appears on either the pesticide label or the container. In case something goes wrong, it identifies the facility that produced the product.



Signal Words and Symbols. Almost every label contains a signal word that will give you a clue to how dangerous the product is to humans. Knowing the product's hazard helps you to choose the proper precautionary measures for yourself, your workers, and other people (or animals) who may be exposed.

The signal word must appear in large letters on the front panel of the pesticide label. It usually is next to the statement, "Keep Out of Reach of Children" which must appear on every pesticide label.

DANGER—Any product which is highly toxic orally, dermally, through inhalation, or causes severe eye or skin burning, will be labeled DANGER. All pesticides which are highly toxic orally, dermally, or through inhalation will also carry the word POISON printed in red and the skull and crossbones symbol. As little as a taste to as much as a teaspoonful taken by mouth could kill an average sized adult.

If a pesticide receives a highly toxic rating because of the possibility for corrosive damage to the skin or eyes, the signal word DANGER will be on the label without the word POISON.

WARNING — Any product which is moderately toxic orally, dermally, or through inhalation or causes moderate eye and skin irritation, will be labeled WARNING. A teaspoonful to a tablespoonful orally could kill the average sized adult.

CAUTION — Any product which is slightly toxic to relatively non-toxic orally, dermally, or through inhalation or causes slight eye and skin irritation, will be labeled CAUTION. An ounce to more than a pint taken orally could kill the average adult.

Precautionary Statements. All pesticide labels contain additional statements to help you decide the proper precautions to take to protect yourself, your helpers, and other persons (or domestic animals) which may be exposed. Part or all of the pesticide label may be written in other languages; the same label requirements apply regardless of the language.

PRECAUTIONARY STATEMENTS

HAZARDS to HUMANS and DOMESTIC ANIMALS.

CAUTION: Keep out of reach of children, pets, domestic animals and wildlife.

Route of Entry Statements. The statements which immediately follow the signal word, either on the front or side of the pesticide label, indicate which route(s) of entry (mouth, skin, lungs) you must particularly protect. Many pesticide products are hazardous by more than one route of entry so study these statements carefully. A "Danger" signal word followed by "may be fatal if swallowed or inhaled" gives you a far different warning than, "Danger: Corrosive — causes eye damage and severe skin burns."

Typical **DANGER** label statements include:

- Fatal if swallowed.
- Poisonous if inhaled.
- Extremely hazardous by skin contact — rapidly absorbed through skin.
- Corrosive — causes eye damage and severe skin burns.

These statements are not uniform on all labels and many variations may be found. More than one, or in some cases all four precautions may be stated on the same label.

Typical **WARNING** label statements include:

- Harmful or fatal if swallowed.
- Harmful or fatal if absorbed through the skin.
- Causes skin and eye irritation.

Warning!

Keep out of reach of children. See additional warning statements on back of container.

Statements on a WARNING label may be exactly like those found on a DANGER label or a CAUTION label. There may be a combination of the two, for example "harmful or fatal."

Typical **CAUTION** label statements include:

- Harmful if swallowed.
- May be harmful if absorbed through the skin.
- May be harmful if inhaled.
- May irritate eyes, nose, throat and skin.

These statements may vary considerably. They usually are more moderate than the statements found on a DANGER label, often using "harmful" instead of "fatal" or "poisonous"; "irritant" instead of "corrosive"; and qualifying the warnings with "may" or "may be." This is in keeping with products having a CAUTION label.

Specific Action Statements. These statements usually follow the route of entry statements. They recommend the specific action needed to prevent poisoning accidents. These statements are directly related to the toxicity of the pesticide product (signal word) and route(s) of entry which must be protected.

DANGER labels typically contain statements such as:

- Do not breathe vapors or spray mist.
- Do not get on skin or clothing.
- Do not get in eyes.

(You would not deliberately swallow the pesticide, so the "Do not swallow" statement is omitted.)

CAUTION labels generally contain specific action statements which are much milder than those on the **DANGER** label:

- Avoid contact with skin or clothing.
- Avoid breathing dusts, vapors, or spray mists.
- Avoid getting in eyes.

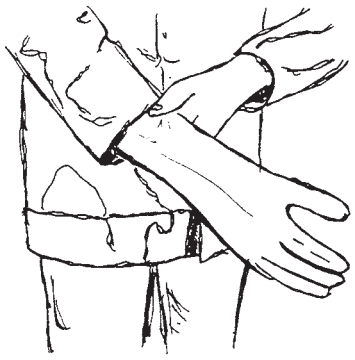
These statements indicate that the toxicity hazard is not as great. The specific action statements help you prevent pesticide poisoning by taking the necessary precautions and wearing the correct protective clothing and equipment.

Hazards to Wildlife. The label may indicate that the product causes undesirable effects in the environment. In this case, the precautionary statement may tell you what to avoid doing. Some labels indicate toxicity to bees, birds, fish and crustaceans. Labeling may indicate limitations

imposed to protect endangered species. These limitations may include reduced rates, restrictions on types of application, or a ban on the pesticide's use within the species range. The label may also tell you where additional information can be obtained.

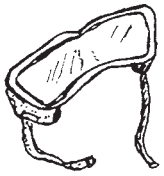
Protective Clothing and Equipment Statements. Pesticide labels vary in the type of protective equipment statement they contain. Some labels fully describe appropriate protective equipment. A few list the kinds of respirators which should be worn when handling and applying the product. Others require the use of a respirator but do not specify type or model to be used. Many labels carry no statement at all.

You should follow all advice on protective clothing or equipment which appears on the label. However, the lack of any statement or the mention of only one piece of equipment does not rule out the need for additional protection.



The best way to determine the correct type of protective equipment is to use the signal word, the route of entry statements, the formulation, and the specific action statements. Sensible selection of protective equipment depends on a thorough understanding of the pesticide, the job, the weather, the handler and how these factors interact. (See Chapter VII Safety Precautions).

A WARNING label, for example, might carry the statements: "Causes skin and eye irritation. Do not get in eyes, on skin, or on clothing. Wear goggles while handling." Even though the label does not specifically require them, you should wear coveralls over regular work clothing, chemical-resistant gloves, and footwear. You should wear a chemical-resistant protective suit and hat if you will be in prolonged contact with the chemical or are using an overhead spray application.



The safe use of pesticides depends on risk awareness, use of appropriate protective equipment, skill at handling equipment and pesticides, careful personal hygiene, and regular medical care.

Other Precautionary Statements. Labels often list other precautions to take while handling the product.

- Do not contaminate food or feed.
- Remove and wash contaminated clothing before reuse.
- Wash thoroughly after handling and before eating or smoking.
- Wash clothes daily.
- Not for use or storage in and around a house.
- Do not allow children or domestic animals into the treated area.

These statements represent actions which an applicator should always follow whether they are on the label or not.

FIRST AID

First Aid or Statement of Practical Treatment. These statements tell you the first aid treatments recommended in case of poisoning. Typical statements include:

- In case of contact with skin, wash immediately with plenty of soap and water.
- In case of contact with eyes, flush with water for 15 minutes and get medical attention.
- In case of inhalation exposure, move from contaminated area and give artificial respiration if necessary.
- If swallowed, drink large quantities of milk, egg white, or water — do not induce vomiting.

All DANGER labels and some WARNING and CAUTION labels have a section on First Aid Treatment, Poison Signs or Symptoms, Note to Physicians, or Antidote and an Emergency Assistance Call telephone number. WARNING and CAUTION labels usually do not provide this information, although some may provide an Emergency Assistance Call telephone number near the signal word or precautionary statements. Individuals experiencing poisoning symptoms should seek medical attention. The pesticide label is an extremely important document which should accompany the victim to the treatment facility.

Environmental Hazards. Pesticides may be harmful to the environment. Some products are classified RESTRICTED USE because of environmental hazards alone. Label warnings may include groundwater advisories and protection information. Look for special warning statements on the label concerning hazards to the environment.

Special Toxicity Statements. If a particular pesticide is especially hazardous to wildlife, it will be stated on the label. For example:

- This product is highly toxic to bees.
- This product is toxic to fish.
- This product is toxic to birds and other wildlife.

These statements alert you to the special hazards that the use of the product may pose. They should help you choose the safest product for a particular job and remind you to take extra precautions.

General Environmental Statements. These statements appear on nearly every pesticide label. They are reminders of common sense actions to follow to avoid contaminating the environment. The absence of any or all of these statements DOES NOT indicate that you do not have to take adequate precautions.

Sometimes these statements will follow a "specific toxicity statement" and provide practical steps to avoid harm to wildlife.

Examples of general environmental statements include:

- Do not apply when runoff is likely to occur.
- Do not apply when weather conditions favor drift from treated areas.
- Do not contaminate water when cleaning equipment or disposing of wastes.
- Keep out of any body of water.
- Do not allow drift on desirable plants or trees.
- Do not apply when bees are likely to be in the area.
- Do not apply where the water table is close to the surface.

Physical or Chemical Hazards. This section of the label will tell you of any special fire, explosion, or chemical hazards the product may pose. For example:

- Flammable — Do not use, pour, spill, or store near heat or an open flame. Do not cut or weld container.
- Corrosive — Store only in a corrosion-resistant tank.

NOTE: Hazard statements (hazards to humans and domestic animals, environmental hazards, and physical-chemical hazards) are not located in the same place on all pesticide labels. Some newer labels group them in a box under the headings listed above. Other labels may list them on the front panel beneath the signal word. Still, other labels list the hazards in paragraph form somewhere else on the label, under headings such as "Note" or "Important." You should search the label for statements which will help you to apply the pesticide safely and knowledgeably.

Entry Restriction. Some pesticide labels contain a reentry precaution. This statement tells you how much time must pass before people can reenter a treated area without appropriate protective clothing. These entry restrictions are set by both EPA and some states. Entry restrictions set by states are not always listed on the label. It is your responsibility to determine if one has been set. It is illegal to ignore entry restrictions.

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

REENTRY STATEMENT

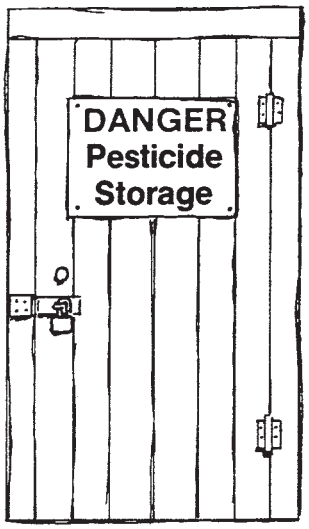
Do not enter area within five days after application.

The minimum standard for legal protective clothing for early reentry following agricultural and other outdoor treatments are:

- A long-sleeved shirt
- Long-legged trousers or coveralls
- Hat
- Sturdy shoes with socks
- Gloves are suggested. For early reentry in enclosed areas, a respirator may be necessary.

The entry restriction may be printed in any one of several places, such as under "General Information," or "Directions for Use," etc. If no

entry restriction statement appears on the label and is not set by your state, then you must wait at least until sprays are dried or dusts have settled before reentering, or allowing others to reenter a treated area without protective clothing. This is the minimum legal reentry interval.



Storage and Disposal. All pesticide labels contain general instructions for the appropriate storage and disposal of the pesticide and its container. State and local laws vary considerably, so specific instructions usually are not included. Typical statements include:

- Not for use or storage in or around the home.
- Store away from fertilizers, insecticides, fungicides, and seeds.
- Store at temperatures above 32°F (0°C).
- Do not reuse container.
- Do not contaminate water, food or feed by storage and disposal.
- Open dumping is prohibited.
- Triple-rinse and offer this container for recycling or reconditioning, or dispose in an approved landfill or bury in a safe place.
- Use excess or dispose in an approved landfill or bury in a safe place.
- Do not reuse bag. Burn or bury in a safe place.

You should try to determine the best storage and disposal procedures for your operation and location. These statements may appear in a special section of the label titled "Storage and Disposal" or under headings such as "Important," "Note," or "General Instructions." For additional information on proper pesticide disposal and storage contact your state regulatory agency.

Directions for Use. Correct application of a pesticide product is accomplished by following the use instructions found on the label. The use instructions will tell you:

- The pests which the manufacturer claims the product will control. (Federal law legally allows you to apply a pesticide against a pest that is not specified on the labeling if the application is to a crop, animal, or site which the labeling approves. **Your state may not permit such a use**.)
- The crop, animal, or site the product is intended to protect.
- In what form the product should be applied.
- The proper equipment to be used.
- How much to use.
- Mixing directions.
- Compatibility with other often-used products.
- Phytotoxicity and other possible injury or straining problems.
- Where the material should be applied.
- When it should be applied.

Labels for agricultural pesticides often list the least number of days which must pass between the last pesticide application and crop harvest, slaughter, or grazing livestock. These are intervals set by EPA to allow time for the pesticide to break down in the environment. This prevents illegal residues on food, feed, or animal products and possible poisoning of grazing animals. This information may appear as a chart or it may be listed just after the application directions for the target crop or animal.

Directions for Use by Reference

In the future there may be some directions for use (which pesticide applicators must obey) that are refered to on the label, but may not come with the product when it is sold. Directions by reference may include use instructions required by EPA regulations. As an example, a pesticide label may have a statement like this:

"You must use this product in a manner consistent with its labeling and with EPA Worker Protection Standards for Agricultural Pesticides, Part 170 of Title 40, Code of Federal Regulations."

This statement means you are responsible to determine if the regulation applies to your situation and intended use of that pesticide. If the regulation does apply, you are responsible for complying with these directions as well as the label and labeling directions. EPA regulations that may require additional pesticide use directions are:

- agricultural worker protection
- ground and surface water protection
- endangered species protection
- pesticide transportation, storage, and disposal

The use directions for each of the programs above may be long and exceed the room available on the traditional pesticide label. EPA's decision to refer to use directions places great responsibility on the pesticide applicator. A paragraph or a sentence on the label may be the only notice an applicator will receive that more directions are required for proper and legal application of that product.

The applicator must:

- Read the label carefully and recognize statements referring to additional use-directions.
- Locate and read the additional use-directions.
- Determine if they affect the planned use.
- Decide how to comply.
- Comply with the additional directions.

Reading the Label

Before you buy a pesticide, read the label to determine:

- Whether it is the pesticide you need for the job.
- Whether the pesticide can be used safely under the application conditions.
- Where the pesticide can be used (livestock, crops, structures, etc.)
- Whether there are any restrictions for use of the pesticide.
- How much product you need.

Before you mix the pesticide, read the label to determine:

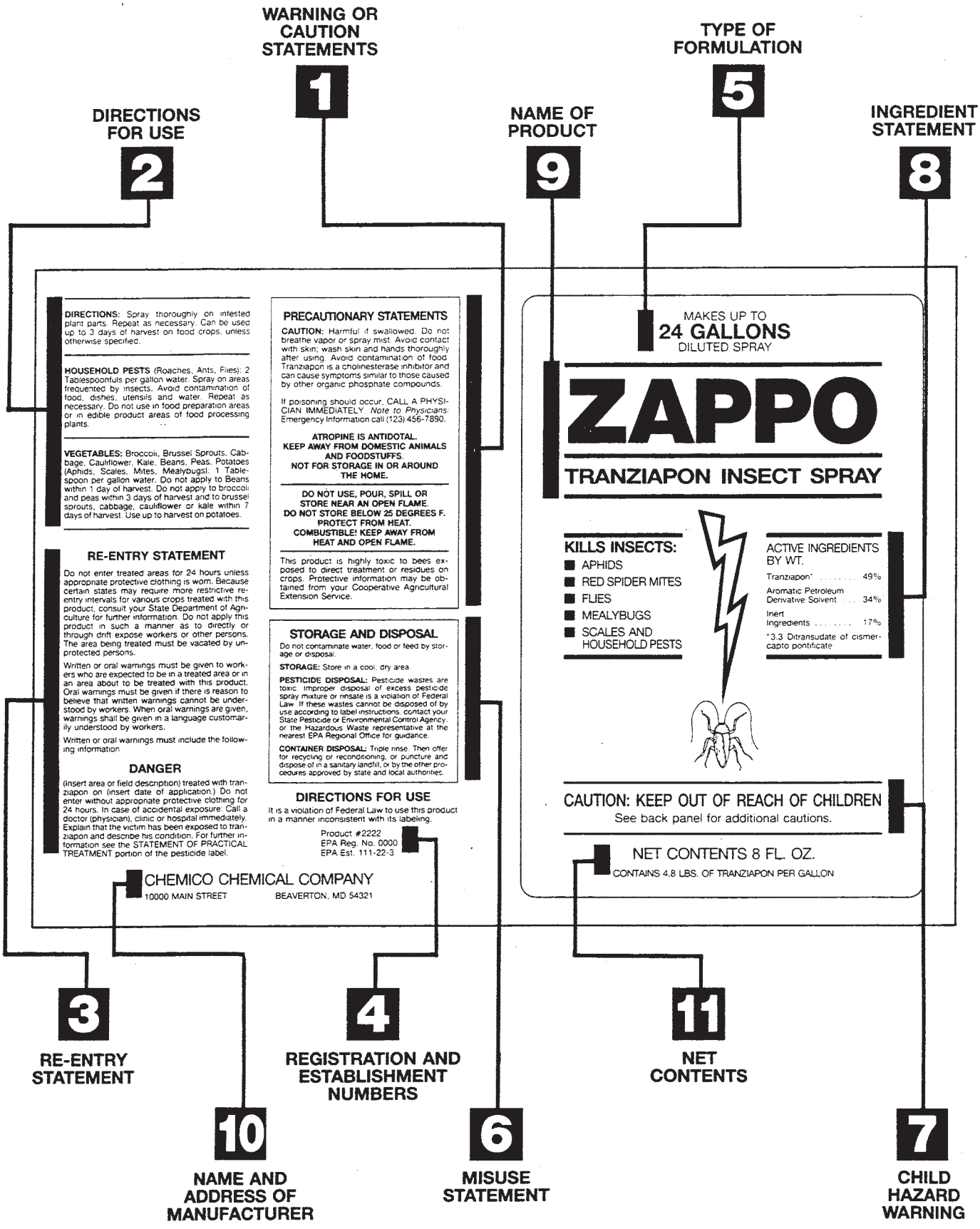
- What protective equipment you should use.
- What the pesticide can be mixed with (compatibility).
- How much pesticide to use.
- The mixing procedure.

Before you apply the pesticide, read the label to determine:

- What safety measures you should follow.
- When to apply the pesticide (including the waiting period for crops and animals).
- How to apply the pesticide.

Before you store or dispose of the pesticide or pesticide container, read the label to determine:

- Where and how to store the pesticide.
- How to decontaminate and dispose of the pesticide container.
- Where and how to dispose of surplus pesticides.


WARNING OR CAUTION STATEMENTS
1
TYPE OF FORMULATION
5
DIRECTIONS FOR USE
2
NAME OF PRODUCT
9
INGREDIENT STATEMENT
8
DIRECTIONS: Spray thoroughly on infested plant parts. Repeat as necessary. Can be used up to 3 days of harvest on food crops, unless otherwise specified.
HOUSEHOLD PESTS (Roaches, Ants, Flies): 2 Tablespoonfuls per gallon water. Spray on areas frequented by insects. Avoid contamination of food, dishes, utensils and water. Repeat as necessary. Do not use in food preparation areas or in edible product areas of food processing plants.
VEGETABLES: Broccoli, Brussel Sprouts, Cabbage, Cauliflower, Kale, Beans, Peas, Potatoes (Aphids, Scales, Mites, Mealybugs): 1 Tablespoon per gallon water. Do not apply to Beans within 1 day of harvest. Do not apply to broccoli and peas within 3 days of harvest and to brussel sprouts, cabbage, cauliflower or kale within 7 days of harvest. Use up to harvest on potatoes.
RE-ENTRY STATEMENT
Do not enter treated areas for 24 hours unless appropriate protective clothing is worn. Because certain states may require more restrictive re-entry intervals for various crops treated with this product, consult your State Department of Agriculture for further information. Do not apply this product in such a manner as to directly or through drift expose workers or other persons. The area being treated must be vacated by unprotected persons.
Written or oral warnings must be given to workers who are expected to be in a treated area or in an area about to be treated with this product. Oral warnings must be given if there is reason to believe that written warnings cannot be understood by workers. When oral warnings are given, warnings shall be given in a language customarily understood by workers.
Written or oral warnings must include the following information
DANGER
(insert area or field description) treated with tranziapon on (insert date of application.) Do not enter without appropriate protective clothing for 24 hours. In case of accidental exposure: Call a doctor (physician), clinic or hospital immediately. Explain that the victim has been exposed to tranziapon and describe his condition. For further information see the STATEMENT OF PRACTICAL TREATMENT portion of the pesticide label.
PRECAUTIONARY STATEMENTS
CAUTION: Harmful if swallowed. Do not breathe vapor or spray mist. Avoid contact with skin; wash skin and hands thoroughly after using. Avoid contamination of food. Tranziapon is a cholinesterase inhibitor and can cause symptoms similar to those caused by other organic phosphate compounds.
If poisoning should occur, CALL A PHYSICIAN IMMEDIATELY. Note to Physicians: Emergency Information call (123) 456-7890.
ATROPINE IS ANTIDOTAL.
KEEP AWAY FROM DOMESTIC ANIMALS AND FOODSTUFFS.
NOT FOR STORAGE IN OR AROUND THE HOME.
DO NOT USE, POUR, SPILL OR STORE NEAR AN OPEN FLAME.
DO NOT STORE BELOW 25 DEGREES F.
PROTECT FROM HEAT.
COMBUSTIBLE! KEEP AWAY FROM HEAT AND OPEN FLAME.
This product is highly toxic to bees exposed to direct treatment or residues on crops. Protective information may be obtained from your Cooperative Agricultural Extension Service.
STORAGE AND DISPOSAL
Do not contaminate water, food or feed by storage or disposal.
STORAGE: Store in a cool, dry area.
PESTICIDE DISPOSAL: Pesticide wastes are toxic. Improper disposal of excess pesticide spray mixture or rinsate is a violation of Federal Law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.
CONTAINER DISPOSAL: Triple rinse. Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by the other procedures approved by state and local authorities.
DIRECTIONS FOR USE
It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.
Product #2222
EPA Reg. No. 0000
EPA Est. 111-22-3
CHEMICO CHEMICAL COMPANY
10000 MAIN STREET BEAVERTON, MD 54321
MAKES UP TO
24 GALLONS
DILUTED SPRAY
ZAPPO
TRANZIAPON INSECT SPRAY
KILLS INSECTS:
APHIDS
RED SPIDER MITES
FLIES
MEALYBUGS
SCALES AND HOUSEHOLD PESTS
ACTIVE INGREDIENTS BY WT.
Tranziapon* 49%
Aromatic Petroleum Derivative Solvent ... 34%
Inert Ingredients 17%
*3,3 Ditransudate of cismercapto pontificate
CAUTION: KEEP OUT OF REACH OF CHILDREN
See back panel for additional cautions.
NET CONTENTS 8 FL. OZ.
CONTAINS 4.8 LBS. OF TRANZIAPON PER GALLON
3
RE-ENTRY STATEMENT
4
REGISTRATION AND ESTABLISHMENT NUMBERS
11
NET CONTENTS
10
NAME AND ADDRESS OF MANUFACTURER
6
MISUSE STATEMENT
7
CHILD HAZARD WARNING

Questions for Self Study — Chapter XIV

1. Are the words "Keep Out of Reach of Children" on all pesticide labels?

2. Does the label specify the protective equipment necessary for cautious use of each pesticide?

3. If the intended use is not listed on the label, but you are pretty sure it works, should you go ahead and use it anyway?

4. If you use a non-registered material and problems arise, are you liable or is it just too bad for your client?

5. Is the label just something the manufacturer invents to help sell his product or is it approved and registered by EPA?

6. What are the toxicity warnings on the label based on?

7. The pesticide and the label will be registered by EPA only when what four things are protected?

8. Are official common names available for all pesticides?

9. What two words and diagram must appear on all labels for *highly toxic* products? The word "WARNING" may also appear.

10. What labels must carry an antidote statement and the sentence "Call a physician immediately"?

11. Is the signal word WARNING required on labels for *moderately toxic* products?

12. All labels for slightly toxic materials must carry the word _____. The word "WARNING" may also appear.

13. What directions for use can you find on the label?

14. What other recommendations are on the label?

15. Name the four different times you should read the label and give the reasons why for each time.

16. On the "Misuse Statement" (i.e., Storage and Disposal), legal disposal steps are required for both the _____ and the _____.

17. The insecticide Zappo can be used on what pests?

18. What are the directions to use Zappo?

19. What vegetables can Zappo be used on?

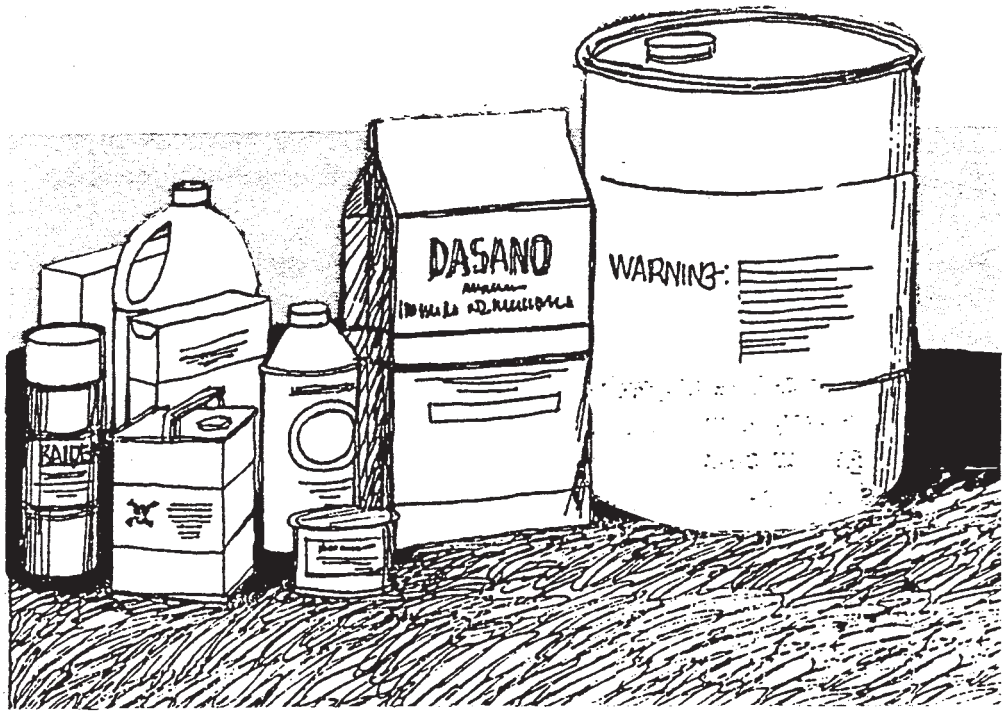
20. What is the reentry period for Zappo?

21. For specific product information, an applicator might have to contact the manufacturer with the EPA Registration Number. What is the registration number?

Formulations

Chapter XV

A pesticide chemical can rarely be used as originally manufactured. The pesticide must be diluted with water, oil, air or chemically inactive (inert) solids so that it can be handled by application equipment and spread evenly over the area to be treated. Usually the basic chemical cannot be added directly to water or mixed in the field with solids, so the manufacturer must further modify his product by combining it with other materials such as solvents, wetting agents, stickers, powders, or granules. The final product is called a pesticide formulation and is ready for use either as packaged or diluted with water or other carriers.



Goals of This Chapter

- Learn the definitions and abbreviations for types of formulations.
- Determine what to consider in choosing the best formulation and when to use it.
- Understand the dangers of these formulations and the steps taken to protect yourself.

Types of Formulations

A single pesticide is often sold in several different formulations. The applicator should choose the formulation that will best meet his requirements for a particular job. Considerations in making a choice include effectiveness against the pest, habits of the pest, the plant, animal or surface to be protected, application equipment, danger of drift and runoff, and possible injury to the protected surface. Abbreviations are often used to describe the type of formulation involved. These abbreviations are used on labels and in recommendations. Some of the common ones are: WP for wettable powder; F for flowable; G for granules or granular; D for dusts; SP for soluble powder; EC for emulsifiable concentrate; and SC for spray concentrate.

Aerosols (A)

Aerosols (pressurized cans, "bug bombs") contain a small amount of pesticide, or a combination of pesticides that are driven through a fine opening by a chemically inactive gas under pressure, when the nozzle is triggered. Usually they are small, weighing about one pound.

Advantages. Aerosols are very convenient in that they are always ready to use. They are also a convenient way to buy small quantities of a pesticide. They are easily stored and the pesticides do not lose their strength (potency, activity) while in the can during their normal period of use.

Disadvantages. Aerosols are only practical for use in small areas. There is not much active ingredient in any one can. Because of this, it is an expensive way to buy pesticides. Unfortunately, they are also attractive playthings for small children and, if left within reach, are a hazard. Aerosols can be dangerous if punctured or overheated. They may explode and injure someone. Don't ever try to burn aerosol cans.

Principal Uses. Aerosols are most often used in households, backyards, tents and other small areas. They may be used either as space sprays for flying insects or as residual sprays. Usually they are used against insects, but some are designed for plant diseases or weed killers. There are commercial models available for use in greenhouses, barns, etc. These are larger models holding five to ten pounds of material, and are usually refillable.

Dusts (D)

A prepared dust is a finely ground, dry mixture combining a low concentration of the pesticide with an inert carrier such as talc, clay, or volcanic ash. There is a wide range in size of the dust particles in any one formulation.

Advantages. Dusts are ready to use as purchased and require no mixing. They can be applied with simple, lightweight equipment even in commercial use.

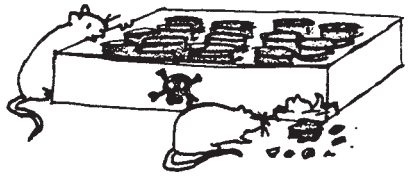
Disadvantages. Because dust particles are finely ground, they may drift long distances from the treated area and may contaminate off target areas. While drifting they are highly visible and may cause public criticism. When used outside, they are easily dislodged from the treated surface by wind and rain and soon become inactive. Never apply dust formulations on a windy day.

Principal Uses. Because of drift, dusts are not recommended for large scale outside use. Outside they are used principally for spot treatments and home gardens. They work best when applied to dewy surfaces in the early morning. Inside, they are used in cracks and crevices for roaches and other domestic insects. Dusts are also used to control lice, fleas, and other external parasites on pets and livestock.

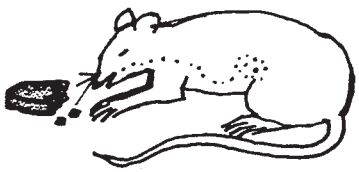
Poisonous Baits

A poisonous bait is a food or other substance mixed with a pesticide that will attract and be eaten by pests and eventually cause their death.

Advantages. Baits are useful for controlling pests such as flies, rats, etc., that range over a large area. Often the whole area need not be covered, just those spots where the pests gather. Baits may be carefully placed in homes, gardens, granaries, and other agricultural buildings so that they do not contaminate food or feed, and can be removed after use. Usually only small amounts of pesticide are used in comparison to the total area treated, so potential environmental pollution is minimized.



Disadvantages. Within the home, baits are often attractive and dangerous to children or pets and therefore must be used with care. Outside, they may kill domestic animals and wildlife as well as the pest. Often the pest will prefer the protected crop or food rather than the bait, so the bait may be ineffective. When larger pests are killed by baits, the bodies must be disposed of. If not, they may cause an odor and/or sanitation problem. Unfortunately, other animals feeding on the poisoned pests can also be poisoned.



Principal Uses. Baits are used inside buildings for pests such as ants, roaches, flies, rats, and mice. They may be used outside in gardens for control of slugs, in dumps and similar areas for rat control, and in fields to control slugs and insects.

Granules (G)

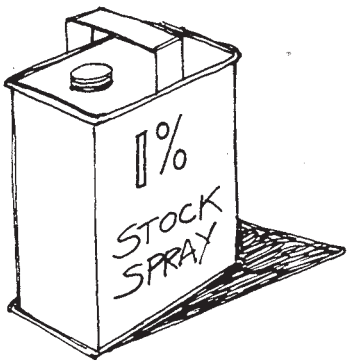
Like dusts, pesticide granules are dry, ready-to-use, low concentrate mixtures of pesticide(s) and inert carriers. However, unlike dusts, almost all of the particles in a granular formulation are about the same size and are larger than those making up a dust. A fine granular pesticide pours like ordinary salt or sugar.

Advantages. Granules are ready to use as purchased, with no further mixing necessary. Because the particles are large, relatively heavy, and more or less the same size, granulars drift less than most other formulations. There is little toxic dust to drift up to the operator's face and be inhaled by him. They can be applied with simple, often multi-purpose equipment such as seeders or fertilizer spreaders. They also will work their way through dense foliage to a target underneath.

Disadvantages. With a few exceptions, granulars are not suitable for treating foliage because they will not stick to it.

Principal Uses. Granular pesticides are often used for soil treatments to control pests living at ground level or underground. They may be used as soil systemics, that is, formulations applied to soil that are absorbed into the plant through the roots and carried throughout the plant. Granular herbicides and/or insecticides are frequently applied in combination with fertilizers on turf, thereby saving labor. Granular formulations may be the choice when applied by agricultural aircraft where drift is a problem, or when treating water for mosquitoes where there is a heavy foliage cover over the water.

Ready-To-Use (RTU)



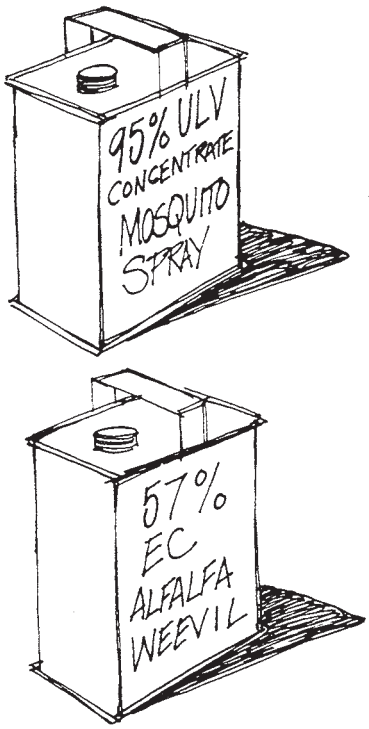
These preparations are usually solutions in highly refined oils that contain low concentrations of the pesticide. They are generally used as purchased.

Advantages. Low concentrate solutions are designed to be sprayed as purchased. Because of this, no mixing is necessary and this lessens the chances for making mistakes. Household formulations have no unpleasant odors and usually the liquid carrier evaporates quickly and does not stain fabrics, furniture, etc.

Disadvantages. Low concentrate formulations are usually fairly expensive for the amount of actual pesticide bought and the uses for such materials are few and specialized.

Principal Uses. Low concentrate solutions may be used in the household for flying or crawling insects and for mothproofing clothes. In barns they are used as space sprays and fly sprays for livestock. They are also used as prepared sprays for mosquito control and shade tree insect control.

Emulsifiable Concentrates (EC)



These preparations are usually solutions containing a high concentration of the pesticide. Most of them are designed to be mixed with water or oil and contain wetting agents, stickers, and other additives. They may contain as much as eight or more pounds of a pesticide per gallon of concentrate.

Advantages. These formulations contain a high concentration of pesticide, so the price per pound of active ingredient is rather low. Only moderate agitation is required in the tank, so they are especially suitable for low-pressure, low-volume weed sprayers, mist blowers, and small home ground sprayers. They are not abrasive and do not settle out when the sprayer is not running. There is little visible residue, which generally allows their use in populated areas. Because of the high pesticide content, the applicator is not required to store, transport, or handle a large bulk of chemical for a particular job.

Disadvantages. It is easy to underdose or overdose because of the high concentration of pesticide, if directions for mixing are not carefully followed. Mixtures of emulsifiable concentrates may be phytotoxic. Also, because of the high concentration and liquid form, which is usually easily absorbed through the skin, there may be hazard to the applicator. The hazard of improperly stored concentrates can also be high. Because of their solvents, most liquid concentrates cause rubber hoses, gaskets, and pump parts to deteriorate rapidly unless they are made of neoprene rubber. Some formulations cause pitting in car finishes.

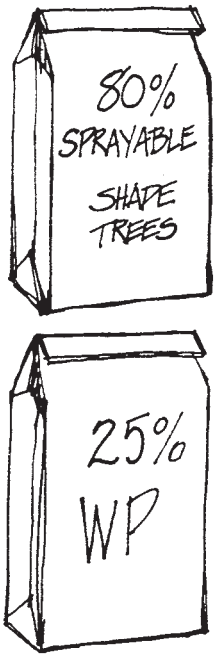
Principal Uses. High concentrate liquids can be diluted and used in many ways — on fruit, vegetables, shade trees, for residual sprays on farm animals, for structural pests. They are adaptable to many types of application equipment ranging from household sprayers to dilute hydraulic sprayers, low-volume ground sprayers, mist blowers, low volume agricultural aircraft sprayers, and ultra-low volume sprayers (usually on aircraft).

Flowables (F)

Some pesticides can be manufactured only as solid materials, not as liquids. Often these pesticides are formulated as flowables. Flowables are made from very finely ground solid materials, which are suspended in a liquid. In this form, they can be mixed with water and applied. Flowables are similar to emulsifiable concentrates and are used in the same way. Flowables do not usually clog nozzles and require only moderate agitation.

Wetable or Soluble Powders (WP or SP)

Wettable powders and soluble powders are dry preparations containing a relatively high concentration of pesticides. Wettable powders are mixed with water to form suspensions. Soluble powders dissolve in water to form solutions. The amount of pesticide in these powders varies from 15% to 95%.



Advantages. As is true with liquid concentrates, the pesticides in wettable powders are relatively low in cost and easy to store, transport, and handle. They are safer to use on tender foliage and usually do not absorb through the skin as rapidly as liquid concentrates. They are easily measured and mixed when preparing spray suspensions.

Disadvantages. Wettable powders may be hazardous to the applicator if he inhales their concentrated dust while mixing. They require good agitation (usually mechanical) in the sprayer tank and will settle quickly if the sprayer is turned off. They cause some pumps to wear out quickly. Their residues are more subject to weathering than liquid concentrates, and being more visible may soil cars, windows, and other finished surfaces.

Principal Uses. Liquid concentrates and wettable powders are the formulations most widely used by commercial applicators. Like liquid concentrates, wettable powders can be used for most pest problems and in most spray machinery. Where toxicity to the plant or absorption through the skin of an animal is a problem, use a wettable powder suspension rather than a liquid emulsion or solution of the pesticide.

Fumigants

Fumigants are pesticides in the form of poisonous gases that kill when absorbed or inhaled.

Advantages. A single fumigant may be toxic to many different forms and types of pests. Therefore, a single treatment with one fumigant may kill insects, weed seeds, nematodes, and fungi. Fumigants penetrate into cracks, crevices, burrows, partitions, soil, and other areas that are not gastight and expose hidden pests to the killing action of the pesticide.

Disadvantages. The area to be fumigated almost always must be enclosed. Even in outdoor treatments the area must be covered by a tarp or the fumigant incorporated into the soil, so that it doesn't escape. Frequently, fumigants are highly toxic. Proper techniques and all recommended protective gear must be used when applying them. Most fumigants burn the skin.

Principal Uses. Fumigants are used inside dwellings or other buildings to control vermin that cannot easily be reached by other pesticide formulations. They are used in ports of entry and at state borders for treatment of plants and other materials to prevent the introduction of new pests into an area. Stored grain pests are often controlled by fumigants. Soil is fumigated to sterilize it from pests before planting.

Choosing the right formulation can make the difference between a successful control job or a failed application that does more harm than good.

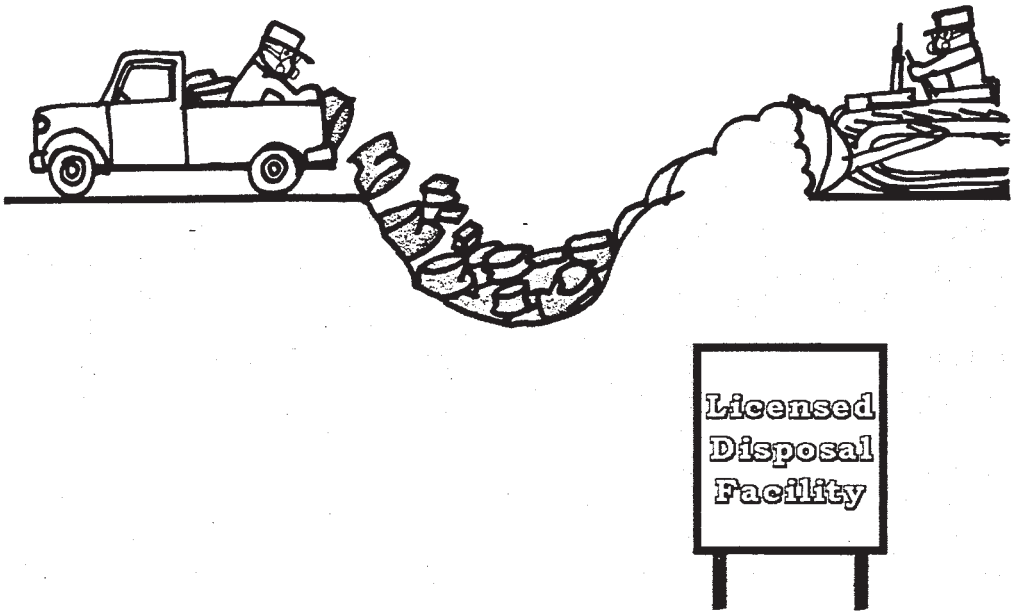
Questions for Self Study — Chapter XV

1. When a pesticide chemical is mixed with solvents, wetting agents, stickers, powders, granules, etc., the finished product is called a _____.
2. What are the common abbreviations for these types of formulations — wettable powder _____, emulsifiable concentrate _____, dust _____, granules _____.
3. What must you consider when choosing the best formulation for your job? (six items)
4. Which pesticide formulation is most often used in household, backyards and other small areas.
5. Which pesticide formulation can be dangerous if the cans are punctured or overheated?
6. Why are dust formulations usually not used on a large scale out-of-doors?
7. In what type of job are dusts often used?
8. What type of pests are poisonous bait formulations used to control?
9. Why are poisonous baits often used in small amounts?
10. How do *granule* formulations differ from d*ust* formulations?
11. What advantage do granules have over dusts and sprays?
12. Why wouldn't you choose a granular if you were going to treat a tree or lettuce leaf?
13. Why would you choose a low concentrate liquid formulation if you wanted to be sure in getting the right mixture?
14. What formulation would you choose if you wanted little visible residue and only moderate agitation?
15. Which formulation is more hazardous to the applicator than most because it is highly concentrated and is absorbed easily by the skin?
16. What is the difference between em*ulsifiable concentrates* and *flowables*?
17. Would you choose an EC or a WP if phytotoxicity might be a problem?
18. Why should an applicator consider wearing a respirator when mixing soluble or wettable powders?
19. What formulation would you choose if you wanted to penetrate cracks, crevices, soil, burrows, partitions and other unexposed areas?
20. Name two disadvantages of fumigants.

Disposal

See Chapters II and III for State and Federal Laws

As an applicator you have two disposal problems. First you must safely dispose of surplus pesticides — concentrated or tank mixed — that you have no use for or cannot store. Secondly, you must safely dispose of empty pesticide containers. Careless disposal practices are a common cause of pesticide misuse and environmental contamination. Take the time to dispose of surplus pesticides and empty containers carefully and legally. Never give empty containers away for any purpose.



Goals of This Chapter

- Learn the importance of preventing pesticide surplus.
- Know what to do in case you have a pesticide surplus.
- Understand and learn the steps taken to properly dispose of pesticide containers.
- Learn proper procedure for triple-rinsing containers and equipment.

Surplus Pesticides

There are several ways in which you can end up with surplus pesticides. The government or the pesticide manufacturer may cancel the registration on the pesticide, or the use may no longer be effective. You may buy more pesticide than you really need or you may have some left in the tank after the job is done. You may have contaminated water left over from cleaning operations, spills, or rinsing. The pesticide may have lost its strength in storage, the container may be damaged, or the label may be missing

Preventing Pesticide Surplus. Although you cannot always avoid having surplus pesticides, there are ways to cut down on pesticide surplus. Always check to make sure that the pesticide is registered by the EPA and your state. Make sure the pesticide is labeled for the pest before you buy it. Recommendations may change and newer chemicals may be better than older ones. The storage period may also exceed the effective shelf life of the product. Estimate your needs and buy only what you need. Do not stockpile materials. This will reduce carryover and the chance of spills, damaged containers, and loss of strength of the pesticide. Always check out the job before you mix the pesticide in the tank. This way you are not faced with the disposal of a tankload of the wrong pesticide for the pest problem. Mix only enough pesticide for the job at hand so that you finish with an empty tank or hopper. Preventing surplus is the best way to take care of your pesticide disposal problem.

What to Do with Surplus Pesticides. If you have pesticides that you cannot use or do not want, you must take steps to safely and legally dispose of them. Pesticides which are still factory-sealed may be returned to the manufacturer. Check with the company and see if they will take your surplus back. You may be able to apply the excess pesticide mixture to another site where a pest problem exists and that can be treated with the same pesticide. If possible use the rinsewater from your spray tank in a future spray mix of the same pesticide. Be careful with herbicide-contaminated rinsewater on sensitive plants. Caution must also be exercised with reusing rinsewater in mixtures of other pesticides. It is not legal and may cause illegal food or feed crop residues. Never

dispose of pesticide contaminated rinsewater in a manner that will contaminate public or private water sources or sewage treatment facilities.

Farmers who need to dispose of a surplus spray mixture or contaminated rinsewater should do so on their own property, only if it is not prohibited on the label and only in labeled sites. If the manufacturer won't take back your concentrates and/or you cannot use up your pesticides, you must find other safe and legal ways to dispose of your surplus. Other certified applicators might be able to use your pesticide leftovers to control a similar pest problem. The Resource Conservation and Recovery Act supports regional "Pesticide Waste Clean Up Days" to properly discard of hazardous material and waste. Contact your state pesticide regulatory agency and urge them to have "Pesticide Clean Up Days" if they are not available in your state. If containers begin to leak or are damaged, they should be packed in another container that is appropriately labeled. Store your extra pesticides in a locked storage area while you are waiting to dispose of them. They must be kept in their original containers with the label intact.

Empty Pesticide Containers

Empty pesticide containers are not really "empty." They still contain small amounts of pesticide even after they have been rinsed out properly. Never toss them into streams, ponds, fields, or vacant buildings. Be able to account for every pesticide container you used for the job. Never give them to children to play with or allow uninformed persons to have them for any use. Dispose of all your pesticide containers carefully and properly. You should separate the empty containers for disposal into three main types; those that will burn, those that will not burn, and those that contain mercury, lead, cadmium, arsenic, or inorganic pesticides. All empty containers for liquids should be rinsed three times before disposal.

When using containers holding liquid formulations:

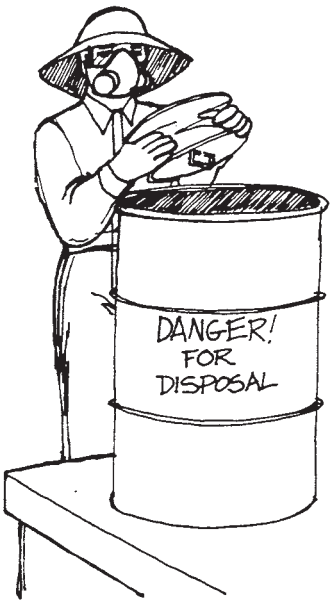
- Triple-rinse the container **immediately** after emptying.
  - — Fill the container one-quarter full with the proper diluent (water, oil or liquid fertilizer).
  - — Replace the closure or plug the opening of the container.
  - — Rotate the container, making sure to rinse all surfaces.
  - — Turn the container upside down.
  - — Add the rinsate to the spray tank.
  - — Allow 30 seconds for rinsate to drain.
  - — Repeat this procedure two more times.
- Puncture the top and bottom of the container to prevent reuse. Crush flat.
- Deposit the container in a licensed sanitary landfill.

When using containers holding dry formulations:

- Completely empty the contents of the container into the tank.
- Open both ends of the container to help remove any remaining pesticide and to prevent reuse of the container.
- Deposit the container in a licensed sanitary landfill.

When using containers holding aerosol formulations:

- Relieve pressure as much as possible. Do not puncture the container.
- Deposit the container in a licensed sanitary landfill.



Triple-rinsed containers that will be held for disposal at a later time should be marked to indicate that triple-rinsing has been done along with the date. Pesticide containers that will not be recycled through a recycling facility or the dealer should be rendered unusable by breaking, puncturing, or crushing. Never reuse pesticide containers. All containers should be kept in a locked storage area until disposal and kept away from all possible contact with children and animals.

Burnable Containers are usually cardboard or paper. Only with state approval and permission on the label can containers be burned. Never burn containers that hold 2,4-D type weed killers. The smoke from such a fire could cause serious damage to nearby plants and trees. Large quantities of burnable containers should be held for proper disposal. Check local, state, and federal regulations. Federal laws that govern incineration are; the Resource Conservation and Recovery Act (RCRA), the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), and the Clean Air Act.

Non-Burnable Containers are usually metal, glass, or plastic. Some of these may be returned to the manufacturer for reuse. Before you ship back the containers, reseal them carefully and wash off the outside completely. Metal drums that cannot be returned can be crushed with a backhoe, front end loader, truck, or tractor. Store them in a locked storage area for disposal. Glass containers may be carefully broken and stored. Plastic containers may be cut apart to take up less room.

Containers that held organic or inorganic pesticides with mercury, lead, cadmium, and arsenic have special disposal requirements. Improper disposal could create serious environmental pollution and long term health hazards. The label will specify legal disposal methods. Special methods such as encapsulation may be necessary for their safe disposal. Encapsulation means to seal the pesticide and "empty" container in a sturdy, waterproof container so that the contents cannot possibly get out. Check federal and state regulations for disposal of these containers. If you need to store these empty containers while waiting to dispose of them, they can be crushed and stored in a locked storage area.

If they are emptied and stored in larger drums, keep these containers separate from drums that hold regular non-burnable pesticide containers. Burial in designated hazardous waste landfills and incineration in specially designed, extremely high temperature incinerators are often the only acceptable legal methods for pesticide waste disposal. You are responsible for the costs of packing the pesticides for shipment, transportation, disposal fees from the facility, and the chemical analysis if the exact identity and concentration of the unwanted substances are unknown. Do not burn empty containers which held mercury, lead, cadmium, arsenic or inorganic pesticides. Cardboard and paper containers of this type should be crushed and stored for future disposal.

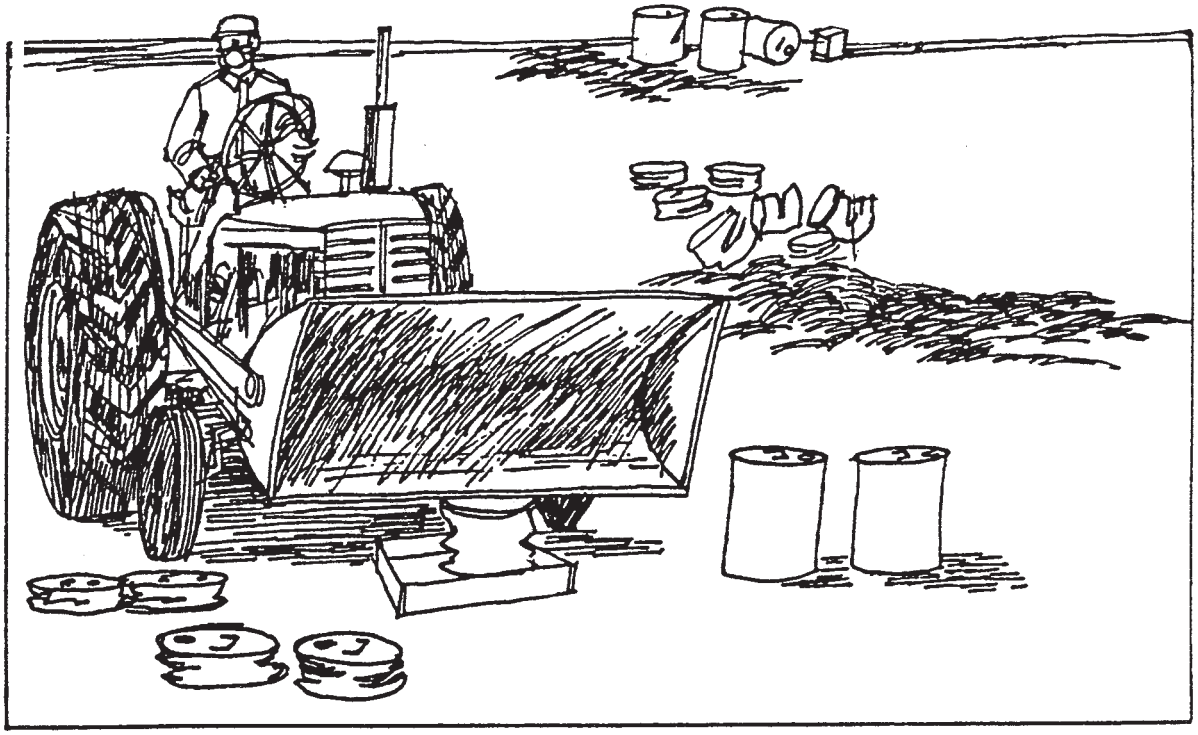
Methods for the Disposal of Pesticides and Pesticide Containers

Disposal of pesticides and their containers can be a problem. They should be returned to the manufacturer whenever possible. Otherwise, you must choose the method which is best for you and still protects others and the environment. Federal and state laws may require that you use certain methods when disposing of specific pesticides.

Incineration. Burning pesticides and containers in special, high temperature incinerators is one safe method of disposal. These incinerators are specially designed so that the pesticides will be reduced to harmless gases and solid ashes. This special incineration method is often only carried out in EPA-approved landfill facilities. It is a safer and more reliable disposal method than ordinary incineration. To find the pesticide incinerator that is nearest to your operation, contact your county extension agent, state college or university, state regulatory officials, or your regional Environmental Protection Agency office.

Burial. The least preferred option for pesticide waste disposal. It is no longer listed on any pesticide label as a disposal option. It is only legal if specifically allowed by state or local laws. Because it is difficult to tell if a burial site is close to underground water sources, there is always the possibility of chemicals leaching through soils and polluting subsurface waters and groundwater. Surface and underground water systems should be carefully protected. Check to see if there is a special pesticide landfill in your area. Do not bury pesticides or containers that contained mercury, lead, cadmium, arsenic, or inorganic pesticides. Although encapsulation of buried containers prevents chemicals from leaching through the soil, once a hazardous material is buried, its fate in the environment is never clear. State or federal regulatory officials should be contacted if pesticide waste is disposed of by burial.

Take the extra time and effort to dispose of surplus pesticides and empty containers properly in licensed facilities. It is well worth your effort!



Questions for Self Study — Chapter XXI

1. Why is it important that the pesticide applicator take the time to dispose of surplus pesticides and empty containers carefully?

2. What problems can result from buying more pesticides than you can use?

3. What are the proper ways to dispose of surplus concentrated pesticides that are still in their original containers?

4. If you can't dispose of your surplus pesticides right away, what should you do with them?

5. If you have rinsed out an empty pesticide container three times, can you toss them aside or give them to children to play with?

6. What should you do with the rinse water if you can't add it to the tank mix?

7. If you have a couple of empty cardboard fungicide containers, how should you dispose of them?

8. If those cardboard containers had held 2,4-D would you still dispose of them the same way?

9. What should you do to dispose of empty metal, glass, or plastic containers?

10. What does *encapsulation* mean?

11. *Incineration* is an acceptable method of pesticide disposal. Does that mean you can throw them in a wood stove or trash fire?

12. How should you choose a site to bury surplus pesticides and empty containers?

13. Can you incinerate or bury surplus pesticides or containers that have mercury, lead, cadmium, arsenic or other inorganic chemicals in them?

14. Identify which federal laws regulate pesticide disposal methods?

15. What are the ways to dispose of pesticide rinsate remaining after an application job has been completed?

16. Describe the triple-rinse steps for cleaning pesticide containers and explain why it is important to follow them prior to final disposal.

17. Cite reasons why burial is not a good disposal method for pesticides when compared with incineration.

18. Name the ways to prevent pesticide waste surplus and point out the benefits.

19. Disposal of pesticide waste can indirectly lead to contamination of drinking water supplies — explain the ways this might happen.

20. What type of pesticide container cannot be punctured for disposal?

21. In terms of disposal, why should pesticides be kept in the original container with the label intact?

22. Why are EPA-approved sanitary landfills more appropriate for pesticide waste disposal over municipal dumps?

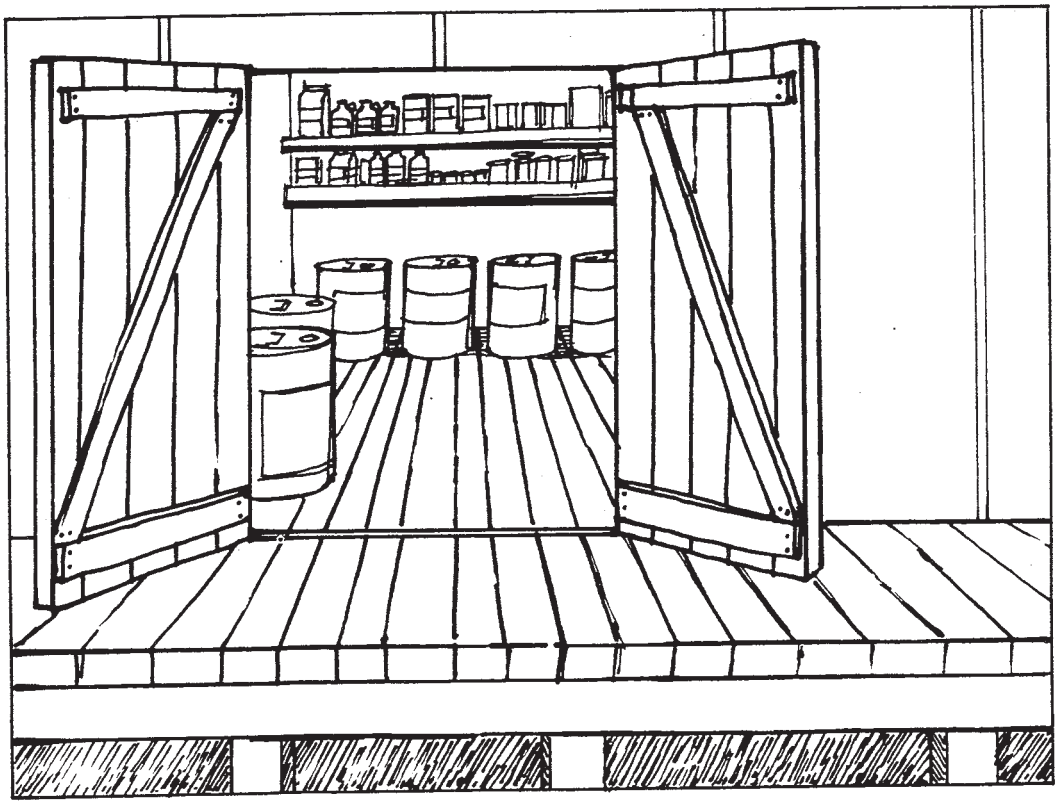
23. Identify the consequences of final disposal of pesticide waste and how it relates to groundwater.

Storage

Chapter XXII

See Chapter II and III for State and Federal Laws

No job is really finished until the pesticides, containers, and your equipment have been put away properly. Get into the habit of storing all of your materials safely before you clean up and go home, or on to the next job. While you are cleaning up and putting away the pesticides, containers, and equipment you should wear all the personal protective equipment you used on the job. Consider wearing gloves and other protective equipment, even if they weren't recommended on the label. Spills and accidental contamination often occur during storage procedures.



Goals of This Chapter

- Learn how to choose and arrange a storage area for pesticides.
- Understand the importance of handling, storing, and disposing of pesticides properly.
- Learn what to do in case of a pesticide spill.

The Storage Building

Most applicators use existing buildings or areas within existing buildings for pesticide storage. However, if you use large amounts of pesticides and/or equipment, it would be best to build a special storage building just for your pesticide needs. If possible, use a separate building for your pesticide storage. If you do not have a separate building, choose a wing or corner on the first floor of a building.

Before you build a new structure, you should look into suggestions and plans for pesticide storage put out by state colleges, chemical companies, county extension agents, etc. When you are setting up any new storage area be sure to check federal, state, and local regulations on storage areas.

Choosing the Best Site. Whether you choose a site to build a new storage area or use existing buildings, you need to consider several points. The site should be in an area where flooding is unlikely. It should be downwind and downhill from sensitive areas such as houses, ponds, and play areas. There should be no chance that runoff or drainage from the site could contaminate surface or groundwater. Sites should be selected so that the soil, geologic, and hydrologic characteristics will not lead to contamination of any water systems through runoff or percolation.

Setting Up the Storage Area. Pesticides should be stored in a cool, dry, airy room or building which is fireproof. Fans are an important feature of any pesticide storage building. A properly installed ventilation system should have a switch outside, so that the fan can be turned on before anyone enters the facility. The storage area should be fenced in or at least able to be locked tightly. Weatherproof warning signs should be hung over every door and window. Pesticides which may be in tank rinsings, spills, seepage from the storage, and heavy runoff from fire fighting or floods must be controlled. Otherwise, they may contaminate surface or groundwater. Dikes, collecting pools, and washing slabs with sumps will provide a proper drainage system and may be required. All the collected runoff water should be treated as a surplus pesticide and disposed of properly. A good supply of detergent or soap, hand cleanser, and water is a must in the storage area. It's convenient for filling tanks, cleaning off equipment, and for you and your help to clean up with. It's also quick first aid in a poisoning emergency. Adsorptive clay, activated charcoal, vermiculite, pet litter, or sawdust should be readily available at

the storage site to soak up spills and leaks. Hydrated lime and high pH commercial detergent should also be on hand to neutralize the pesticide in an emergency. A shovel, broom, dust pan, and a fire extinguisher are other "musts" in any storage area.

Arranging Your Storage Area

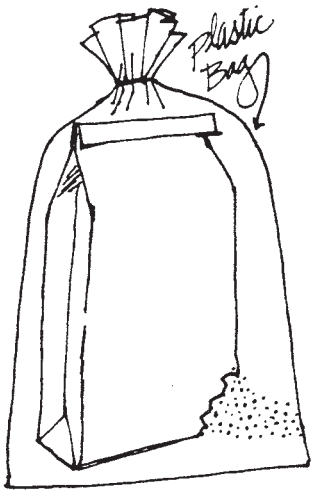
A pesticide storage area, whether it is a room or a whole building, should be used **only** for pesticides and pesticide equipment. Never store or use food, drinks, silverware, tobacco products, or personal protective clothing in the storage or loading area. Livestock feed, living plants, and seeds should never be stored with or near pesticides.

Avoid Hot Places. Glass and metal containers of liquid pesticides should be stored where they are not in the sun or near other sources of heat, such as steam pipes, furnaces, etc. Store pesticides at temperatures above freezing or as directed on the label. Do not store liquid pesticide in a place where the temperature can fall below 40 degrees Fahrenheit or go above 100 degrees Fahrenheit. Protect sensitive pesticides from freezing. Freezing will destroy the usefulness of some pesticide products. Freezing may also cause liquid pesticides to break their containers, resulting in leakage. Heat will cause the liquid to expand so that the contents will be under pressure. Therefore, when the container is opened the pesticide could splash out on you. **No** pesticides should be allowed to become overheated. Some formulations will catch on fire if they get too hot, while others lose their strength and break down when they are exposed to heat. Still others will vaporize and become a health hazard.

Special Areas. Herbicides should be stored in a special place apart from other pesticides, fertilizers, and seeds or bulbs. Some herbicides can vaporize and get into other pesticides nearby. When the contaminated pesticide is used, the herbicide vapors in it could injure or kill crops and sensitive plants. All highly toxic pesticides should be stored together in a special area. Then you and your helper working in that area can take special precautions to keep from being exposed. Also, you are less likely to use a highly toxic pesticide by accident. A special "disposal" area should be used for surplus pesticides and their containers being held for disposal. They should be grouped together and plainly labeled according to how you plan to dispose of them. This will help prevent mix-ups resulting in improper disposal and accidental reuse.

Handling Pesticide Containers

Pesticide containers should be stored with the label in plain sight. They should be stored up off the floor, especially if they can be damaged by dampness. Rigid containers should always be set in an upright position so they cannot spill. All containers should be placed in orderly rows with enough room to allow you and your helpers to walk between them.



Damaged Containers. All pesticide containers should be checked often for corrosion, leaks, loose caps, or bungs. You must correct these dangerous conditions immediately. Pesticides should be stored in their original container with the label attached. If containers are damaged, however, you should put the pesticide in a sound and suitable larger container which can be sealed and labeled. Oftentimes the label from the damaged container can be firmly fastened to the new container. Paper drums or plastic bags placed within another container are handy for this purpose. Unlabeled pesticides are dangerous since you don't know what they are or how to use them. They should be set aside and held for disposal. Partly empty pesticide containers should be resealed and returned to storage. Opened containers of chlorates (often used as weed killers) should **not** be stored. They can burst into flames at any time.

Improper Containers. Pesticides should be stored in their original containers, with the label plainly visible and the seal cap securely closed. Containers should be dated when purchased. Outdated material should be discarded. To reduce the chances for improper storage, a complete inventory should be maintained indicating the amount, identity, and date of material purchased. Pesticides should never be stored in soda bottles, fruit jars, milk cartons, etc. Storing pesticides in improper containers such as these is a common cause of pesticide poisoning. **Never** dump a little of your tank mix in a jar and give it to someone.

Pesticide Equipment Storage

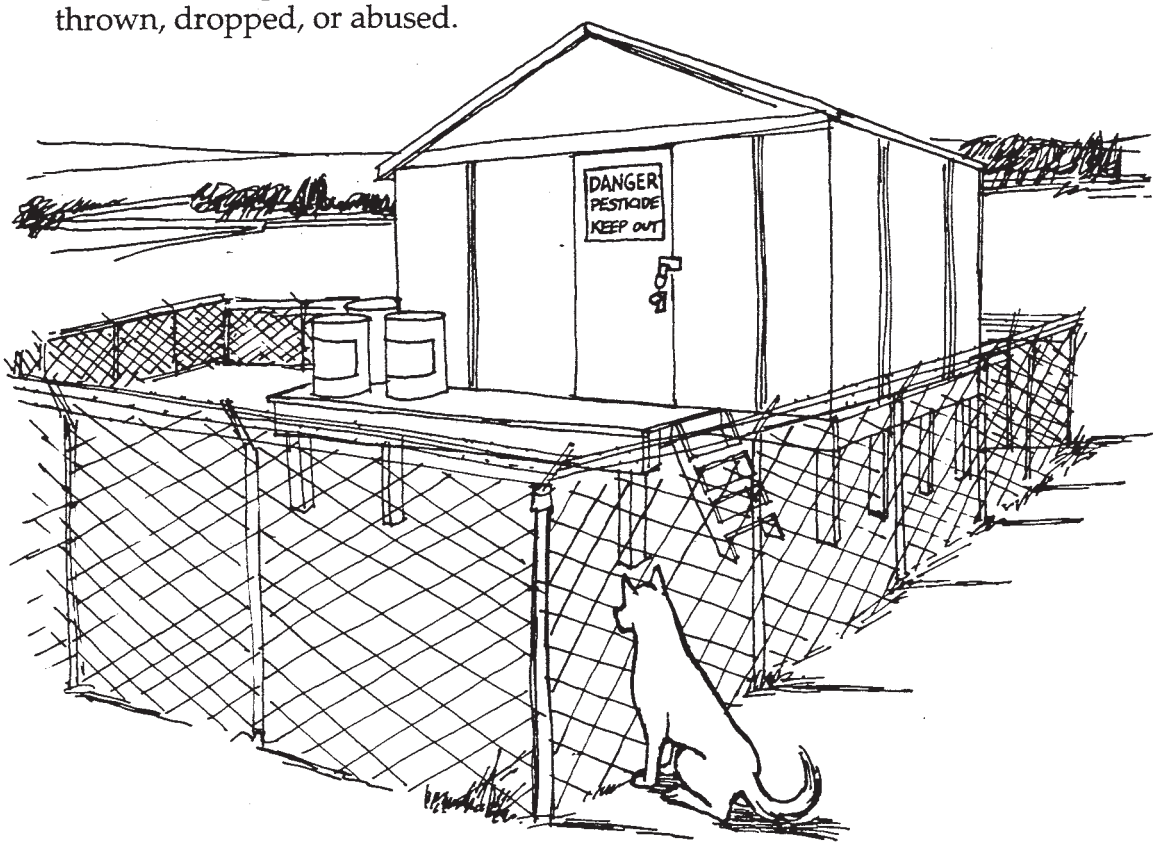
All pesticide application equipment should be stored in a special area. The equipment could be contaminated with pesticides. All items used for handling pesticides at the storage site, which might be used for other purposes, should be labeled "contaminated with pesticides" and should not be removed from the site unless thoroughly decontaminated. Never let children or uninformed people play on or around your equipment. They could pick up a harmful dose of pesticide. Do not store pesticides next to food, feed, or other articles intended for consumption by humans or animals. Always wash your equipment carefully before you store it. Thoroughly rinse off the outside while it is parked in the special wash area. Do not allow rinse water to get on the ground and into streams, ponds, or other sensitive areas. Collect it and hold for proper disposal. All movable pesticide equipment should have a sign: "Danger . . Pesticides" to warn people to stay away. Delivery trucks, nurse tanks, and other support equipment should also be rinsed thoroughly and stored. Materials such as adsorptive clay, hydrated lime, and high pH commercial detergent should be available for use as appropriate emergency cleanup agents for spills or leaks. Keep a shovel, broom, dust pan, absorbant material, container for disposal, and sprinkler can for decontamination and cleanup of spilled materials.

Safety Measures

A little care and common sense can help prevent many accidents and emergencies in the storage area. You and your helpers should know the basic safety rules and follow them. You should also know what to do in case of an emergency. Make a list of safety procedures and post it in the storage area. Be sure that **everyone** follows these rules.

Protect Yourself and Others:

- Follow all safety precautions specified on the label and any accompanying label information.
- Inspect all containers of pesticides for leaks before handling.
- Do not allow children, pets, or uninformed persons into the storage area.
- Wear gloves when you are handling containers of pesticide concentrates. Use more personal protective equipment if the label says to.
- Do not put your fingers in your mouth or rub your eyes while you are working.
- Do not store or use tobacco, food, or drinks in areas where pesticides are present.
- Wash your hands carefully before eating, drinking, smoking, or using the toilet. Wash them as soon as you are finished handling the pesticides.
- Do not handle pesticide containers roughly; they are not meant to be thrown, dropped, or abused.



Spills. In spite of all safety precautions, accidents can happen. If a pesticide spills in your storage area, quick action must be taken. If the pesticide gets on anyone, wash it off immediately. Have them get out of the area, wash thoroughly, change clothes, and see a doctor if necessary. Clear the storage area except for a small clean-up crew. Be sure the crew wears the proper personal protective equipment. Notify the authorities as described in Chapter III under SARA Title III, Section 304, Emergency Release Reporting, if the spilled pesticide is covered by SARA, or by contacting federal, state, or local pesticide authorities.

If the spill is a liquid, throw activated charcoal, absorptive clay, vermiculite, pet litter, or sawdust over the entire spill. Use enough to soak up most of the liquid. Then sweep or shovel it into a large drum. If the spill is a dust, granular, or powder, sweep or shovel it directly into a large drum. Sweeping compound can be useful when picking up spills of dry pesticides. Next cover the spill area with a decontamination agent recommended for that particular pesticide. The manufacturer or your supplier may have to be consulted. Hydrated lime and high pH commercial detergents are often recommended. Repeat this procedure several times. Rinse the whole area with plenty of water to wash away any remaining poison. Collect the rinse water and hold it for proper disposal. Check your storage area carefully to see if any other pesticides were contaminated by the spill. If so, do not take a chance on using them — dispose of them as well. When you are all finished, seal the drum tightly and store for disposal.

Fire. Inform your local fire department, hospital, public health officials, and police of the location of your pesticide storage building. Warn them of possible hazards and of proper protective clothing to wear in case of fire. Suggest that they wear air-supplied respirators and chemical resistant clothing. They should avoid breathing or contacting the smoke or fumes at all times. If they do contact the smoke and fumes, they should get out of the area fast and wash off. Post signs around the area and, if possible, give fire department officials a floor plan of the storage area. Keep all people without protective gear away from the fire. Anyone who might contact the smoke, fumes, or contaminated surfaces must be removed from the area. Because it could be poisonous, all water used in fire fighting should be contained in the storage area drainage system for safe disposal.

Monitoring System. If you store large quantities of pesticides, consider setting up an environmental monitoring system. Arrange to have samples taken from water, wildlife, and plants near the storage area. The samples should be assessed to be sure that no pesticides are getting out into the environment.

Storage Facility Check List

Yes	No	
☐	☐	Separated from offices, workshops, livestock areas
☐	☐	Separated from wells, streams, lakes, ponds, wildlife
☐	☐	Separated from food and feed
☐	☐	Fire resistant building materials
☐	☐	Impermeable flooring
☐	☐	Liquid spill containment (berms, 25% of liquid storage)
☐	☐	Anti-spark electrical components
☐	☐	Heating system (maintain above 32 degrees F)
☐	☐	Ventilation system with an outside switch (to vent vapors and maintain at less than 95 degrees F)
☐	☐	Locked doors
☐	☐	Fenced
☐	☐	Warning signs posted
☐	☐	Racks for off floor storage
☐	☐	Emergency eyewash and shower immediately available
☐	☐	Routine wash-up facilities near by
☐	☐	Spill kit and fire extinguishers readily available
☐	☐	Personal protective equipment available
☐	☐	First aid kit
☐	☐	Prepared emergency response plan on file
☐	☐	Pesticide inventory on file

Make it a habit! Store your pesticides and equipment properly before you clean up and go home, or on to the next job.

Questions for Self Study — Chapter XXII

1. Why wear protective clothing while you store your pesticides, containers, and equipment?
2. In case of fire in your storage area, what should firefighters wear?
3. Name several points you need to consider when choosing a storage site?
4. Pesticides should be stored in what kind of container?
5. What are the main problems with runoff water from your storage area?
6. How should you treat collected runoff water?
7. Why is a good supply of soap and water a "must" in any pesticide storage area?
8. What other materials should be on hand in a good storage area?
9. Why is the storage area not a good place to keep your lunch, tobacco, and street clothes while you are on the job?
10. Why should the storage area be kept cool?
11. Why do herbicides need to be stored in a special area apart from other pesticides?
12. How should you organize the *disposal* section of your storage area?
13. What should you do when you discover that one of your pesticide containers is corroding?
14. Why should all pesticides be stored in their original container whenever possible?
15. How should you store opened containers of chlorates?
16. If a customer asks for a little of your tank mix and hands you an empty glass jar, is it all right for you to give him some as long as you warn him carefully?
17. Why not wash off your pesticide equipment in your backyard?
18. Describe how you would clean up a pesticide spill.
19. Do materials that absorb a spill need to be treated as pesticide waste?

Answers

to Self Study Questions

❑ Pesticide Dealer Licensing -Chapter I

1. Refer to Vermont Agency of Agriculture's PHARM Pesticide Division's web page to conduct a seach.

2. Class " A " -Restricted Use pesticides, as determined by federal and state government.

Class "B" -"Controlled Sale" includes all turf products and any pesticide that is for use outside of the home and not marketed as ready-to-use, excluding products containing either Bacillus thuringienesis or potassium fatty acids regardless of percent of total active ingredient and does not meet Class A definition.

Class "C" -Homeowner -includes any pesticide applied in and around the home and that are marketed as ready-to-use and have total active ingredient of 3% or less.

3. Class "A" Dealers must submit annual sales reports of Restricted Use and By-Permit-Only pesticides. These reports must contain: the product name, EPA registration number, size and number of the containers sold, and the county of intended use (you may use the applicator's county of residence).

4. Pesticide dealers can sell restricted use pesticides only to certified applicators, or individuals operating under the direct supervision of a certified applicator. Dealers should ask to see the applicators' s certificate. Uncertified applicators should possess a note, signed by a certified applicator, authorizing them to purchase restricted use pesticides.

5. Class "B" pesticide dealers are authorized to sell Class "B" and "C" pesticides.

6. Pesticides may not be stored in food areas; legible manufactruer labels should be maintained on all

pesticide containers and bulk storage containers at all times; storage facilities shall be secured against entry by unauthorized persons, livestock, or wildlife; storage containers and appurtenances shall be constructed, installed, and maintained so as to prevent the discharge of liquid bulk pesticide.

7. Storage areas should be well ventilated; there should be adequate light when employees must enter the area; storage areas should be inaccessible by unauthorized people; labeled as a pesticide storage area; there should be no floor drains or sump pumps; the floor should be constructed of concrete or other non-porous material.

8. Some herbicides can vaporize and get into other pesticides nearby. When the contaminated product is used, the herbicide vapors in it can injure or kill crops and sensitive plants.

❑ Federal Pesticide Laws - Chapter III

1. What is the full name and acronym of the federal agency mandated to regulate pesticides?

Environmental Protection Agency - EPA

2. What is the full name and acronym for the law that EPA uses to manage pesticides.

Federal Insecticide,Fungicide, and Rodenticide Act - FIFRA

3. FIFRA governs the licensing or registration of pesticide products. Before a pesticide may be marketed in the US, what must EPA do?

EPA must review an application for registration, approve each use pattern, and assigns a product registration number.

4. What is EPA's pesticide registration decision based upon?

Data demonstrating that the use of a specific pesticide will not result in 'unreasonable human health or environmental effects.'

5. If EPA determines that a pesticide poses a risk to consumers, what options for regulation does EPA have?

Longer pre-harvest intervals, changes in the manufacturing process, restrictions in the frequency of applicastaionand/or rates. They can also cancel or deny registration.

❑ Toxicity of Pesticides-Chapter IV

1. Toxicity is the capacity of a material to cause injury or poisoning to a living system, such as a human being, an animal, a lake, or a forest.

2. Through the skin (dermally), by ingestion (orally), or by breathing them (inhalation).

3. Yes, some pesticides are just as dangerous when taken orally as they are when they contact the skin. Dermal exposure to pesticides can actually become oral exposure if there is not careful washing-up between pesticide work and eating or smoking.

4. Oil or paste pesticide solutions are most likely to be absorbed through the skin.

5. The eyes, ears, scalp and groin tend to absorb pesticides more quickly than other areas.

6. The dermal and inhalation routes of entry are likely to be more important to the pesticide applicator than the oral route.

7. The appropriate respirator or self contained breathing apparatus.

8. Hands should be properly washed after applying pesticides, especially before eating or smoking. Pesticides should never be stored in any container that could be mistaken for a food or beverage container.

9. Pesticide exposure is defined as coming in contact with the pesticide.

10. Acute exposure refers to a one-time contact with a pesticide. Chronic exposure refers to a repeated contact with a pesticide.

11. Acute effects can be more easily detected and studied than chronic effects.

12. The dose is the quantity of a substance that a surface, plant, or animal is exposed to. Exposure is coming in contact with the pesticide.

13. Acute toxicity refers to how poisonous a pesticide is to humans, animals, or plants, after a single exposure to the chemical. Chronic toxicity refers to the ability of a pesticide to do damage as a result of many repeated exposures, over a prolonged period of time.

14. There are many factors that affect the toxicity of a pesticide. They include: its route of entry; the frequency and duration of exposure; the dose received; toxic characteristics inherent to the pesticide; etc.

❑ Personal Protection for the Applicator and the Worker- Chapter VIII

1. The most common cause of pesticide poisoning for applicators is through skin contact.

2. Always wear unlined, elbow length chemical-resistant gloves when handling all pesticides, except those that are relatively nontoxic.

3. Cotton and leather gloves can be more hazardous than no protection at all because they absorb and hold the pesticide close to your skin for long periods of time.

4. Chemical-resistant suits are recommended when handling highly toxic (category I) pesticides.

5. Spray clothing should be changed and washed daily.

6. Absolutely. Wash boots after each use and dry thoroughly inside and out.

7. Wear goggles or face shield whenever the pesticide could contact your eyes, when you are pouring or mixing concentrates, or working in a highly toxic spray or dust.

8. If the headband absorbs chemicals, it will become contaminated and continuously expose you to pesticides.

9. Chemical-resistant rain hats, wide brimmed hats, and washable hard hats (with no absorbing liner) are good.

10. These hats adsorb the pesticide and should be avoided.

11. The label will tell if a respirator is needed.

12. When mixing or filling highly toxic pesticides.

13. Yes. If the applicator will constantly be exposed to small amounts of toxic pesticides for several days in a row, the toxic effects could build up.

❑ Symptoms of Pesticide Poisoning-Chapter IX

1. No. Symptoms of pesticide poisoning are similar to those of other types of poisoning or other diseases.

2. Yes.

3. No. Each chemical family can attack the human body in a different way.

4. Headache, fatigue, soreness in joints, irritation of nose and throat.

5. Yes.

6. Fever, intense thirst, vomiting, muscle twitches, pinpoint pupils, unconsciousness.

7. Yes.

❑ First Aid for Pesticide Poisoning-Chapter X

1. Call an ambulance or doctor. If you are alone with the victim, you must see that he is breathing and that he is not further exposed to poison.

2. So that he can obtain the antidote and keep it on hand.

3. Wash with large quantities of running water.

4. Carry patient to fresh air immediately. Wear an air-supplied respirator if victim is in an enclosed space.

5. Except: If victim is unconscious or in convulsions; if victim has swallowed corrosive poison; if victim has swallowed petroleum products.

6. Activated charcoal, used to absorb many poisons. Milk in water, used to dilute poisons quickly. Milk of Magnesia, used to dilute acids.

7. Atropine can be poisonous if misused. It should never be used to prevent poisoning.

8. The skin will be pale, moist, cold and clammy. Eyes are vacant with dilated pupils. Breathing is shallow and irregular. The pulse is very weak, rapid and irregular, victim may be unconscious. Raise legs above head, keep warm, keep quiet, reassure often.

9. A thermos or large plastic bottle (at least one quart) of clean water, kept in a first aid kit. Ponds, hoses or running streams if available.

10. They give pertinent information on all types of poisonings and their treatment.

❑ Integrated Pest Management -Chapter XI

1. Prevention, Suppression, Eradication

2. Cultural, physical/mechanical, biological, and chemical

3. Approaches and methods

4. A) Identify the pest; B) Monitor to determine the location and extent of the pest problem.

5. A) The disease organism; B) A susceptible species; C) The proper environmental conditions

6. It is easier to alter the environment through the use of cultural methods that result in healthy vigorous plants that can resist diseases.

7. Information accumulated through good record keeping allows you to: detect patterns of pest damage; anticipate next year's pest problems; evaluate the success of control strategies.

8. Through regular monitoring of the home and garden, pest problems can be detected before they get out of control, and when they are most easily treated.

9. Simply stated, the action threshold is the point at which you decide to take action to control a pest problem. While very specific "economic" thresholds exist for agricultural crops to prevent an economic loss of commodity crops, urban thresholds are often dependent upon how much damage a homeowner is willing to tolerate -to his/her lawn or garden. In cases where public health is an issue, such as hospitals and food processing facilities, the action threshold for pests may be zero.

10. The three non-chemical pest control methods include: 1)Cultural; 2) Mechanical/physical; and, 3) Biological.

Cultural methods involve the manipulation of the environment to make it less suitable for pest survival. Examples include: keeping plants and animals healthy so they can resist pest attacks, and eliminating pest harborages so a population cannot become established in the home, yard or garden. For effective cultural control, you need a good understanding of the pest's life history and habits.

Mechanical/physical methods are directed against the pest itself and include methods such as exclusion, hand removal and trapping of pests.

Biological methods include the use of "beneficial" organisms to control the pest population. Beneficials can either be released into the landscape, or homeowners can attract beneficial organisms to their yard/garden by landscaping with a variety of plants that provide food and cover. Extreme care must be taken with the use of pesticides to make sure that beneficial populations are not affected.

11. Proper selection and timing of pesticide applications is extremely important in obtaining the best possible pest control with the least effect on the environment. Always try to select pesticides labeled "Caution" over those labeled "Warning" or "Danger". Read the label carefully and follow the directions exactly. The label is the law!

❑ Pests-Chapter XII

1. Anything that injures, spreads disease, or competes with humans, domestic animals, or feed crops.

2. About 1% of insects are considered pests.

3. Head, thorax and abdomen.

4. Centipedes and millipedes, crustaceans, and arachnids.

5. Diseases are caused by biological agents called pathogens.

6. Bacteria, fungi, viruses, and nematodes.

7. Causing skin irritation, poisoning, hindering fishing, clog drainage areas, etc.

8. Annuals, biennials, and perennials.

9. Animals with a jointed backbone.

10. Rodents and some birds.

❑ Types of Pesticides-Chapter XIII

1. A pesticide is any chemical which is used to control pests.

2. No. An insecticide specifically kills insects and is just one of many types of pesticides.

3. A systemic flows inside the plant to all of its parts and kills an insect that eats the plant.

4. Will beneficial insects die? Do I really need to use an insecticide that kills more than one species?

5. Short terms offer safety advantages in dwellings. Residuals are useful when the insects are a constant problem.

6. Insecticides.

7. Fungi.

8. They are used to protect against disease or to eradicate the disease once it is present.

9. Eradicants are used when protectants aren't available, haven't been applied on time, are too expensive, or when the disease outbreak is unexpected.

10. A selective herbicide.

11. Care must be used to get the job done without harming desirable plants.

12. Pre-plant is before the crop is planted. Pre-emergence is before the weed appears. Post-emergence is after both the crop and the weed appear.

13. Growth regulators.

14. Rodenticides.

15. Nematodes are tiny hair-like worms.

16. Chitin inhibitors interfere with the development and molting of insects, causing their death.

17. IGRs attack a growth process found only in insects. This is the reason for the large safety margin for humans and other vertebrates.

18. Yes. Repellents are registered by the EPA.

❒ The Label-Chapter XIV

1. Yes. All pesticide labels have the warning "Keep Out of Reach of Children."

2. Yes. The label will state the necessary protective equipment.

3. No. Pesticides are developed to control specific target pests on specific sites. Use of a pesticide on a site not listed on the label is illegal.

4. The pesticide applicator is liable for the misuse of a pesticide.

5. The label is approved and registered by EPA.

6. Toxicity warnings on labels are based on the results of several toxicity tests.

7. The applicator, fish and wildlife, and the consumer are protected.

8. No, because only common names officially accepted by EPA are on the ingredient label. Some pesticides have not been given approved common names.

9. The words "POISON" and "DANGER."

10. "DANGER" labels.

11. Yes, the word "WARNING" is required on labels for moderately toxic pesticides.

12. The word "CAUTION."

13. The pests to be controlled by the pesticide, the rate for application, and methods of application.

14. The recommended crop and site included to be protected, the equipment, quantity of pesticide, mixing directions, compatibility with other products, health precautions, and the location and timing of applications.

15. The four different types are: before buying pesticides, mixing, storing and disposing.

16. The label specifies disposal steps for both the pesticide and the container.

17. Roaches, ants, flies, aphids, scales, mealybugs, and mites.

18. Spray thoroughly on infested plant parts. Repeat as necessary. Can be used up to three days of harvest on food crops, unless otherwise specified.

19. Broccoli, Brussels Sprouts, Cabbage, Cauliflower, Kale, Beans, Peas, and Potatoes.

20. Do not enter the treated area for 24 hours unless the proper protective clothing is worn.

21. The EPA Registration Number is 0000.

❑ Formulations - Chapter XV

1. Formulation.

2. WP, EC, D, G.

3. Effectiveness against the pest; the plant, animal or surface to be protected; application machinery; danger of drift and runoff; and possible injury to the protected surface.

4. Aerosols.

5. Aerosols.

6. They may drift long distances from the treated area.

7. To control lice, fleas, and other external parasites on pets and farm animals. In cracks and crevices for roaches and other domestic insects.

8. Ants, roaches, flies, rats, mice, and slugs.

9. Baits are needed only where pests gather.

10. Almost all particles in a granular formulation are the same size and are larger than those making up a dust.

11. Granules drift less, applied with simple, often multi-purpose equipment. They can work their way through dense foliage to a target underneath.

12. They will not stick to the foliage surface.

13. They are designed to be sprayed as purchased.

14. Emulsifiable concentrate.

15. Emulsifiable concentrate.

16. Flowables start as solids, are ground into powder, and are suspended in liquid. Emulsifiable concentrates start as liquids and are formulated to mix with water or oil.

17. WP.

18. They may be hazardous to the applicator if he inhales their concentrated dust while mixing.
19. Fumigants.

20. Two disadvantages of fumigants are: they must be applied in an enclosed area or incorporated into the soil; are highly toxic, so all recommended protective gear must be used when applying them.

❑ Weather- Wise Application-Chapter XX

1. Yes. Wind can aid in reducing pollution caused by an inversion.

2. Yes. Drift wastes pesticides and money.

3. Wind causes pesticide particles to drift off target.

4. Drifting pesticides are out of the applicator's control, therefore they are able to land and damage non-target organisms at random.

5. Yes. Quiet day application reduces the inhalation and contact hazard to the applicator and the bystander.

6. The applicator is legally responsible for any injury or money loss due to pesticide drift.

7. Rains cause pesticides to run off target.

8. Pesticide runoff can cause injury to crops, wildlife, or contaminate surface waters.

9. Wind speed is lowest. Children and animals are not likely to be present.

10. Wind, high temperatures, and humidity .

11. Inversions occur when the air near the soil surface is cooler than the air above it.

❑ Disposal-Chapter XXI

1. Improper disposal of pesticides and containers could lead to health hazards for people and livestock. A buildup of pesticide waste allows chemicals to accumulate in the soil, which then might leach into groundwater.

2. Leftover pesticides are a potential health hazard if improperly stored or left unattended in a field. It is illegal and might hurt crop production if the dose rate is surpassed on the label. Container disposal must follow label instructions.

3. If the container has never been opened, try to return it to the manufacturer or distributor. Surplus concentrated pesticides can also be given to another certified applicator who could use it according to label directions.

4. Proper safe storage of pesticides is important. If storage requirements are unclear, contact your regional EPA representative.

5. No.

6. Apply rinsewater on sites that have the same pest control problem.

7. Read the pesticide label for proper disposal instructions.

8. Again, consult the pesticide label for proper disposal instructions.

9. Triple-rinse the container.

10. Encapsulation seals the pesticide container so that leaking of dangerous chemicals does not occur in the final disposal.

11. No.

12. Consult the pesticide label for proper disposal. If this is still unclear, consult the regional EPA representative.

13. No.

14. Federal Insecticide, Fungicide, and Rodenticide Act, the Resource Conservation and Recovery Act, and the Clean Air Act deal with pesticide waste disposal.

15. Remaining rinsate should be used on an area with the same pest control problem. Be careful not to exceed the dose rate listed on the container label.

16. Fill the pesticide container with clean water. Rotate the container. Empty the container into the tank mix for future applications if possible. Repeat these steps two more times. Puncture the container and/ or crush unless it is an aerosol. A triple-rinsed container is free of potentially dangerous residues.

17. Burial of empty containers might lead to pesticides eventually leaching into the soil. A buildup of pesticide waste underground means the environmental fate is unclear. This is both a health and safety hazard.

18. Only buy the amount of pesticide needed. After calculating how much you need, calibrate the application equipment so that the application rate satisfies the level of needed pest control.

19. Slow leaking of containers can mean that pesticides can leach through the soil into groundwater. When an overdose of pesticide application occurs, rain may carry pesticides through the soil to the groundwater. Dumping containers into surface waters means groundwater will eventually receive this flow.

20. Aerosol.

21. A container without a label means the disposal instructions are not known.

22. Some pesticides are hazardous materials under the Resource Conservation and Recovery Act. Disposal is regulated by EP A because the operation, certified personnel, and construction of these landfills must meet federally approved standards.

23. Final disposal by leaching in the soil and burial can mean that pesticide concentrates and diluted chemicals can eventually come into contact with groundwater. Rain and natural environmental conditions carry pesticides through soil layers. This can contaminate water supplies.

❑ Storage-Chapter XXII

1. When storing pesticides, protective clothing minimizes exposure to pesticide chemicals in case of a spill.

2. Wear air-supplied respirators and rubber clothing.

3. When choosing a storage site, it is important to consider whether flooding is possible and whether the location is downwind or uphill from sensitive areas such as homes and ponds. Choose an area that offers protection for sensitive sites in case windblown pesticide dusts spread.

4. Pesticides should be stored in their original container with the label clearly legible. If this container is unsafe, the label should be retained from the original container and a new clean, container should be used to hold the remaining pesticide. The label should then be attached to the new container.

5. Runoff from storage areas could contaminate surface or groundwater with pesticide residues.

6. Collected runoff water should be treated as a surplus pesticide and disposed of properly.

7. Soap and water is a "must" in a storage area to make decontamination and cleanup convenient.

8. A well stocked storage area should have adsorptive clay, activated charcoal, vermiculite, pet litter, or sawdust to soak up spills; hydrated lime and high pH detergent; shovel, broom, dust pan, and fire extinguisher.

9. Storage of pesticides should be away from food, tobacco, and street clothing because of possible pesticide contamination.

10. A cool temperature preserves pesticides and minimizes the chances of fires from flammable chemicals.

11. A separate area for herbicides is needed because they can vaporize and spread into adjacent pesticides.

12. The disposal areas of storage units should have pesticides grouped according to their disposal method, with the labels facing forward.

13. A corroding pesticide container should be put in a suitable larger container which can be sealed and labeled.

14. The original container has the label for proper handling and safety instructions.

15. Once opened, do not store chlorates.

16. No. Never distribute a pesticide this way.

17. Pesticide equipment can contain residual pesticides and handling this in a yard exposes non-target areas to potentially dangerous chemicals.

18. A pesticide spill should be washed off of a person first, before changing into dry clothing. The person might need to see a doctor. Clean the storage area with a crew wearing the proper protection. For spilled liquid, throw an adsorptive material over the spilled chemical to soak up as much as possible. Then shovel this contaminated material into a large drum. For spills that can be swept dry, collect this in a drum. Next, neutralize the pesticide with hydrated lime before rinsing the entire area with water. This rinsewater should be disposed of properly.

19. Yes. These materials have pesticides and they should be disposed of properly.

Glossary

Pesticide terms used in this manual

ABRASION—A scrape, scratch, sore, or cut which breaks the skin.

ABRASIVE—Something that grinds down or wears away an object. Example: wettable powders wear quickly on pumps and nozzles.

ABSORB—To take a pesticide into a plant, animal, or the soil.

ABSORPTION—The entrance of a pesticide into the body through the skin. May also refer to the entrance of a pesticide into a plant or microorganism.

ABSORPTIVE CLAY—A special type of clay powder which can take up chemicals and hold them. It is sometimes used to clean up spills of pesticides.

ACARACIDE—Pesticide used to control mites and ticks. Same as miticide.

ACCUMULATE—Build up, pile up, store.

ACCUMULATIVE PESTICIDES—Those chemicals which tend to build up in animals or the environment.

ACID—A very sharp, sour liquid which is usually very dangerous in concentrated form.

ACRE—43,560 square feet. An area of land about 209 feet long by 209 feet wide.

ACTIVATED CHARCOAL—Very finely ground, high quality charcoal which absorbs liquids and gasses easily.

ACTIVE INGREDIENT—The part of the pesticide which will kill pests or prevent damage by them. Usually it is the same as the "technical" material in the formulated product.

ACTUAL DOSAGE—The amount of active ingredient (not formulated product) which is applied to an area or other target.

ACUTE POISONING—Severe poisoning which occurs after one exposure to a pesticide.

ACUTE TOXICITY—It is the toxicity of a material determined at the end of 24 hours and which causes injury or death from a single or limited exposure to an animal or man.

ADHESIVE—An adjuvant which helps the pesticide stick to the treated surface.

ADJUVANT/ADDITIVE—A relatively nontoxic ingredient added to the pesticide mixture to help the active ingredient do a better job. Examples: wetting agent, spreader, adhesive, emulsifying agent, penetrant.

ADSORPTION—The binding of a pesticide to the outside surface of small soil particles or to plant parts in such a manner that the chemical is only slowly available.

AEROSOL—Pesticide chemical stored in a container under pressure. The pesticide is drive through a fine opening by an inactive gas under pressure when the nozzle is triggered.

AGITATE—To keep a pesticide chemical mixed up; to keep it from settling or separating in the spray tank.

AIRBLAST SPRAYER— A sprayer that uses a high speed and high volume air supply to help break up and disperse spray from nozzles.

ALKALI—Opposite of an acid; it is usually dangerous in concentrated form.

ANNUAL—A plant that grows from seed, produces seed the same year, then dies.

ANTAGONISTIC EFFECT—Reduced toxicity or effectiveness as a result of combining one pesticide with another.

ANTIDOTE—A treatment given by a doctor to reduce the effects of pesticide poisoning.

ANTI-SIPHONING DEVICE—A small piece of equipment attached to the filling hose to prevent fill water from draining back into the water source. Example: check valve.

APIARY—Place where colonies of bees are purposely kept.

APPLICATION—Putting a pesticide on or in plants, animals, buildings, soil, air, water, or other targets to kill pests or prevent damage by them.

APPLICATION RATE— The quantity of pesticide applied to a particular area.

AQUATIC WEEDS—Weeds that grow in water, either on top or under the surface.

ARTIFICIAL RESPIRATION—First aid for someone who has stopped breathing, by blowing air into his lungs or applying pressure to his back to start breathing again.

ATROPINE—An antidote for organophosphate and carbamate poisoning. Full name is atropine sulfate.

ATTRACTIVE NUISANCE—A legal term for any object which might attract children or other persons to it and then might injure or hurt them as a result. Examples: sprayers, empty pesticide containers.

BAIT—A food or other material which will attract a pest to a pesticide or to a trap where it will be destroyed.

BAND APPLICATION—Application made as a band over or parallel to a crop row.

BASE —Alkali; opposite of an acid.

BIOLOGICAL CONTROL—Pest control without the use of chemicals. Parasites, predators, diseases, etc., are used to control pests.

BOOM—Several nozzles joined together by sections of pipe or tubing to apply pesticides over a wider area at one time.

BROADCAST APPLICATION—Application made uniformly over an entire area rather than only on rows, beds, or middle of an area.

BROADLEAF PLANTS —Plants with wide, flat leaves and netted veins. Example: dandelion, rose.

BROAD SPECTRUM PESTICIDES—General purpose or wide range of uses. They are effective when several different pests are a problem.

CALCULATE—Do some arithmetic; work with numbers, determine, figure out.

CALIBRATE-CALIBRATION—To figure or measure how much pesticide will be applied by the equipment to the target.

CANCELLED—A pesticide use that is no longer registered as a legal use by the Environmental Protection Agency. Remaining stocks can be used by order of the Administrator, EPA.

CARBAMATE PESTICIDE—A family of pesticides which are chemically similar. They all attack a pest in the same way. Common ones are carbaryl (Sevin), carbofuran (Furadan) and methomyl (Lannate).

CARRIER—(two meanings) The liquid or solid that is used to dilute the active ingredient in manufacturing a pesticide formulation. Example: talc, petroleum solvents. OR–The material used to carry the pesticide to the target. Example: water in a hydraulic sprayer, air in a mist blower.

CARTRIDGE—The cylinder-shaped part of the respirator which absorbs the fumes and vapors from the air before you breathe them. It should be replaced often.

CAUTION—A signal word used on labels of pesticides to alert users that the pesticide is slightly toxic.

CHEMICAL—Often used here to mean "pesticide" chemical.

CHEMICAL NAME—Scientific name telling the contents or formula of the active ingredients of the poison.

CHEMICALLY INACTIVE—Will not easily react with any other chemical or object. Examples: talc, clay.

CHEMICAL REACTION—When two or more substances are combined and as a result undergo a complete change to make new substances or materials.

CHEMICAL RESISTANT—In the proposed worker protection standards for agricultural pesticides, the EPA defines a material as "chemical resistant" if it shows no measurable movement of pesticide through the material during use.

CHLORINATED HYDROCARBONS—A family of pesticides which are chemically similar — they all contain chlorine. They are generally very persistent as compared to carbamates or organophosphates. Examples include chlordane, lindane, methoxychlor.

CHRONIC POISONING—Poisoning which occurs as a result of small, repeated doses of pesticide over a long period of time.

CHRONIC TOXICITY—How poisonous a pesticide is to an animal (or man) after small, repeated doses over a period of time.

CIRCULATE—To move completely through something in a path that returns to the starting point.

COMMERCIAL—A job or business whose purpose is to make money or earn a profit.

COMMON NAME —A well-known, simple name of a pesticide accepted by the Pesticide Regulation Division of the Environmental Protection Agency. Examples: carbaryl, atrazine, benomyl.

COMPATIBILITY—When two or more pesticides can be mixed together without reducing their effectiveness or harming the target.

CONCENTRATE—A pesticide as it is sold, before diluting it. Usually contains a lot of the active ingredient.

CONCENTRATION—The amount of active ingredient of pesticide in a formulation or mixture.

CONDEMNATION—The act of removing a crop or product which does not meet legal standards for tolerances on food and thus is not to be sold.

CONTACT—To touch or be touched by.

CONTAMINATE—Pollute; the addition of an unwanted material (often a pesticide) where it could do harm or damage.

CONTRACT—An agreement with someone to do a job or perform a service for him.

CONTROL—To reduce damage; to keep down the number of pests in an area.

CORROSION—The effect of being worn down or eaten away slowly.

CORROSIVE POISON—A type of poison containing a strong acid or base which will severely burn the skin, mouth, stomach, etc.

CROSS CONTAMINATION—When one pesticide gets into or mixes with another pesticide accidentally — usually occurs in a pesticide container or in a poorly cleaned sprayer.

CULTURAL CONTROLS —Control measures including modifications of the planting, growing, cultivating, and harvesting of crops aimed at prevention of damage rather than destruction of an existing infestation.

CUTICLE—The outer-most layer of skin on an organism.

DAYS TO HARVEST—The least number of days between the last pesticide application and the harvest date, as set by law.

DAYS TO SLAUGHTER—The least number of days between the last pesticide application and the date the animal is slaughtered, as set by law.

DECONTAMINATE—To remove or break down the unwanted material (usually pesticide) so it cannot do any harm or damage.

DEFOLIANT—A type of pesticide which causes the leaves of a plant to drop off.

DEGRADE—Break down, decompose.

DEGREE OF EXPOSURE—The amount or extent to which a person has been in contact with a toxic pesticide.

DEPOSIT—The pesticide on the leaves or skin or other surface right after a pesticide application.

DERMAL TOXICITY—How poisonous a pesticide is to an animal when absorbed through the skin.

DESICCANT—A type of pesticide which draws moisture (liquids) from a plant or plant part causing it to wither and die.

DETERIORATE—To decay, to wear away, to break down.

DILUENT—A liquid or dust used to "water down" or weaken a concentrated pesticide.

DILUTE—To make a pesticide thinner or weaker by adding water, oil, or other material; to "water down."

DISINFECTANT—A pesticide or other chemical that kills or inactivates a disease-producing microorganism such as bacteria.

DISPOSAL—The act or process of discarding or throwing away a pesticide. Should be done carefully and safely.

DOMESTIC ANIMAL—Tame animal used for man's benefit. Examples: cow, sheep, horse.

DORMANT SPRAY—Pesticide application made before trees and other plant life begin to leaf out in the spring. Such sprays, if applied during active growth, would cause damage to the plant.

DOSE-DOSAGE—The portion or amount of pesticide mixture which is applied to the target.

DOWNWIND—On the side which the prevailing wind is blowing towards.

DRIFT—The movement by wind and air currents of droplets or particles of a pesticide from the target area to an area not intended to be treated.

DUST—A finely ground, dry mixture containing a small amount of pesticide and an inert carrier such as talc or clay. The dust particles are of many different sizes.

ECOLOGY—Study of the relationship between a plant or animal and its surroundings.

EMULSIFIABLE CONCENTRATE—A pesticide formulation with a large amount of active ingredient dissolved in a liquid. An emulsifier is also used so that the pesticide can be diluted, usually with water.

ECONOMIC THRESHOLD—The point of pest infestation where application of a control measure would return more money than the cost of the control procedure.

EMULSIFIER—A chemical which helps one liquid form tiny droplets and thus remain mixed in another liquid. It is used to form a stable mixture between two liquids which usually would not mix. Example: oil in water.

ENCAPSULATION—Method of disposal of pesticides and pesticide containers by sealing them in a sturdy, waterproof container so the contents cannot possibly get out. Also a method of formulating pesticides.

ENDANGERED SPECIES—Population of wildlife species that is being reduced due to man's activities that alter the species habitat.

ENVIRONMENT—Surroundings — usually water, air, soil, plants, and wildlife.

ENVIRONMENTAL PROTECTION AGENCY/EPA—The federal agency responsible for pesticide rules and regulations.

EPA REGISTRATION NUMBER—A number assigned by EPA to a product when it is registered, that must appear on all labels for that product. It will appear as "EPA Reg. No." or "EPA Registration No." followed by the company number and product number. Sometimes a state alphabetical designation and distributor number will appear.

ERADICANT FUNGICIDE—Type of fungicide which kills the disease after it appears on or in a plant.

EVAPORATE—To form a gas and disappear into the air.

EXEMPTION—Exception

EXOSKELETON—The external supportive covering of an animal (i.e. insect)

EXPOSE-EXPOSURE—Not shielded or protected; come in contact with the pesticide.

FACE SHIELD—A transparent piece of protective equipment used by a pesticide applicator to protect his/her face from exposure to pesticides.

FEED—Food used for the purpose of feeding livestock and domestic animals.

FILTER—To screen out the unwanted material; clean by straining out the undesirable parts, or a piece of equipment for doing this.

FINITE TOLERANCE—The maximum amount of pesticide which can remain on food or feed crops at harvest, after the pesticide has been directly applied to the crops.

FLOWABLE—Very finely ground solid materials of pesticide which are mixed in a liquid carrier. Flowables require only moderate agitation and seldom clog spray nozzles.

FLUID—Liquid.

FOAMING AGENT—Chemical substance which causes the pesticide mixture to form a thick foam. It is used to reduce drift during application.

FOGGER—An application machine that sprays liquid solutions in the form of a fine mist or a fog. May also use a low speed air supply or some other device to aid in dispersal of the fog.

FOLIAGE—Leaves, needles, or blades of a plant.

FOLIAR SPRAYS—Pesticides which are applied on the stems, leaves, needles, or blades of a plant.

FOOD CHAIN—A way of describing how all animals depend on each other for food. It is a link between plant-eaters, plant and meat-eaters, and meat-eaters.

FORMULA—A brief way of writing a complicated idea by using abbreviations and symbols.

FORMULATION—A mixture of one or more pesticides plus other materials such as carriers, diluents, etc., needed to make it safe and easy to store, dilute and apply. The formulation is the form the pesticide is bought in; does not include tank mixes, adjuvants, etc.

FUME—Unpleasant or irritating smoke, vapor, or gas.

FUMIGANT—A pesticide in the form of a poisonous gas that will kill destructive microorganisms, animals, and plants when absorbed or inhaled.

FUMIGATION—The use of a fumigant to destroy a pest.

FUNGI (FUNGUS)—Group of small organisms which cause rots, molds, and plant diseases.

FUNGICIDE—Pesticide used to control organisms which cause molds, rots, and plant diseases (fungi).

GAS MASK—Type of respirator which covers the entire face and protects the eyes as well as the nose and mouth. They contain better filters and more absorbing material to cleanse the air than cartridge respirators and are less likely to leak around the edges.

GRANARY—A storage area for threshed grain.

GRANULES —Pellets; a pesticide formulation of dry, ready-to-use, low concentrate pesticide plus an inert carrier. The particles are all about the same size and are larger than those making up a dust.

GROUND DRIVEN—Power supplied to a pump, auger, or spinning disc from one of the trailer wheels as the machine is towed.

GROUNDWATER—Water in a subsurface layer of soil or rock.

GROWTH REGULATOR—A pesticide chemical which increases, decreases, or changes the normal growth or reproduction of a plant or insect.

HAZARD—The risk of danger; the chance that danger or harm will come to the applicator, bystanders, consumers, livestock, wildlife or crops, etc. A hazard constitutes both toxicity and exposure.

HERBICIDE—Pesticide that is used to control unwanted plants. A weed or grass killer.

HYDRAULIC AGITATOR—A device which keeps the tank mix from settling out by means of water flow under pressure.

HYDRAULIC SPRAYER—A machine which applies pesticides by using water under pressure to deliver the pesticide to the target.

ILLEGAL RESIDUE—A quantity of pesticide remaining on the crop at harvest which is either above the set tolerance or which is not allowed on the crop at all.

INACTIVE—Will not react chemically with anything; not involved in the pesticide action.

INCINERATOR—A high heat furnace or burner which reduces everything to ashes and vapors or non-harmful residues.

INCOMPATIBLE—Two or more materials or chemicals that can not be mixed or used together to produce a desired effect.

INCORPORATE—To work or blend a pesticide into the soil completely.

INERT INGREDIENTS—Inactive part of a pesticide or formulation; any material in a pesticide mixture which would not prevent damage or destroy pests if used by itself.

INFESTATION—Any pests found in an area or place where they are not desirable.

INGEST—To eat or swallow.

INGREDIENT STATEMENT—The part of the label on a pesticide container which gives the name and amount of each pesticide chemical and the amount of inactive material in the mixture.

INHALATION—To take air into the lungs, to breathe in.

INHALATION TOXICITY—How poisonous a pesticide is to man or an animal when breathed in through the lungs.

INJECT—To force a pesticide chemical into a plant, animal, building, or the soil.

INSECTICIDE—A pesticide that is used to control or prevent damage caused by insects.

INTEGRATED CONTROL—A system in which two or more methods are used to control a pest. These methods may include cultural practices, natural enemies, and selective pesticides.

INTEGUMENT—The skin or membrane covering an organism.

INTERVAL—Period of time. The time period between two pesticide applications or between the last pesticide application and harvest.

INVERT EMULSIFIER—An agent or additive which allows water to remain suspended in oil rather than settling out. The usual emulsifier allows suspension of oil in water.

IRRITATING—Annoying. Making an animal (or person) uncomfortable by burning, stinging, tickling, making the eyes water, etc.

ISOBUTYL—A kind of additive or adjuvant which aids the pesticide to get through the outer surface (leaf, root, skin) and into the plant.

JOINTLY LIABLE—Two or more persons or companies would share legal responsibility for negligence.

Kg OR KILOGRAM—A unit of weight in the metric system equal to 2.2 pounds.

LABEL—The printed material attached to or part of a pesticide container.

LANDFILL—Land area approved by a municipality with operations to dispose of municipal waste. State and federal approval of disposal practices, staff activities, and operating equipment are required for handling of hazardous wastes.

LARVICIDE—An insecticide used to kill larvae of insects.

LC_{50}—The concentration of a pesticide in air which would kill half of the test animals exposed to it. The lower the LC_{50} value, the more poisonous the pesticide is. It is often used as the measure of acute inhalation toxicity.

LD_{50}—The dose or amount of a pesticide which would kill half of a large number of test animals if eaten or absorbed through the skin. The lower the LD_{50} value, the more poisonous the pesticide. LD_{50} values are the commonly used measure of acute oral and acute dermal toxicity.

LETHAL—Deadly, toxic.

LIABLE-LIABILITY—Legal responsibility for.

LIMITATION—Restriction, the most that is allowed.

LITER—A unit of volume in the metric system equal to a little more than one quart.

MARINE—Having to do with animals and plants which live in the ocean.

MATERIAL—A substance, often used to mean a pesticide chemical.

MAXIMUM DOSAGE—The largest amount of a pesticide chemical that is safe to use without resulting in excess residues or damage to whatever is being protected.

MECHANICAL AGITATOR—A device which keeps the pesticide and any additives thoroughly mixed in the spray tank by paddling, swirling, or stirring.

METRIC—A system of measurement that is used by most of the world except the U.S. and Canada and that is used in scientific work. It uses meters, grams, and liters as units.

Mg or MILLIGRAM—A unit of weight in the metric system; about 28,500 mg equals one ounce.

MIST BLOWER—An application machine that uses a low volume and low speed air supply to assist in dispersal and break up of spray leaving a nozzle.

MISDIAGNOSE—To make a mistake in deciding what pest has caused the problem.

MITE—A tiny animal which is very similar to an insect but has eight legs rather than six. Its body is divided into two parts and it has no antennae (feelers).

MITICIDE—Acaricide, a pesticide used to control mites and ticks.

MOLD—A growth caused by a fungus which is often found in damp or decaying areas or on living things.

MOLLUSCICIDE—A pesticide used to control snails and slugs.

MOLTING—The process of shedding and renewing the exoskeleton.

MONITORING SYSTEM—A regular system of keeping track of and checking up on whether pesticides are escaping into the environment.

MULTIPURPOSE—Doing more than one job, a pesticide which kills more than one pest.

NATURAL ENEMIES—The predators and parasites which exist in the environment and attack pest species.

NATURAL RUBBER—A material made by chemically treating and toughening the latex from rubber trees and plants. It is used in boots and gloves.

NEGLIGENCE—Failure to do your job or duty, to be neglectful.

NEGLIGIBLE RESIDUE—A tolerance which is set on a food or feed crop which will have a very small amount of pesticide at harvest as a result of indirect contact with the chemical.

NEMATICIDE—A pesticide used to control nematodes.

NEMATODE—A tiny, hair-like worm that causes damage by feeding on roots or other plant parts.

NERVOUS SYSTEM—The brain, spinal cord and nerves of animals.

NEUTRALIZE—To destroy the effectiveness of, to counteract.

NON- ACCUMULATIVE—Will not build up in an animal's body or in the environment.

NON-LABELED—Use or method which is not written on the pesticide label and therefore is not legal.

NON-PERSISTENT—Only lasts a short time (a few weeks or less) after being applied, breaks down rapidly in the environment.

NONSELECTIVE PESTICIDE— A chemical that is generally toxic to plants or animals without regard to species. A nonselective insecticide may kill or harm beneficial insects.

NON-TARGET—Any plant, animal or other organism that a pesticide application is not aimed at, but may accidently be injured by the chemical.

NON-VOLATILE—A pesticide chemical that does not evaporate (turn into a gas or vapor) at normal temperatures.

NOZZLE—Devices which control droplet size, rate, uniformity, thoroughness, and safety of a pesticide application.

NYMPH—The immature stage of an insect that passes through three stages (egg, nymph, and adult) in its development.

OPERATING SPEED—The steady rate at which your pesticide sprayer is moving along the ground — usually measured in miles per hour or feet per minute.

ORAL—Through the mouth.

ORGANISM—Any living thing; plant, animal, fungus, bacteria, insect, etc.

ORGANOPHOSPHATE PESTICIDES—A family of pesticides which are chemically similar — they all contain phosphorous. They are generally less persistent than the chlorinated hydrocarbon family. They act by inhibiting a blood chemical called cholinesterase. Examples include malathion, Diazinon, parathion.

ORIFICE—Usually in the form of discs or cores with holes in them that regulate the flow rate of liquid solutions.

ORIGINAL CONTAINER—The package (bag, can, bottle, etc.) that a pesticide is sold in. The package must have a label telling what the pesticide is and how to use it correctly and safely.

ORNAMENTALS—Plants used to add beauty to homes, lawns, gardens, and parks. They include trees, shrubs, and small colorful plants.

2-PAM OR PROTOPAM CHLORIDE—An antidote used for organophosphate poisoning, but not for carbamate poisoning.

PARASITE—A plant or animal that harms another living plant or animal (called the host) by living or feeding on or in it. Sometimes parasites are helpful to man by attacking and controlling pests which could injure crops or animals. These parasites are forms of biological control.

PARTS PER MILLION or PPM—The amount of pesticide that remains on or in a plant, animal, food, or feed crop after treatment (residue) is often measured in parts per million.

PERCENT BY WEIGHT—The amount of actual pesticide chemical in a mixture based on its weight compared to the weight of the whole mixture. Example: One pound of actual pesticide plus three pounds of other material would give you a 25% pesticide by weight in the mixture.

PERENNIAL—A plant that normally lives for more than two years. Trees and shrubs are perennials.

PERSIST—To stay for a period of time; to remain.

PEST—An unwanted organism (animal, plant, bacteria, fungus, virus, etc.).

PESTICIDE—Any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest, or intended for use as a plant regulator, defoliant or desiccant.

PESTICIDE CHEMICAL—Term used to describe a pesticide which is a chemical rather than a parasite, virus or some other type of pest killer.

PESTICIDE KILL—When careless or improper use of a pesticide results in the death of large numbers of non-target organisms.

PESTICIDE RESISTANCE—The ability of an organism to suppress or retard the injurious effects of a pesticide.

PESTICIDE WASTE—Remaining concentrate, rinsate, spill, mix water, wash water, and containers after a pesticide application job has been completed.

PETROLEUM PRODUCTS—Anything which contains gasoline, kerosene, oil, or similar products.

PHYTOTOXICITY—Injury to plant life caused by a chemical or other agent.

PLANT DISEASE—Any sickness which affects plant life. Usually caused by fungi or bacteria.

PLANT REGULATOR—Growth regulator; a chemical which increases, decreases, or changes the normal growth or reproduction of a plant.

PNEUMATIC—Moves or worked by air.

POINT OF RUNOFF—When a spray is applied until it starts to run or drip off the ends of the leaves and down the stems ofplants, or off the hair or feathers of animals.

POISON—Any chemical or agent that can cause illness or death when eaten, absorbed through the skin, inhaled, or otherwise absorbed by man, animals, or plants.

POISON CONTROL CENTER—An agency (usually a hospital) in all the major cities which is informed of the proper first aid and antidotes for poisoning emergencies — including pesticide poisoning.

POLLINATORS—Bees, flies, and other insects which visit flowers and carry pollen from flower to flower on many plants to produce fruit, vegetables, nuts and seeds.

POLLUTE—To make unclean or unsafe through carelessness or misuse.

PORT OF ENTRY—Place where foreign goods (plants, animals, crops, etc.) enter the United States.

POSTEMERGENCE—The time period just following emergence of seedlings.

POTENCY—The strength of something. Example: How deadly a poison is.

PPM—See Parts Per Million.

PRECAUTIONS—Safeguards; safety measures; warnings.

PREDATOR—Any animal or insect that attacks, feeds on, and destroys other animals or insects. Predators are important in the food chain and some help to reduce pests which cause disease, damage, or harm.

PRE-EMERGENCE—The time period between planting seeds and the seedlings pushing up through the soil.

PREHARVEST—The time period just before a crop is ready to be picked, cut, or dug.

PREPLANT—Incorporation of pesticides into the soil to control weeds prior to planting crop seeds.

PRESSURE—The amount of force on a given area. The pressure of a liquid pesticide forced out of a nozzle to form a spray is measured in pounds per square inch.

PRODUCT—A term used to describe the pesticide as it is sold — it usually contains the pesticide chemical plus a number of additives.

PROPERTIES—The characteristics or traits which describe a certain chemical or other matter.

PROTECTANT—A pesticide applied before pests are actually found but where they are expected. The pests are destroyed before they cause any disease, damage, or harm.

PROTECTIVE EQUIPMENT—Clothing and other gear that protect a person against injury or death when using poisonous pesticides. They include gloves, apron, shoes, coveralls, hat, cartridge, respirator, and gas mask.

PUPA —The resting stage of an insect that passes through four stages (egg, larva, pupa, and adult) in its development.

RATE—The amount of material which is being delivered to a plant, animal, or surface. Usually measured as per acre, per 1000 square feet, or per hour.

RECOMMENDED DOSAGE—Advice from a county agency, extension specialist, other authority, or written on the label on how much of a pesticide to use for preventing damage by or destroying a pest. This amount is not always the maximum allowed by law.

REGISTRATION—Approval by the Environmental Protection Agency of a pesticide for uses as stated on its label.

REGULATORY OFFICIALS—Those persons working for the federal or state government who enforce the rules and laws.

REPELLENT —A pesticide that keeps or drives insects or other pests away from the plant, animal, or surface treated.

RESIDUAL PESTICIDE——A pesticide that can destroy pests or keep them from causing damage for long periods of time after it is applied (days, weeks, months).

RESIDUE—The amount of pesticide that remains on a crop, animal, or surface for a while after it has been treated. Not the same as deposit.

RESISTANCE—Genetic abilities developed by pest populations that enable them to resist the effects of certain types of pesticides that are toxic to other members of that species.

RESPIRATOR—A face mask which filters out poisonous gases and particles from the air so that a person can breathe and work safely.

RESTRICTED ENTRY INTERVAL (REI)—Period of time after the application of a pesticide during which worker entry to the treated area is restricted.

RESTRICTIONS—Limitations.

RINSATE—Rinsewater or dilute pesticide from mixing pesticide formulations.

RODENTICIDE—A pesticide used to control rats, mice, rabbits, and their relatives.

RUNAWAY PESTS—Insects, diseases, weeds or other pests which get into an area for the first time and therefore have no natural enemies — they often reproduce in large numbers and overrun an area.

SCIENTIFIC NAME—The one name used throughout the world by scientists for each plant and animal. The names are based on Latin or Greek languages.

SCOUTING—The regular checking and identification of pests and effects of biological control.

SEIZURE—To take or impound a crop or animal if it contains more than the allowable pesticide residue.

SELECTIVE PESTICIDE/SPECIFIC PESTICIDE—A pesticide which will control only a few pest species and is not as poisonous to other plants and animals.

SENSITIVE AREAS—Places where pesticides could cause great harm if not used with special care and caution. Examples: houses, barns, parks, ponds, streams, etc.

SENSITIVE CROPS—Crops which are easily injured by pesticide chemicals — even slight drift could cause major damage.

SHOCK—The severe reaction of the human body to a serious injury which can result in death if not treated, even if the injury itself would not be fatal.

SHORT TERM PESTICIDE—A pesticide which breaks down almost immediately after application into nontoxic by-products.

SIGNAL WORD—Word which must appear on pesticide labels to show how toxic the pesticide is. The signal words used are "Danger...Poison" or "Warning" or "Caution".

SOIL FUMIGANT—A pesticide which is added to the soil and takes the form of a gas or vapor to kill many pests. Often a tarpaulin, plastic sheet or layer of water is used to trap the gas in the soil until it does its job.

SOIL INJECTION—Placing a pesticide below the soil surface with little or no soil mixing. Example: Forcing a pesticide into the ground through a tube.

SOLUBLE POWDER—A finely ground, solid pesticide that will dissolve in water or other liquid when ready for application.

SOLUTION—A mixture made by dissolving a solid, liquid, or gas in a liquid. The mixture will not separate or settle out in normal use. Example: Sugar that is dissolved in water.

SOLVENT—A liquid such as water, kerosene, or alcohol that a pesticide or other substance will dissolve in and form a solution.

SPACE SPRAY—A pesticide which is applied in the form of tiny droplets which fill the air and destroy insects and other pests, either inside or out-of-doors.

SPRAY—A mixture of a pesticide with water or other liquid and applied as tiny droplets.

SPRAY CONCENTRATE—A liquid formulation of pesticide that is diluted with another liquid (usually water or oil) before using.

SPECIES—A group of living organisms which are very nearly alike, are called by the same common name, and can interbreed successfully.

SPOT TREATMENT—Application to a restricted or small area.

SPREADER STICKER—A chemical added to a pesticide mixture to make the droplets of the spray spread out and stick better to the animal, plant, or other treated surface.

STAGE OF DEVELOPMENT—Time period during the growth from newborn or egg to adulthood. Example: An insect goes through many changes from egg to adult — any one of these changes is a stage of development.

STERILIZE—Treat with a chemical or other agent to kill every living thing in a certain area.

STRUCTURAL PESTS—Insects, rodents, and other pests which attack and harm barns, houses, and other buildings. Example: termites, carpenter ants.

SUCTION HOSES—The hose through which water is pulled from a pond or stream, or spray from the spray tank to the pump.

SURFACE SPRAY—A pesticide spray which is applied in order to completely cover the entire outside of the object to be protected.

SURFACE WATER—Rivers, lakes, ponds, streams, etc., which are located above ground.

SURFACTANT—A chemical or agent used in a pesticide formulation to make mixing easier and help the material to spread over and completely wet the surface to be sprayed. Example: detergent, emulsifier, wetting agent.

SUSCEPTIBLE—Can be killed or injured by the pesticide at the rates used.

SUSPENDED—A pesticide that is no longer legal and remaining stocks cannot be used. More severe than cancelled.

SUSPENSION—A mixture in which fine particles of a pesticide chemical are floating in a liquid.

SWATH—The width of the area covered by a sprayer making one sweep or one trip across the field or other treated area.

SYMPTOM—A warning that something is wrong. An outward signal or a disease or poisoning in a plant, animal, or man.

SYNERGISM—The action of two pesticides that produces a greater cumulative effect when the pesticides are used together than when they are used individually.

SYSTEMIC—A pesticide that is drawn up by one part of a plant or animal and moved to another section where it acts against a pest.

SYNTHETIC RUBBER—A material that looks like natural rubber but is made by a chemical process in a laboratory. Latex is not used in its formation. Neoprene and butyl are synthetic rubbers used in boots and gloves.

TARGET—The area, buildings, plants, animals, or pests intended to be treated with a pesticide application.

TECHNICAL MATERIAL OR PESTICIDE—The pesticide as it is first manufactured by the company before formulation. It is usually almost pure.

TEST ANIMALS—Laboratory animals, usually rats, fish, birds, mice, or rabbits used to determine the toxicity and hazards of different pesticides.

THERMAL—Related to heat.

TICK—A small, eight legged, blood sucking, insect-like organism often found on dogs, cows, or wild animals.

TOLERANCE—The amount of a pesticide that can remain on any food (plant or animal) that is to be eaten by livestock or humans. The tolerance is set by the Environmental Protection Agency.

TOLERANT—Not susceptible to (injured by) a pesticide application.

TOXIC—Poisonous, deadly, injurious to plants, animals, or humans.

TOXICANT—A poison. The chemical in a pesticide formulation that can injure or kill the pest as well as humans, animals or plants.

TOXICITY—"How poisonous" a pesticide is to a living organism.

TRADE NAME—A brand name. The name given to a pesticide by a manufacturing company to identify it as their product.

TRANSPORT—Carry from one place to another — usually in a car or truck.

TREATED AREA—A building, field, forest, garden or other place where a pesticide is applied.

ULTRA-HAZARDOUS—A job or activity that is very dangerous.

ULTRA-LOW VOLUME, ULV—The application of a pesticide that is almost pure toxicant or technical material by spraying it in extremely small amounts over a large area — usually only a few ounces per acre.

UNAUTHORIZED PERSONS—People who have no right doing something because they have not been told or trained to do it.

UNCONTAMINATED—Does not contain hazardous pesticide residues.

UNDERGROUND WATER—Waterways that are located beneath the soil surface, where wells get their water.

UNIFORMLY—Done exactly the same way each time or over each area. Done evenly.

UNINFORMED PERSONS—People who are not trained to use and handle pesticides safely.

UNINTENTIONALLY—Did not mean to do it; accidentally.

USDA—United States Department of Agriculture, no longer in charge of pesticide legislation and laws.

VAPOR—Gas; steam.

VAPORIZE—Evaporate; become a gas.

VERMIN—Pests, usually rats, mice, or insects.

VICTIM—Someone who is injured, poisoned, or hurt in any way.

VOLATILITY—The rate of evaporation of a pesticide.

VOLATILIZE—To become vapor.

VOLUME—The amount, mass, or bulk.

VOMITUS—The matter which is vomited.

WEATHERING—The action of wind, snow, rain, ice and heat to wear away pesticides from the surfaces they are applied to.

WEED—Any plant growing in a place where it is not wanted.

WETTABLE POWDER—A pesticide formulation in the form of powder that is mixed with water to be applied. It does not dissolve in the water but forms a suspension.

WETTING AGENT—An additive which helps the pesticide spread out and coat a surface more evenly. It cuts down on the amount of spray that rolls off smooth surfaces or waxy leaves, and helps sprays to spread evenly on hairy leaves.

WIDE RANGE—Ability to kill many different types of pests.

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